Final Report: Documenting Significant Nexus to Navigable Waters in the Southeast
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North Carolina Department of Environment and Natural Resources
Division of Water Quality
Larry Eaton and Ross Vander Vorste
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1. Introduction

1.1 Background

Recent legal debates have brought attention to headwater streams in the United States. In 2006, decisions from the U.S. Supreme Court on the Rapanos v. U.S. and Carabell v. U.S. prompted new guidance for regulatory agencies responsible for determining jurisdiction of streams and wetlands (US EPA and US ACE 2008). In the new guidance, jurisdiction of streams can be asserted if it has a permanent or seasonal (e.g., typically 3 mo.) hydrologic connection with Traditionally Navigable Waters (TNW). Those streams that are determined not to have a relatively permanent hydrologic connection can still be classified as jurisdictional if it creates a significant nexus with downstream navigable waters. A significant nexus was loosely defined as a connection through hydrological and ecological factors that affect the chemical, physical, and biological integrity of a TNW (US EPA and US ACE 2008).

The Supreme Court affirmed that the US ACE had jurisdiction to protect TNW under the Commerce clause of the U.S. Constitution. The justices also agreed that in order to protect these waters, US ACE also had jurisdiction over waters that drained into a TNW. A TNW was defined as water that is or was used for interstate commerce; however, it was left to the individual US ACE district to decide exactly how they defined these waters. For instance, in North Carolina, TNW are generally limited to the main stems of rivers, where barges were once used to move goods from NC to the Atlantic Ocean or Tennessee. Reportedly, the definition in Indiana includes streams listed in a book of kayaking runs, since it was documented that kayakers from other states and Canada came to paddle these streams and engaged in commerce (purchasing meals, lodging and gasoline) while in the state. These inconsistencies in defining TNW have created significantly different numbers of TNW stream miles between states.

Justice Kennedy posited the need for a test to demonstrate that a water has a “Significant Nexus” to jurisdictional waters for a feature to be considered jurisdictional. The single most obvious connection was whether water, and pollutants in the water, could flow from someplace into a TNW (i.e., hydrologic nexus), however Justice Kennedy stated that other nexus were possible. Aquatic organisms could be one of the proposed nexus because of the propensity of many aquatic species to drift downstream as a means of colonization and escape from predation which also ensures gene flow along the stream gradient (Bishop and Hynes 1969, Brittain and Eikeland 1988). It is critical for regulatory agencies to make accurate and consistent jurisdictional determinations when a significant nexus is present. A succession of inaccurate or overly conservative jurisdictional determinations that erroneously exclude headwater streams could jeopardize miles of ecologically valuable streams and be detrimental to our nation’s freshwaters.

Deriving a practical working definition from the legal rulings presents a challenge and interpretation of the US ACE/EPA guidance has been uneven across US ACE districts, which varied in what they called jurisdictional wetlands and streams even before the
Supreme Court ruling. North Carolina’s state 401 wetlands programs are closely linked to the US ACE 404 program, allowing differing jurisdictional interpretations within the US ACE, to lead to uncertainty within the state 401 programs.

1.2 Headwater Streams

In a watershed, there are an abundance of small order streams ($1^{st}$–$3^{rd}$) which connect aquatic and terrestrial ecosystems. These streams, referred to as headwaters, drain up to 70–80% of the catchment area (Gomi et al. 2002). Estimates indicate that headwater streams may comprise more than 70% of stream and river miles in the United States (Lowe and Likens 2005). These streams occupy the upper reaches of the watershed and are typically the initial site of degradation from non-point source pollution and anthropogenic landscape disturbances (Figure 1). Despite their small size, headwater streams contribute a large amount of water, sediment, and biota in freshwater ecosystems because of their high density and location in the watershed (Clarke et al. 2008, Finn et al. 2011). Headwater streams contribute over half of the mean-annual water volume and approximately 40% of nitrogen flux to fourth-order and higher-orders streams, including TNW (Alexander et al. 2007). Water quality characteristics of reaches downstream from headwaters are highly correlated with riparian land cover adjacent to the $1^{st}$-order streams located upstream, proving that headwater streams have a strong influence on downstream water quality (Dodds and Oakes 2008)

Headwater streams across the Southeast display a range of hydrologic regimes. Streams are ephemeral, intermittent, or perennial depending primarily on their geology, topography, and local climate (i.e., precipitation). Ephemeral streams are defined as conveyances of storm water runoff during and shortly after a precipitation or snowmelt event. Intermittent streams typically flow for several months out of a year but lose their surface water connection with downstream waters during the peak of the growing season and during drought. Perennial streams convey surface water throughout the entire year, except under more extreme drought conditions or, in some cases, after anthropogenic watershed alterations (NC DWQ 2005). Distinguishing between these stream types without historical knowledge requires analyzing indicators of stream geomorphology, hydrology, and biology.
Figure 1: Stream ordering (1st–4th) and predicted hydrologic permanency in a typical watershed.

1.3 Previous Research

Recent literature has stressed the need for more research on headwater streams (Lowe and Likens 2005, Fritz 2007, Dodds and Oakes 2008). Between 2002 and 2005, the North Carolina Division of Water Quality (NC DWQ) studied 15 streams from the Piedmont and Blue Ridge ecoregions (Penrose and Eaton 2005). This study (EPA grant 974043-00-0) identified a group of Perennial Indicator Taxa (PIT) that required perennial streams to support their life cycle and only rarely occurred in intermittent waters (Appendix II). Occurrence of more than one PIT was determined to be sufficient evidence to classify a stream as perennial, regardless of other geomorphologic and hydrologic indicators associated with the North Carolina Stream Origins Method (NC DWQ 2005).

Finn et al. (2011) recently published a review of global headwater stream literature finding that headwaters contributed a disproportionately large amount of macroinvertebrate diversity to overall stream systems. Meyer et al. (2007) highlighted the diverse habitat available in headwater streams for microbial, plant, and animal life. They emphasized the importance of these streams to primary producers, decomposers, insects and other invertebrates, fishes, amphibians, reptiles, birds, and mammals. Morse et al. (1997) indicated that streams in the Southeast are one of the most biologically diverse freshwater habitats in the world and are home to many species of aquatic insects that are rare and vulnerable to extirpation.

1.4 Objectives

Despite knowledge that streams in the southeastern United States supply drinking water to a rapidly growing population and are also some of the most biologically diverse habitats in the world, they are becoming increasingly imperiled by anthropogenic activities. The Rapanos/Carabell decision left a need to identify what determines a
significant nexus between wetlands and headwaters and downstream jurisdictional waters (i.e., TNW). Without consistent and accurate jurisdictional determinations of headwater streams, thousands of miles of streams risk being impacted without mitigation.

The objectives of this project are to demonstrate where jurisdiction of streams begins by determining when biological communities provide a significant nexus with Traditionally Navigable Waters in EPA Region IV in the southeastern United States. We also aim to describe macroinvertebrate composition and relationships within intermittent and perennial streams. Our third objective is to test the applicability of the North Carolina Methodology for Identification of Intermittent and Perennial Streams in states other than North Carolina. This information may be used by the U.S. Army Corps of Engineers (US ACE), NC DWQ, and other state biologists to make more accurate jurisdictional stream determinations and to better understand the biology of headwater streams.

2. Methods

2.1 Site Selection

Headwater stream sites were selected from 7 states in EPA Region IV in the Southeast (SC, GA, FL, AL, MS, TN, and KY) (Figure 2). We attempted to select sites from all 14 Level III ecoregions within this study region but found the Southern Florida Coastal Plain (76) lacked the necessary topography and was too heavily channelized to feasibly locate unimpaired sites from this region. Study sites were selected in minimally impacted watersheds with little to no upstream land or water quality disturbances. Minimally impacted watersheds were selected to reduce the effect of anthropogenic disturbance and impairments to the hydrology, geomorphology, and biology of study sites. Aerial imagery (e.g., Google Earth) along with atlases, gazetteers (DeLorme Inc.), and local knowledge were used to find candidate streams. These candidate sites were usually within state forests, state parks, wildlife management areas, national forests, or municipal parks to avoid needing landowner permission and maximize reference site quality. Once a candidate stream was found, we hiked to the top of the watershed and located the stream origin.
We collected macroinvertebrate samples from 117 streams from January, 2009 to September, 2011. We attempted to distribute study sites proportionally in Level III ecoregions within the appropriate state (Table 1). When possible, study sites were sampled multiple times, once in the winter/spring season and once in the summer/fall season. Additional samples were collected from sites when possible. Multiple samples were not always collected in cases where intermittent streams were dry during a visit or re-visiting sites was not logistically possible because of time and travel constraints.
Table 1: List of ecoregions sampled and number of samples collected.

<table>
<thead>
<tr>
<th>Ecoregion (Level III)</th>
<th>Number of Samples</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>22</td>
<td>Piedmont</td>
</tr>
<tr>
<td>63</td>
<td>12</td>
<td>Middle Atlantic Coastal Plain</td>
</tr>
<tr>
<td>65</td>
<td>41</td>
<td>South Eastern Plains</td>
</tr>
<tr>
<td>66</td>
<td>23</td>
<td>Blue Ridge</td>
</tr>
<tr>
<td>67</td>
<td>16</td>
<td>Ridge and Valley</td>
</tr>
<tr>
<td>68</td>
<td>30</td>
<td>South Western Appalachians</td>
</tr>
<tr>
<td>69</td>
<td>10</td>
<td>Central Appalachians</td>
</tr>
<tr>
<td>70</td>
<td>4</td>
<td>Western Allegheny Plains</td>
</tr>
<tr>
<td>71</td>
<td>43</td>
<td>Interior Plateau</td>
</tr>
<tr>
<td>72</td>
<td>8</td>
<td>Interior River Lowland</td>
</tr>
<tr>
<td>73</td>
<td>2</td>
<td>Mississippi Alluvial Plain</td>
</tr>
<tr>
<td>74</td>
<td>9</td>
<td>Mississippi Valley Loess Plains</td>
</tr>
<tr>
<td>75</td>
<td>18</td>
<td>Southern Coastal Plain</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>238</strong></td>
<td></td>
</tr>
</tbody>
</table>

We gathered macroinvertebrate lists from TNW in all states possible using contacts at corresponding state agencies and US ACE regional offices (Appendices IV-VIII). South Carolina, Florida, Mississippi, Tennessee and Kentucky had both TNW and invertebrate data available while TNW data was unavailable in Georgia and invertebrate data was unavailable in Alabama. Traditionally Navigable Waters varied in size and density for each state and were not necessarily directly downstream from study sites.

2.2 NC Stream Identification Form

We used the North Carolina Methodology for Identification of Intermittent and Perennial Streams v.3.1 field form at each site visited (NC DWQ 2005, Appendix I). This methodology incorporates visible and measurable indicators of geomorphology, hydrology, and biology within and adjacent to the stream to determine whether the stream has an intermittent or perennial flow regime. Completion of the field form by a trained professional yields a numerical value which corresponds to a particular flow regime. Scores between ≥ 19 and < 30 generally indicate an intermittent flow regime and scores ≥ 30 usually represent perennial regimes. Results from our previous work in North Carolina introduced PIT into supplemental criteria while using the form. For instance, a stream can be determined perennial if more than one PIT is collected during the corresponding search effort. Also, a stream can be determined to be perennial if fish or amphibians (larval salamanders and large, multi-year tadpoles) are found or if large crayfish or fingernail clams are found and the numerical value is > 18. Using this methodology we identified the intermittent and perennial points of origin along the stream channel.
2.3 Macroinvertebrate Collection and Identification

Benthic macroinvertebrate samples were collected from the best available habitats near the ephemeral−intermittent and intermittent−perennial transition points in each stream. Sampling was done qualitatively using a D-framed sweep net (500 µm, Wildlife Supply Co.) at two habitat locations along the stream reach. Habitat locations were chosen using best professional judgment and were usually taken from riffles, leaf packs, root wads, and/or pools. This method allowed us to capture the most biodiversity while keeping sampling time short and the amount of material collected at a reasonable level. This approach allowed us to travel longer distances and through thick vegetation to reach the stream without burdensome equipment. The D-framed sweep net was capable of sampling small, narrow stream channels and shallow surface waters more adequately than large-stream sampling equipment.

Samples from the intermittent and perennial stream reaches were composited separately to allow comparisons of upstream and downstream samples. Once composited, sample material was preserved in 70% ethanol. Samples were then spread in a white pan and 100% of macroinvertebrates were picked by trained individuals. A quality assurance/quality control (QA/QC) check of the material was performed by a separate trained individual on 10% of samples.

Identification of benthic macroinvertebrates was performed by trained professionals using regional identification keys (e.g., Brigham et al. 1982, Merritt et al. 2008). Specimens were identified to the lowest practical taxonomic level (i.e., genus, species). When specimens were damaged or immature they were taken to lowest taxonomic level possible (i.e., family, order). Taxa that were particularly difficult to identify (e.g., Nematoda, Oligochaeta) were typically left at a broader taxonomic level (i.e., family, order). Taxonomists at the North Carolina DWQ Biological Assessment Unit were consulted regularly when new or difficult taxa were identified to ensure accuracy. A trained professional performed QA/QC on approximately 10% of samples identified and taxonomists interacted regularly to keep the identification process consistent within the group.

2.4 Data Analysis

We used Excel® (Microsoft Inc.) spreadsheets to manage data collected during this study. JMP® (SAS Inc.) was used for statistical analysis procedures. In instances where we described overall stream diversity, we compiled data from multiple sampling visits and sampling points (i.e. intermittent, perennial) to generate a single data point for a more comprehensive comparison. We generated Biotic Index scores using regional values of tolerance to organic pollution (NC DWQ 2011). Biotic Indices were calculated for the 96 sites with 20 or more aquatic taxa. Twenty taxa were chosen as a cut-off value that had enough taxa to reduce variability but still include enough sites that region-wide trends might be detectable. We used ANOVA to test for significant differences ($\alpha = 0.05$) between sites and metrics in the dataset.
were compared, we used an All-pairs Tukey-Kramer test for significant differences ($p \leq 0.05$) between groups. Simpson’s diversity ($D_s$) is a measure of probability of an individual in the community encountering a member of another species (Simpson 1949). Evenness is expressed by considering how close a set of observed species abundances are to the maximum possible diversity for a given number of individuals and species. The maximum possibility exists when the numbers of individuals are distributed evenly among the number of species. Simpson’s diversity takes into account both the species richness and evenness to describe the diversity within the community (Brower and Zar 1977).

3. Results and Discussion

3.1 Geography and Stream Origins

Streams across the study area tended to develop in three different forms: perennial and wet weather springs, wetland outflows, and gradually erosive features. Spring seeps were common in the Blue Ridge and found sporadically in the Mississippi Valley Loess Plain, South Eastern Plains, and Interior Plateau. Blue Ridge ecoregion (66) is located in western North Carolina, eastern Tennessee, northwest Georgia, and northwest South Carolina. These streams typically had gravel and rock substrate and shallow depth (Error! Reference source not found.3A). The Mississippi Valley Loess Plains (74) is located in western Kentucky and Tennessee with a band through central Mississippi. We found a series of spring seeps emerging from the Bluff Hills (74a) ecoregion at the base of the escarpment draining into the Mississippi Alluvial Plain (73). These springs had sand and gravel bottoms, shallow flow, and seemed surprisingly uncharacteristic for the region. South Eastern Plains (65), the largest ecoregion in the Southeast, covers areas in eastern Mississippi, southern Alabama, southern Georgia, central South Carolina, and north Florida. We found spring seeps present in the Tifton Uplands (65h) of northern Florida and Southern Atlantic Loam Plains (65l) in South Carolina. These springs had sand and gravel bottoms, shallow flow, and appeared from the base of small headcuts. The Interior Plateau (71) is located in central Kentucky, central Tennessee, and northern Georgia. We discovered spring seeps in the Outer Nashville Basin (71h) in Tennessee and the Eastern Highland Rim (71g) in central Kentucky (Figure 3G). Angel Spring, in the Clay Hill Memorial Forest, emerged onto the landscape as a cascade over large boulders and rocks. In general, spring seeps drained small, steep watersheds and had a strong groundwater connection.

Streams that begin as constricted outflow from wetlands were common in the Middle Atlantic Coastal Plain and Southern Coastal Plain. The Middle Atlantic Coastal Plain (63) covers areas in eastern South and North Carolina and the Southern Coastal Plain (75) covers eastern Georgia and the majority of Florida. The majority of streams found in these regions resembled wetlands and had little to no flowing water, except in winter months (Figure 3C, Error! Reference source not found.3D). Visible flow was present in cases where wide streams became constricted from culverts or ditching and a channel was formed. Streams in these regions tended to be blackwater systems with high levels of tannins. The Mississippi Alluvial Plains (73) in western Mississippi were similar to the
coastal plains streams, in that they were large floodplains resembling wetlands with little flow. A long history of farming in this region has led to extensive ditching of streams in this area and few, if any, natural headwater streams exist.

Finally, the third major way streams originated in the study area was through a transition of erosive features. These streams typically had an ephemeral, intermittent, and perennial transition point which was identifiable from the stream's geomorphology. Within transitional stream types, we found certain streams had long and short intermittent reaches. Streams that have extensive intermittent reaches were found in the Interior Plateau ecoregion (71) of central Kentucky, Tennessee, and northern Alabama. Streams in these areas often flow underground through porous limestone formations (karst) (Error! Reference source not found.3G). For example, we found a stream channel in the Cedars of Lebanon State Park in Tennessee (approximately 52 km² (20 mi²) watershed) which was dry likely due to subsurface flow. Regions in north Florida (65o) and South Carolina were also found to have karst geology making stream studies difficult. Calculating watershed areas in karst topography is problematic and biologists from Kentucky Division of Water (KY DOW) have found that aquifer watershed areas are not equivalent in area to surface topography watersheds (Bryan Marbert, personal communication, October, 2009).

Streams in the Ridge and Valley ecoregion (67) are characterized by very steep slopes and intermittent reaches are usually less than 100m in length (Figure 3E). Slopes in this region are so steep that biologists for the State of Tennessee have been known to use ropes to get to certain streams. The Central Appalachians (69) and Southwestern Appalachians (68) ecoregions also frequently contain short to moderate intermittent reaches. The Central Appalachians, covering areas in eastern Kentucky and a small segment of northeastern Tennessee, is characterized by steep terrain (Error! Reference source not found.3F). The Southwestern Appalachians occupy significant portions of Kentucky, Tennessee, and Alabama. Streams in this region tend to have relatively shallow soils underlain by bedrock (Error! Reference source not found.3H). This bedrock separates surface and subsurface water causing large streams (5−10m width) to dry or nearly dry during summer months. Both the Central and Southwestern Appalachians have significant influence from coal mining. Interestingly, the bedrock substrate can be black in streams near active coal mining areas outside Birmingham, Alabama. The Piedmont (45), Mississippi Loess Plains (74), Interior Plateau (71) ecoregions have Level IV ecoregions within them that also contain streams with intermittent origins. For example, we found several streams in Mississippi state parks in the Mississippi Loess Plains that had long ephemeral reaches followed by very short intermittent reaches that created headcuts which formed perennial streams when erosion intersected groundwater at the clay/marl layer (Figure 3B).
3A. Blue Ridge, 66, GA
3B. Mississippi Loess Plains 74, MS
3C. Mid Atlantic Coastal Plain 63, SC
3D. Southern Coastal Plain 75, FL
3E. Ridge and Valley 67, TN
3F. Central Appalachians 69, KY
While most streams in the Southeast begin in watersheds of a few dozen acres or less, the South Carolina Coastal Plain ecoregion (63h) supports intermittent streams in watersheds of nearly 200 acres. This is likely caused by the shallow clay lens soil layer which has disconnected the surface water from the ground water (Devendra Amatya, personal communication, December 2008). Streams arising around the Castle Hayne aquifer in North Carolina and the Yorktown aquifer in Virginia have stream origins in watersheds half this size or less. Turkey Creek in South Carolina exemplifies the flashy nature of these streams, in four months going from a nearly dry channel to nearly waist deep water over 50 feet across (Figure 4).
3.2 Overall Diversity and Assemblage Composition

We collected 47,683 organisms in 238 samples from 117 streams during this project. Figure 5 is breakdown of the taxonomic level of identification showing 96% of taxa collected in this study were identified to the Genus or Species level. The mean number of total aquatic taxa in the 67 intermittent reaches sampled (\( \bar{x} = 9 \)) was significantly (\( p < 0.05 \)) less than in the 145 perennial reaches (\( \bar{x} = 22 \)). There was also a significant (\( p < 0.05 \)) difference in the number of Perennial Indicator Taxa (PIT; taxa with long life cycles generally associated with permanent water) at each site (\( \bar{x} < 1 \) PIT intermittent, \( \bar{x} = 6 \) PIT perennial).

![Pie chart showing taxonomic levels](image)

**Figure 5: Percentage of taxonomic level reached during identification of aquatic macroinvertebrates during this study.**

Data analysis found overlap in the most frequently occurring macroinvertebrates in headwater streams across the study area (Figure 6). Some of these region-wide species include the amphipod *Crangonyx*, the winter stoneflies *Leuctra* and *Amphinemoura delosa*, the midge *Parametriocnemus lundbecki* and the lumbriculid family of worms. Crustaceans seemed to be the single largest group; at least one amphipod or isopod was one of the most frequent and most abundant taxa in ten of the 13 ecoregions in this study.
3.3 Mountain, Piedmont, and Coastal Plain Assemblages

We analyzed large scale differences by grouping sites into Level II ecoregions (Figure 7). These ecoregions generally corresponded to: 8.3 – Mountains; 8.4 – Piedmont; 8.5 – Coastal Plain. The sites in ecoregions defined as Mountains (66, 67, 68, 69 and 70) had an average of over ten more taxa per site than ecoregions defined as Piedmont or Coastal Plain. Most of this difference was in intolerant EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa where there were over twice as many taxa (13) in Mountain sites than Piedmont sites (5) and even fewer in Coastal Plain sites (2). Coastal Plain sites (ecoregions 63, 73 and 75) had more tolerant groups (i.e. Odonata, Coleoptera) represented than the other two regions.
Differences between Level III ecoregions were minor compared to Level II differences (Figure 8). We found the Blue Ridge ecoregion (66) had significantly more aquatic taxa and total taxa than all others. This ecoregion was unique in that nearly every unimpacted stream begins as a spring whereas most other ecoregions usually had a mix of origin types. It is unclear from this graph alone whether the increased taxa richness in the Blue Ridge ecoregion (66) is due to the cooler temperatures due to higher altitude, stable temperatures due to the constant flow of groundwater, other reasons or a combination of the above.
3.4 Significant Biological Nexus with Traditionally Navigable Waters

The percentage of taxa collected in headwater streams that are also found in TNW (i.e., overlap) is a possible source for describing significant biological nexus (Figure 9). We examined taxa lists generated for each state collected from headwater streams during this project and TNW for states with available records for overlap (Appendix III). Florida had 80% (111 / 139 taxa) overlap of headwater stream and TNW taxa, the highest overlap found in this study.
Appendix IV). Tennessee had 70% (216 / 308 taxa) overlap between headwater streams and TNW taxa (Appendix VIII). In the 27 samples collected in Florida, each sample had between 50-100 percent of taxa collected listed on the Florida TNW list. South Carolina had 50% (81 / 160 taxa) overlap between headwaters and TNW taxa (Appendix VI). Kentucky and Mississippi had 46% (91 / 196 taxa) and 30% (38 / 129 taxa) overlap, respectively (Appendix V, Appendix VII). The five states listed had between 168 and 1850 TNW taxa. Florida had the largest TNW taxa list and subsequently had the largest percent overlap while Mississippi listed the fewest TNW taxa and was found to have the least amount of overlap. Thus, the number of headwater stream taxa found in TNW depends greatly on the number of taxa collected in TNW of that state.

Figure 9: Percentage of Traditionally Navigable Waters (TNW) taxa and Non Traditionally Navigable Waters taxa found in headwater streams taxa lists generated for each state with available taxa lists.

We also examined site overlap to determine the percentage of taxa in each site that correspond with TNW lists for that state (Figure 10). Interestingly, despite Mississippi having the lowest percent overlap of macroinvertebrate communities, 87% (20 / 23 sites) of headwater stream sites sampled contained at least one species found on the TNW list. The mean percentage of the aquatic community per site that was also listed as TNW taxa was 23% (range 0−50% (0−14 taxa)). One of the three sites lacking species found on the TNW list scored 17.5 points on the North Carolina Stream Determination Form, which suggests the stream could have been ephemeral, in which case this may not have been a jurisdictional feature. In Tennessee, every study site contained at least one taxa found on the state TNW list (n = 49, \( \bar{x} = 75\% \), Range = 40−100%). In Florida, every study site contained at least one taxa found on the state
TNW list (n = 27, \( \bar{x} = 83\% \), range = 50–100%). These results show that TNW taxa could be used as an indicator of jurisdictional significant nexus in headwater streams.

![Bar chart showing percentage of Traditionally Navigable Waters (TNW) taxa in headwater study sites in Mississippi, Tennessee, and Florida.]

**Figure 10: Percentage of Traditionally Navigable Waters (TNW) taxa in headwater study sites in Mississippi, Tennessee, and Florida.**

### 3.5 Intermittent vs. Perennial Assemblages

Differences occurred between upstream (intermittent) reaches and downstream (perennial) reaches of study sites but upstream reaches appeared to be subsets of downstream reaches (Figure 11, Appendix III). Data selected for this analysis was derived from a subset of sites that showed intermittent and perennial conditions during the study period. Generally, total richness and EPT (Ephemeroptera, Plecoptera, Trichoptera) richness increased downstream from intermittent reaches. Mean values for Simpson’s Diversity, total richness, and EPT richness were significantly higher (ANOVA, \( p \leq 0.05 \)) in downstream samples when stream from across Level III ecoregions were compared. Relationships were similar when stream origin types (i.e., mountain springs, non-mountain springs, non-mountain surface, mountain surface, wetlands) were analyzed but no significant relationships were identified because variability was high and sample size was small.
3.6 Stream Origin Assemblage Differences

We used Biotic Index, a measure of average tolerance of the aquatic community at a site, to compare differences in the macroinvertebrate assemblage between different types of stream origins (Hilsenhoff, 1987, Lenat 1993). Values range from 0–10, where 0 is very intolerant and 10 is very tolerant. North Carolina Biotic Index values were used to generate a tolerance score (NC DENR 2011). Five general stream classes were identified: Spring-fed Mountain Streams (Ecoregion 66), non-mountainous spring-fed streams (usually karst areas in N. Florida and central Tennessee and Kentucky), non-mountainous streams with surface flow including intermittent and perennial flow, mountainous streams with surface flow (Ecoregions 67–70), and coastal plain or wetland (Figure 12).
Results show little difference between communities in the mountain springs of ecoregion 66 (mean BI = 3.31), the non-mountain springs of ecoregion 74, karst area in ecoregion 71 plus parts of ecoregion 65 (mean BI = 3.50), and mountain streams starting as overland flow in the mountain ecoregions 67, 68, 69 and 70 (mean BI = 3.87). Streams with spring origins found in the Appalachian Mountains (e.g., ecoregion 66) support an intolerant community. It should be noted that biological criteria developed for small streams in ecoregion 66 in North Carolina has the range for an Excellent bioclassification as \( \leq 3.29 \), only 0.02 less than the mean BI for mountains found in this study (NCDENR 2009).

Non-mountainous streams (Piedmont surface waters) that start with overland flow had more tolerant benthic communities than the first three groups (mean BI = 5.24). These areas include ecoregions 45 and 72 plus the non-spring origin streams in ecoregions 65 and 71. While the mean BI is significantly higher in this group than the previous ones, it is still low enough that there may be some room for development of region-wide biological criteria for these headwater streams.

Wetlands and coastal plains study sites (ecoregions 63, 73 and 75) contained the most tolerant taxa, with a mean BI of 8.27. These systems appear to be stressed by slow flow, low dissolved oxygen, and low pH, which are characteristic of wetlands. These stressors are natural and affect BI scores and the future development of biological criteria.
3.8 Perennial Indicator Taxa

Perennial Indicator Taxa (PIT) developed for North Carolina headwater streams were significantly higher in perennial streams compared to intermittent segments across the Southeast (Figure 13). Results also showed that nearly twice as many perennial taxa were found in streams that scored over 30 points (perennial) using the North Carolina method that those that score < 30 points (intermittent). This data was skewed by perennial streams that scored < 30 points due to the lack of strong perennial indicators of geomorphology and hydrology (e.g., spring seeps, groundwater fed streams).

Perennial Indicator Taxa, as listed in North Carolina’s stream determination manual (NC DWQ 2005), included all taxa within the orders Ephemeroptera, Trichoptera (except *Ironoquia* sp.), Plecoptera (Perlidae, Perlodidae, Peltoperlidae and Pteronarcyidae), Odonata, Megaloptera, fish (except *Gambusia* sp.), and larval amphibians. It also included gilled snails (including limpets), beetles (Elmidae, Psephenidae, adult Dryopidae) and large dipterans (*Tipula, Bittacomorpha, Ptychoptera*). Only larval specimens that were in late-instar stages (i.e., medium – large size) were counted as PIT to eliminate occurrences of early instars that may not have sufficient time to complete their life cycles before streams dry. In rare occurrences, PIT of sufficient size occasionally occurred in intermittent streams but did not alter our results.

![Figure 13: Comparison of mean Perennial Indicator Taxa (PIT) in intermittent and perennial streams.](image-url)
3.9 Indicator Taxa for Intermittent Streams

There were very few taxa collected during this study that were found only in intermittent reaches. These taxa include *Stygobromus exilis*, a groundwater dwelling amphipod, collected from the bluffs overlooking Chattanooga, Tennessee. *Cymbiodyta chamberlaini*, a rare, but widespread hydrophilid beetle (Coleoptera: Hydrophilidae), from central Mississippi. *Zalutschia* species A, a rare midge (Diptera: Chironomidae), from the South Carolina Coastal Plain. *Lethocerus uherli*, an air breathing belostomatid (Hemiptera: Belostomatidae), from a blackwater stream in north Florida, and *Pseudostenophylax* (Trichoptera: Limnephilidae), a caddisfly, from the mountains in Kentucky. It should be noted that all of these taxa were only collected once, except *Stygobromus*, which was collected in adjacent watersheds on one date and thus there is not enough evidence to suggest that any of these taxa could be used as indicators of intermittent streams. Although, in previous collections in the Blue Ridge ecoregion (66), *Pseudostenophylax* was collected only in wet weather springs, with further research this taxon may need to join *Ironoquia* as caddisflies that are not perennial indicators.

3.10 Rare and Vulnerable Taxa

Several species considered rare or vulnerable to extirpation were collected during this project. Conservation status of aquatic insects is poorly known when compared to other faunal groups due to the lack of sufficient information regarding rare species. State natural history programs and regional professionals were consulted to prepare a list of Ephemeroptera, Plecoptera, and Trichoptera species that are significantly rare or vulnerable to extirpation in the Southeast (TN NHP 2009, NC NHP 2010, Boris Kondratieff, personal communication, December 20, 2011, J. Morse, personal communication, December 15, 2011, KY SNPC 2011, Luke Jacobus, personal communication, December 18, 2011). From this list, we collected five species during this project: *Beloneuria georgiana*, *Diploperla morgani*, *Diplectrona metaqui*, *Homoplectra flinti*, and *H. monticola*. It should be noted that many species of aquatic insects require adult specimens or expert identification because characteristics are dubious and many taxonomic identification keys do not allow species determinations. Therefore, it is possible that rare species were collected but only identified at a higher taxonomic level (e.g., genus) because species-level determinations could not be confidently made.

Several other taxa that are considered locally rare or require specific habitat were also collected. *Diplectrona rossi* Morse, historically found in only one spring seep located in eastern Louisiana, was possibly collected from a unique spring seep in western Mississippi (Figure 14). This genus has been under recent review and reorganization by taxonomists which may determine the species to be *D. rossi*, a new species, or possibly a morphotype of *D. modesta* (Jason Robinson, personal communication, February 3, 2012). This specimen is rare and undoubtedly requires habitats found only in headwater streams to survive.
Figure 14: Dorsal head patterns in *Diplectrona rossi* from western MS and its originally described location in eastern LA.

*Goerita betteni*, an uncommon caddisfly species, was collected from a spring seep in Kentucky. This caddisfly inhabits only spring seeps which have swift sheet flow over large bedrock slabs. *Theliopusche* sp., an uncommon Lepidostomatid caddisfly, was collected from a headwater stream in Tennessee. This genus (six species) is restricted to the Appalachian Mountains and breeds in spring runs (Flint, Jr. et al. 2008). The habitat specificity makes *G. betteni* and *Theliopusche* sp. vulnerable to extirpation because remaining habitats could be easily overlooked and destroyed. We collected two species of *Stygobromus* amphipods, *S. exilus* and *S. smithi*, from several headwater study sites. *Stygobromus*, a subterranean species (i.e., eyeless and unpigmented), is a unique genera because they are restricted to groundwater-related habitats like caves, seeps, springs, wells, interstices, and deep lakes (Holsinger 1988). Together, these taxa represent part of the diverse community relying on the myriad of habitats headwater streams provide.

### 3.11 Fish and Amphibians

Fish and amphibians occurred in many of our study sites and were collected as bycatch using the sweep-net method. Despite not using preferred sampling methods for collection of vertebrates, we recorded 17 species inhabiting headwater streams (Table 2). A total of seven amphibian and 10 fish species were identified by experts at the North Carolina Natural History Museum and Biological Assessment Unit.
### Table 2. Fish and amphibian taxa collected from headwater stream study sites in EPA Region IV.

<table>
<thead>
<tr>
<th>Order</th>
<th>Family</th>
<th>Genus</th>
<th>Species</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caudata</td>
<td>Ambystomatida</td>
<td><em>Ambystoma</em></td>
<td><em>opacum</em></td>
<td>Marbled Salamander</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Desmognathus</em></td>
<td><em>conati</em></td>
<td>Spotted Dusky Salamander</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>ochrophaeus</em></td>
<td>Mountain Dusky Salamander</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pseudotriton</em></td>
<td><em>ruber</em></td>
<td>Red Salamander</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Eurycea</em></td>
<td><em>cirrigera</em></td>
<td>Southern Two-lined Salamander</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>widerae</em></td>
<td>Blue Ridge Two-lined Salamander</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Gyrinophilus</em></td>
<td><em>porphyricus</em></td>
<td>Spring Salamander</td>
</tr>
<tr>
<td>Cypriniformes</td>
<td>Cyprinidae</td>
<td><em>Semotilus</em></td>
<td><em>atromaculatus</em></td>
<td>Creek Chub</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>thoreavianus</em></td>
<td></td>
</tr>
<tr>
<td>Cyprinodontiformes</td>
<td>Fundulidae</td>
<td><em>Fundulus</em></td>
<td><em>notatus</em></td>
<td>Blackstripe Topminnow</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>diaphnous</em></td>
<td>Banded Killifish</td>
</tr>
<tr>
<td></td>
<td>Poeciliidae</td>
<td><em>Gambusia</em></td>
<td><em>sp.</em></td>
<td>Mosquito Fish</td>
</tr>
<tr>
<td>Siluriformes</td>
<td>Ictaluridae</td>
<td><em>Ameiurus</em></td>
<td><em>natalis</em></td>
<td>Yellow Bullhead</td>
</tr>
<tr>
<td>Percopsiformes</td>
<td>Aphredoderidae</td>
<td><em>Aphredoderus</em></td>
<td><em>sayanus</em></td>
<td>Pirate perch</td>
</tr>
<tr>
<td>Perciformes</td>
<td>Elasmomatiida</td>
<td><em>Elassoma</em></td>
<td><em>zonatum</em></td>
<td>Banded Pygmy Sunfish</td>
</tr>
<tr>
<td></td>
<td>Centrarchidae</td>
<td><em>Lepomis</em></td>
<td><em>cyanellus</em></td>
<td>Green Sunfish</td>
</tr>
<tr>
<td></td>
<td>Percidae</td>
<td><em>Etheostoma</em></td>
<td><em>parvipinna</em></td>
<td>Goldstripe Darter</td>
</tr>
</tbody>
</table>

### 4. Conclusions

Previous studies coincide with results from this study to show that intermittent stream taxa are largely subsets of downstream, perennial communities but generally contain a higher proportion of tolerant species (Feminella 1996, Del Rosario and Resh 2000, Bonada et al. 2007, Datry et al. 2011). Simpson’s diversity, evenness, total richness, and EPT richness were significantly different between intermittent and perennial reaches. We did find that PIT taxa were significantly higher in perennial streams compared to intermittent streams. It appears that the PIT taxa are removed from intermittent stream communities because of shorter available hydroperiods and more variable physico-chemical conditions (Feminella 1996, Williams 1996). The list of PIT developed for North Carolina seems to work throughout the study area with the exception of the caddisfly *Pseudostenophylax* (Trichoptera: Limnephilidae), which may be added to the list of exceptions with *Ironoquia* (Trichoptera: Limnephilidae).

We were able to gather state TNW taxa lists for five (SC, FL, TN, KY, MS) of the seven states sampled during this project. Taxa found in TNW within a state were found in headwater stream samples 99% of the time, suggesting that this could be a viable test for significant nexus. There was between 30–80% overlap between the state TNW list and headwater stream taxa collected from each respective state. Criteria for TNW
differed in each state and results showed higher taxa overlap in states with higher numbers of designated TNW. States should be required to publish TNW taxa lists if TNW taxa are to be implemented as indicators of significant nexus.

Streams begin in a variety of ways across the Southeast, largely reflecting the variety of the landscapes in which they form. Steep or flat, clay or limestone, streams tend to have three basic origins: springs, linear overland flow and wetlands narrowing to form a channel. We found the highest diversity and pollution intolerance in mountain streams, specifically spring-fed streams. Coastal Plains streams, where non-ditched streams begin as wetlands, showed the lowest diversity and highest tolerance in the study area. Our results support previous literature emphasizing the important contribution of headwater stream biodiversity to freshwater ecosystems (Lowe and Likens 2005, Meyer et al. 2007, Clarke et al. 2008, Finn et al. 2011). Rare and undescribed taxa were also collected in headwater streams throughout the study area. Our results suggest that headwaters are a critical source of biodiversity to downstream rivers, including TNW, and deserve appropriate protection.

5. References Cited


6. Appendices

Appendix I. North Carolina Division of Water Quality Stream Identification Form v.3.1 for identifying the origins of intermittent and perennial streams.

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

<table>
<thead>
<tr>
<th>Date:</th>
<th>Project:</th>
<th>Latitude:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluator:</td>
<td>Site:</td>
<td>Longitude:</td>
</tr>
</tbody>
</table>

**Total Points:**
Stream is at least intermittent if ≥ 19 or perennial if ≥ 30

<table>
<thead>
<tr>
<th>County:</th>
<th>Other e.g. Quad Name:</th>
</tr>
</thead>
</table>

### A. Geomorphology (Subtotal = _________)

<table>
<thead>
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<th>Absent</th>
<th>Weak</th>
<th>Moderate</th>
<th>Strong</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Continuous bed and bank</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Sinuosity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. In-channel structure: riffle-pool sequence</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Soil texture or stream substrate sorting</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Active/relic floodplain</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Depositional bars or benches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Braided channel</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Recent alluvial deposits</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Natural levees</td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Headcuts</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11. Grade controls</td>
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<td>1.5</td>
</tr>
<tr>
<td>12. Natural valley or drainageway</td>
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<td>0.5</td>
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<td>1.5</td>
</tr>
<tr>
<td>13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.</td>
<td>No = 0</td>
<td>Yes = 3</td>
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</tbody>
</table>

*Man-made ditches are not rated; see discussions in manual*

### B. Hydrology (Subtotal = _________)

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<tbody>
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<td>14. Groundwater flow/discharge</td>
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<td>3</td>
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<tr>
<td>15. Water in channel and &gt; 48 hrs since rain, or Water in channel -- dry or growing season</td>
<td>0</td>
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<td>2</td>
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<tr>
<td>16. Leaf litter</td>
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<td>1</td>
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</tr>
<tr>
<td>17. Sediment on plants or debris</td>
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<tr>
<td>18. Organic debris lines or piles (Wrack lines)</td>
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</tr>
<tr>
<td>19. Hydric soils (redoximorphic features) present?</td>
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### C. Biology (Subtotal = _________)

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</thead>
<tbody>
<tr>
<td>20. Fibrous roots in channel</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>21. Rooted plants in channel</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>22. Crayfish</td>
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<td>0.5</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>23. Bivalves</td>
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<td>3</td>
</tr>
<tr>
<td>24. Fish</td>
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<tr>
<td>25. Amphibians</td>
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</tr>
<tr>
<td>26. Macrobenthos (note diversity and abundance)</td>
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<tr>
<td>27. Filamentous algae; periphyton</td>
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<td>3</td>
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<td>28. Iron oxidizing bacteria/fungus.</td>
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29<sup>b</sup>. Wetland plants in streambed

<table>
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<tr>
<th>FAC</th>
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<th>OBL</th>
<th>SAV</th>
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<tbody>
<tr>
<td>0.5</td>
<td>0.75</td>
<td>1.5</td>
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</tbody>
</table>

<sup>b</sup> Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:
Appendix II. North Carolina Division of Water Quality Perennial Indicator Taxa (PIT) used in Methodology for Identification of Intermittent and Perennial Streams and their origins v.4.11.

North Carolina Division of Water Quality ^
Indicators of Perennial Streams

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<tr>
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<td>Caenidae</td>
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<tr>
<td></td>
<td>Ephemergiidae</td>
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<tr>
<td></td>
<td>Ephemeraidae</td>
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<tr>
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<td>Heptageniidae</td>
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<td>Siphlonuridae</td>
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<td>Stoneflies</td>
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^ Methodology for Identification of Intermittent and Perennial Streams and Their Origins v.4.11
Appendix III. Aquatic species collected from intermittent and perennial study sites with determined hydrologic regime and appearance on Florida or Tennessee state Traditionally Navigable Waters list. Int. = Intermittent, Per. = Perennial, TNW = Traditionally Navigable Waters for Florida and Tennessee.

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<td>Pisidiidae</td>
<td>Musculium</td>
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<td>Sphaerium</td>
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</table>
Appendix IV. Taxa located in Florida Traditionally Navigable Waters

**Ephemeroptera**

Acentrella  
Acentrella alachua  
Acentrella parvula  
Acerpenna (Acentrella) pygmaea  
Ameletus  
Asioplax dolani (Leptohyphes)  
Attaneuria ruralis  
Attenella  
Attenella attenuata  
Baetis  
Baetis alachua  
Baetis armillatus  
Baetis australis  
Baetis ephippiatus  
Baetis frondalis  
Baetis intercalaris  
Baetis propinquus  
Baetis punctiventris  
Baetis pygmaeus  
Baetis spheni  
Baetis spinosus  
Baetisca  
Baetisca becki  
Baetisca callosa  
Baetisca escambsiensis  
Baetisca gibbera  
Baetisca obesa  
Baetisca rogersi  
Blasturus intermedius (Leptophlebia)  
Brachycercus  
Brachycercus lacustris  
Brachycercus maculatus  
Caenis  
Caenis amica  
Caenis diminuta  
Caenis eglinensis  
Caenis hilairei  
Caenis punctata  
Callibaetis  
Callibaetis floridanus  
Callibaetis pretiosus  
Centroptilum  
Centroptilum hobbsi  
Centroptilum triangulifer  
Centroptilum viridocularis  
Cercobrachys etowah  
Choroterpes  
Maccaffertium exiguum  
Maccaffertium mexicanum integrum  
Maccaffertium smithae  
Macdunnoa  
Macdunnoa brunnnea  
Neoephemera  
Neoephemera compressa  
Neoephemera youngi  
Paraleptophlebia  
Paraleptophlebia bradleyi  
Paraleptophlebia volitans  
Pentagenia  
Plauditus  
Plauditus bimaculatus  
Plauditus (Acentrella) parvulus  
Plauditus punctiventris  
Procloeon  
Procloeon hobbsi  
Procloeon rubropictum  
Procloeon viridocularis  
Pseudiron centralis  
Pseudocentroptiloides usa  
Pseudocloeon  
Pseudocloeon alachua  
Pseudocloeon bimaculatus  
Pseudocloeon ephippiatum  
Pseudocloeon frondale  
Pseudocloeon parvulum  
Pseudocloeon propinquum  
Pseudocloeon punctiventris  
Serratella  
Serratella deficiens  
Siphlonurus  
Siphloplecton  
Siphloplecton speciosum  
Sparbarus nasutus  
Stenacron  
Stenacron floridense  
Stenacron interpunctatum  
Stenonema  
Stenonema annexum  
Stenonema exiguum  
Stenonema integrum  
Stenonema interpunctatum  
Stenonema mexicanum integrum  
Stenonema modestum  
Stenonema proximum  
Stenonema pulchellum  
Stenonema smithae
Teloganopsis deficiens (Serratella)
Tortopus
Tortopus incertus

**Plecoptera**
Acroneuria
Acroneuria abnormis
Acroneuria arenosa
Acroneuria arenosa/evoluta
Acroneuria lycorias
Acroneuria mela
Acroneuria perplexa
Acroneuria ruralis
Agnetina
Agnetina annulipes
Allocapnia
Alloperla
Amphinemura
Amphinemura delosa
Amphinemura nigrita
Atoperla
Atoperla ephyre (Perlinella)
Cloperla clio
Diplectrona
Eccoptura
Eccoptura xanthenes
Haploperla
Haploperla (Hastaperla) brevis
Helopicus
Helopicus bogaloosa
Helopicus subvarians
Hydroperla
Hydroperla phormidia
Isoleperla
Isoleperla bilineata
Isoleperla clio
Isoleperla dicala
Isoleperla lata
Isoleperla orata
Leuctra
Leuctra ferruginea
Nemocapnia carolina
Neoperla
Neoperla carlsoni
Neoperla clymene
Neophasganophora capitata
Paragnetina
Paragnetina fumosa
Paragnetina kansensis
Perlesta

Perlesta placida
Perlesta placida complex
Perlinella
Perlinella drymo
Perlinella ephyre
Perlinella fumipennis
Phasganophora capitata
Pteronarcy
Pteronarcy dorsata
Pteronarcy picteti
Taeniopteryx
Taeniopteryx lita
Taeniopteryx nivalis
Taeniopteryx maura

**Trichoptera**
Agapetus
Agarodes
Agarodes libalis
Agraylea
Agrynia vestita
Anisocentropus
Anisocentropus pyraloides
Apatania
Arctopsyche
Athrripsodes (Ceraclea)
Beraea
Brachycentrus
Brachycentrus chelatus
Brachycentrus numerosus
Ceraclea
Ceraclea cancellatus
Ceraclea diluta
Ceraclea flava
Ceraclea maculata
Ceraclea resurgens
Ceraclea transversus
Ceratopsyche
Cemotina
Cemotina spicata
Cemotina truncona
Cheumatopsyche
Chimarra
Chimarra aterrima
Chimarra feria
Chimarra perigua
Chimarra socia
Cyrnellus
Cyrnellus fraternus
Cyrnellus marginalis

Diplectrona
Diplectrona modesta
Glossosoma
Helicopsyche
Helicopsyche borealis
Heteroplectron americanum
Hydatophylax argus
Hydropsyche
Hydropsyche decalda
Hydropsyche elissoma
Hydropsyche frisoni
Hydropsyche incommoda
Hydropsyche mississippiensis
Hydropsyche phalerata
Hydropsyche rossi
Hydropsyche simulans
Hydropsyche sparna
Hydropsyche venularis
Hydroptila
Ionoquia
Ionoquia parvula
Lepidostoma
Leptocella (Nectopsyche)
Leptocella pavaida
Leptocerus
Leptocerus americanus
Lype
Lype diversa
Macronema (Macrostemum)
Macronema carolina
Macrostemum carolina
Mayatrichia
Mayatrichia ayama
Micrasema
Micrasema rusticum
Micrasema sp. n
Micrasema wataga
Molanna
Molanna blenda
Molanna tryphena
Molanna ulmerina
Mystacides
Nectopsyche
Nectopsyche candida
Nectopsyche exquisita
Nectopsyche paludicola
Nectopsyche pavaida
Nectopsyche tavara
Neotrichia
Neureclipsis
Neureclipsis crepuscularis
Neureclipsis melco
Nyctiophylax
Nyctiophylax celta
Nyctiophylax moestus
Ochrotrichia
Oecetis
Oecetis avara
Oecetis cinerascens
Oecetis georgia
Oecetis inconspicua
Oecetis inconspicua cmplx.
Oecetis morsei or sphyra
Oecetis nocturna
Oecetis osteni
Oecetis parva
Oecetis persimilis
Oecetis porteri
Oecetis sp. a floyd
Oecetis sp. c floyd
Oecetis sp. e floyd
Oecetis sp. f floyd
Oecetis sphyra
Oecetis sphyra/morsei
Orthotrichia
Oxyethira
Paranyctiophylax
Parapsyche
Phylocentropus
Phylocentropus carolinus
Phylocentropus placidus
Polycentropus
Polycentropus cinereus
Polycentropus crassicornis
Polycentropus flavus
Polycentropus interruptus
Polycentropus remotus
Polyplectropus
Potamyia
Potamyia flava
Protoptilia
Psychomyia
Psychomyia flavida
Ptilostomis
Pycnostigmia
Pycnopsyche guttifer
Pycnopsyche scabripennis
Rhyacophila
Rhyacophila carolina
Rhyacophila ledra
Setodes
Stactobella
Trienaodes
Trienaodes abus
Trienaodes flavescens
Trienaodes florida
Trienaodes furcellus
Trienaodes helo
Trienaodes ignitus
Trienaodes injusta
Trienaodes ochraceus
Trienaodes perna
Trienaodes perna/helo
Trienaodes sp. a
Trienaodes tarda
Tricorythodes
Tricorythodes albilineatus
Wormaldia moesta
Celina contiger
Celina grossula
Celina slossoni
Cercyon
Chaetarthria
Chaetarthria pallida
Colpius (Coleop)
Colpius inflatus
Conchapelopia
Copelatus
Copelatus caelatipennis
Copelatus chevrolati
Copelatus chevrolati chevrolati
Copelatus glypticus
Coptotomus
Coptotomus interrogatus
Coptotomus fenticus
Coptotomus foticus
Coptotomus venustus
Cybister
Cybister fimbriolatus crotchi
Cymbiodyta
Cyphon
Dactylosternum
Derallus
Derallus altus
Deronecetes
Deronecetes griseostriatus
Derovatellus
Derovatellus lentus floridanus
Desmopachria
Desmopachria grana
Dineutus
Dineutus americanus
Dineutus angustus
Dineutus assimilis
Dineutus carolinus
Dineutus ciliatus
Dineutus discolor
Dineutus emarginatus
Dineutus emarginatus floridensis
Dineutus nigror
Dineutus serrulatus
Dryops
Dubiraphia
Dubiraphia bivittata
Dubiraphia quadritornata
Dubiraphia vittata
Dytiscus
Ectopria
Ectopria nervosa      Hydrobius                  Macronynchus glabrat
Ectopria thoracica   Hydrobius tumidus                Matus
Elodes (Scirted)     Hydrocanthus                  Matus ovatus
Enochrus             Hydrocanthus iricola            Mesonoterus
Enochrus blatchleyi  Hydrocanthus oblongus           Microcylopus
Enochrus cinctus     Hydrocanthus regius             Microcylopus pusillus
Enochrus ochraceus   Hydrochara                    Microcylopus pusillus lodingi
Enochrus pygmaeus    Hydrochus                    Microcylopus pusillus perditus
Enochrus sayi        Hydrochus equicaninatus          Narpus
Enochrus sublongus   Hydrochus foveatus              Neoeolmis
Gonielmis            Hydrochus rugosus              Neoporus
Gonielmis dietrichi  Hydrochus simplex              Neoporus asidytus
Graphoderus          Hydrocolus                    Neoporus clypealis
Graphoderus liberus  Hydrophilus                   Neoporus dixianus
Gymnochthebius fossatus Hydrophilus triangularis  Neoporus lobatus
Gyretes              Hydroporus                    Neoporus mellitus
Gyretes iricolor     Hydroporus cimicoides           Neoporus vittatipennis
Gyrinus              Hydroporus falli               Notomicrus
Gyrinus analis       Hydroporus dixianus             Notomicrus nanulus
Gyrinus elevatus     Hydroporus floridanus           Optioservus
Gyrinus floridanus   Hydroporus hybridus             Ora/scirtes
Gyrinus frosti       Hydroporus lobatus               Oreodytes
Gyrinus lugens       Hydroporus obticus             Pachycus
Gyrinus marginellus  Hydroporus pilatei              Pachycus princeps
Gyrinus minutus      Hydroporus vittatipennis         Paracatus
Gyrinus pachysomus   Hydrotrupes (coleop)           Paracatus nanus
Gyrinus rockinghamensis Hydrovatus                   Paracatus reductus
Gyrinus woodruffi    Hydrovatus peninsularis         Paracatus subcupreus
Haliplus             Hydropusastus pustulatus compressus Pelonomus
Haliplus annulatus   Hygrobes                     Pelonomus obscurus
Haliplus confluentus Hygrotes                     Pelonomus obscurus gracilipes
Haliplus fasciatus   Hygrotes marginipennis         Peltodytes
Haliplus mutchleri   Ilybius oblitus               Peltodytes dietrichi
Haliplus punctatus   Laccobius                     Peltodytes duodecimpantates
Helichus             Laccodytes                    Peltodytes floridensis
Helichus basalis     Laccodytes pumilio              Peltodytes lengi
Helichus fastigias   Laccophilus                       Peltodytes muticus
Helichus lithophilus Laccophilus fasciatus         Peltodytes oppositus
Helobata striata    Laccophilus gentilis              Peltodytes sexmaculatus
Helocares            Laccophilus proximus             Peltodytes shermani
Helocombus           Laccophilus terminalis          Phanocerus clavicorns
Helophorus           Laccornis                     Platumbus (dytiscid)
Heterelmis           Laccornis formis               Prionocyphon
Hydaticus            Limnichus                       Promoresia
Hydaticus bimarginatus Liodessus                  Promoresia elegans
Hydraena             Liodessus flavicollis            Promoresia tardella
Hydraena marginicollis Liopeorus                    Pronoterus
Hydraena pennsylvanica Lioporeus pilatei             Pronoterus addendus
Hydrobiomorpha       Lioporeus triangularis         Pronoterus semipunctata
Hydrobiomorpha castus Macronynchus                  Psephenus
Psephenus herricki
Ptilodactyla
Rhantus calidus
Scirtes
Simsonia quadrinotata
Stenelmis
Stenelmis antennalis
Stenelmis convexula
Stenelmis crenata
Stenelmis fuscata
Stenelmis humerosa
Stenelmis hungerfordi
Stenelmis sinuata
Stenelmis vittipennis
Stenelmis xylonastis
Suphis
Suphis inflatus
Suphisellus
Suphisellus floridanus
Suphisellus gibbus
Suphisellus insularis
Suphisellus parsoni
Suphisellus puncticollis
Thermonectus basillaris
Tropisternus
Tropisternus blatchleyi
Tropisternus collaris
Tropisternus lateralis nimbatus
Tropisternus natator
Tropisternus quadristriatus
Tropisternus striolatus
Uvarus

Odonata
Aeschna
Aeschna umbrosa
Agrion (Calopteryx)
Agrion (Calopteryx) aequabilis
Agrion (Calopteryx) maculata
Anax
Anax amazili
Anax junius
Anax longipes
Anomalagrion
Anomalagrion hastatum
Aphylla
Aphylla williamsoni
Argia
Argia apicalis
Argia bipunctulata
Argia fumipennis
Argia moesta
Argia sedula
Argia tibialis
Argia translata
Arigomphus
Arigomphus pallidus
Basiaschna janata
Boyeria
Boyeria graffiana
Boyeria vinoso
Brachymesia
Brachymesia gravida
Calopteryx
Calopteryx dimidiata
Calopteryx maculata
Cannacia gravida (Brachymesia)
Celithemis
Celithemis amanda
Celithemis eponina
Celithemis ornata
Cordulegaster
Cordulegaster maculata
Cordulegaster obliqua
Coryphaeschna
Coryphaeschna ingens
Coryphaeschna virens
Crocothemis
Didymops
Didymops transversa
Dorocordulia
Dromogomphus
Dromogomphus armatus
Dromogomphus spinosus
Dromogomphus spoliatus
Dythemis
Dythemis rufinervis
Dythemis velox
Enallagma
Enallagma basidens
Enallagma cardenium
Enallagma civile
Enallagma coecum
Enallagma concisum
Enallagma daceki
Enallagma divagans
Enallagma doubledayi
Enallagma dubium
Enallagma durum
Enallagma pallidum

Enallagma pollutum
Enallagma signatum
Enallagma traviatum
Enallagma vesperum
Epiaeschna heros
Epicordulia
Epicordulia princeps
epicordulia princeps regina
Epitheca
epitheca cynosura
Epitheca princeps
Epitheca princeps regina
Epitheca sepsia
Erythemis
Erythemis versiculosa
Erythemis simplicicollis
Erythrodiplax
Erythrodiplax conata
Erythrodiplax conata miniscula
Erythrodiplax umbrata
Gomphaeschna furcellata
Gomphoides
Gomphus
Gomphus cavillaris
Gomphus (Gomphurus) dilatatus
Gomphus geminatus
Gomphus exilis
Gomphus ivae
Gomphus luidus
Gomphus minutus
Gomphus modestus
Gomphus palidus
Gomphus plagiatus
Gynacantha
Gynacantha nervosa
Hagenius
Hagenius brevistylus
Hetaerina
Hetaerina americana
Hetaerina titia
Hylogomphus gerninatus
Ischnura
Ischnura cervula
Ischnura credula
Ischnura hastata
Ischnura posita
Ischnura prognatha
Ischnura ramburi
Ladona deplanata
Lestes
Lestes disjunctus australis
Lestes forcipatus
Lestes inaequalis
Lestes vigilax
Libellula
Libellula auripennis
Libellula diplanata
Libellula incesta
Libellula needhami
Libellula pulchella
Libellula semifasciata
Libellula vibans
Lipogomphus
Macrodiplax
Macromia
Macromia alleghaniensis
Macromia georgiana
Macromia illinoiensis
Macromia illinoiensis georgina
Macromia taeniolata
Macrothemis
Miathyria
Miathyria marcella
Micrathyria
Micrathyria didyma
Nannothemis
Nannothemis bella
Nasiaeschna pentacantha
Nehalennia
Nehalennia interricollis
Neoneura
Neurocordulia
Neurocordulia alabamensis
Neurocordulia molesta
Neurocordulia obsoleta
Neurocordulia virginiensis
Ophiogomphus
Orthemis
Orthemis ferruginea
Pachydiplax
Pachydiplax longipennis
Pantala flavescens
Perithemis
Perithemis seminola
Perithemis tenera
Perithemis tenera seminole
Plathemis
Plathemis lydia
Progomphus
Progomphus alachuensis
Progomphus obscurus
Somatochlora
Stylurus
Stylurus ivae
Stylurus plagiatus
Sympertrum ambiguum
Tarnetrum
Tarnetrum corruptum
Tauriphila
Telebasis
Telebasis byersi
Tetragoneuria
Tetragoneuria cynosura
Tetragoneuria petechialis
Tetragoneuria semiaquea
Tetragoneuria sepia
Tetragoneuria spinosa
Tramea
Tramea carolina
Tramea lacerata
Megaloptera
Chauliodes
Chauliodes pectinicornis
Chauliodes rastricornis
Corydalus
Corydalus comatus
Neohermes
Nigonia
Nigonia fasciatus
Nigonia serricornis
Sialis
Sialis americana
Sialis iola
Sialis mohri
Diptera (Chironomidae)
Ablabesmyia
Ablabesmyia (karelia) grp.
Ablabesmyia americana
Ablabesmyia annulata
Ablabesmyia aspera
Ablabesmyia aurantiens
Ablabesmyia cinctipes
Ablabesmyia hauberi
Ablabesmyia idei
Ablabesmyia illinoensis
Ablabesmyia janta
Ablabesmyia mallochi
Ablabesmyia monilis
Ablabesmyia ornata
Ablabesmyia parajanta
Ablabesmyia peleensis
Ablabesmyia philosphagnos
Ablabesmyia rhamphe
Ablabesmyia rhamphe grp.
Ablabesmyia sp. a epler
Ablabesmyia sp. b epler
Ablabesmyia tarella
Alluadomyia
Alotanypus
Alotanypus aris
Anatopynia (Tanypode)
Antillocladius
Apedilum
Apedilum elachista
Apectrotanypus
Apectrotanypus johnsoni
Asheum beckae (Polypedilum)
Axarus
Beardius
Beardius sp. a epler
Beardius truncatus
Brilia
Brilia flavifrons
Brilia par
Brilia sera
Bryophanacladius
Calopsectra (Tanytarsus)
Cantopelopia gesta
Cardiocladius
Cardiocladius albipalvestis
Cardiocladius obscurus
Chernovskiiia
Chironomin gen. 3 epler
Chironomin gen. a (Fissimentum)
Chironomin genus iv
Chironomus
Chironomus abortivus
Chironomus anthracinus
Chironomus attenuatus
Chironomus carus
Chironomus crassicystaupus
Chironomus decorus
Chironomus fulvipilus
Chironomus ochreatus
Chironomus plumosus
Chironomus riparius
Chironomus staegeri
Chironomus stigmaterus
Cladopelma
Cladopelma galeator
Cladotanytarsus
Cladotanytarsus aeiparthenus
Cladotanytarsus cf. daviesi
Cladotanytarsus mancus
Cladotanytarsus sp. a epler
Cladotanytarsus sp. b epler
Cladotanytarsus sp. c epler
Cladotanytarsus sp. d epler
Cladotanytarsus sp. f epler
Cladotanytarsus sp. g epler
Cladotanytarsus sp. h epler
Cladotanytarsus sp. i epler
Cladotanytarsus viridiventris
Clinotanytus
Clinotanytus pinguis
Coelotanytus
Coelotanytus concinnus
Coelotanytus scapularis
Coelotanytus tricolor
Conchapelopia fasciata
Conchapelopia gigas
Constempellina
Corynoneura
Corynoneura celeripes
Corynoneura lobata
Corynoneura scutellata
Corynoneura sp. b epler
Corynoneura sp. c epler
Corynoneura sp. e epler
Corynoneura sp. f epler
Corynoneura sp. g epler
Corynoneura tiris
Corynoneura xena
Cricotopus
Cricotopus absurds
Cricotopus albiforceps
Cricotopus annulator complex
Cricotopus bicinctus
Cricotopus bicinctus grp.
Cricotopus intersectus
Cricotopus lebetis
Cricotopus or orthocladius
Cricotopus politus
Cricotopus remus
Cricotopus sylvestris grp.
Cricotopus tricinctus
Cricotopus trifasciatus
Cryptochironomus
Cryptochironomus blarina
Cryptochironomus fulvus
Cryptochironomus stylifera
Cryptochironomus pectinatellae
Cryptotendipes
Cryptotendipes casuarius
Demeijerea
Demicrochironomus
Demicrochironomus sp. a
Denopelopia
Denopelopia atria
Dicrotendipes
Dicrotendipes incurvus
Dicrotendipes fumidus
Dicrotendipes leucocelsis
Dicrotendipes lobus
Dicrotendipes lucifer
Dicrotendipes modestus
Dicrotendipes neomodestus
Dicrotendipes nervosus
Dicrotendipes simpsoni
Dicrotendipes sp. a epler
Dicrotendipes sp. b epler
Dicrotendipes thanatogratus
Dicrotendipes tritomus
 Djalmbatista
 Djalmbatista pulcher
 Einfeldia
 Einfeldia austini
 Einfeldia natchitocheae
 Einfeldia sp. a epler
 Endochironomus
 Endochironomus nigricans
 Endochironomus subtendens
 Endotribelos
 Endotribelos hesperium
 Epico cladius
 Epico cladius flavens
 Eukiefferiella
 Eukiefferiella brevicalcar
 Eukiefferiella claripennis grp.
 Eukiefferiella coerulescens
 Eukiefferiella devonica grp. sp. a epler
 Glypotendipes
 Glypotendipes amplus
 Glypotendipes barbipes
 Glypotendipes lobiferus
 Glypotendipes meridionalis
 Glypotendipes paripes
 Glypotendipes seminole
 Glypotendipes senilis
 Glypotendipes sp. b epler
 Glypotendipes sp. f epler
 Glypotendipes sp. g epler
 Goeldichironomus
 Goeldichironomus amazonicus
 Goeldichironomus carus
 Goeldichironomus cf. natans
 Goeldichironomus fluctuans
 Goeldichironomus holoprasinus
 Goeldichironomus natans
 Guttipelopia
 Guttipelopia currani
 Guttipelopia guttipennis
 Gymnometriocnemus
 Harnischia
 Harnischia amachaerus
 Harnischia boydi
 Harnischia collator
 Harnischia complex gen. b epler
 Harnischia curtiamellatus
 Harnischia edwardsi
 Harnischia galeator
 Hayesomyia
 Hayesomyia senata
 Helopelopia
 Heterotri ssocladius
 Heterotri ssocladius marcidus
 Hudsonomyia
 Hydrobaenus
 Kieffererus
 Kieffererus dux
 Kieffererus pungens
 Kloosia dorsenna
 Krenopelopia hudsoni
 Krenosmittia
 Labrundinia
 Labrundinia becki
 Labrundinia floridana
 Labrundinia johannseni
 Labrundinia maculata
 Labrundinia neopilosella
 Labrundinia pilosella
Labrundinia sp. 3 epler
Labrundinia sp. 3 nr. virescens
Labrundinia sp. 4 epler
Labrundinia sp. 6 epler
Labrundinia sp. a epler
Labrundinia sp. b epler
Labrundinia virescens
Larsia
Larsia berneri
Larsia decolorata
Larsia indistincta
Larsia lurida
Larsia sp. a epler
Larsia sp. b
Lauterborniella
Lauterborniella agrayloides
Leptochironomus (Microchironomus)
Limnochironomus (Dicrotendipes)
Limnophyes
Lopescladius
Macropelopia
Mesosmittia
Metriocnemus
Metriocnemus lundbecki
Micropschlaudius
Micropschlaudius sp. c epler
Micropschlaudius sp. d epler
Microtendipes
Microtendipes caelum
Microtendipes pedellus
Microtendipes pedellus grp.
Microtendipes rydalensis
Microtendipes rydalensis grp.
Monopelopia
Monopelopia boliekae
Nanocladius
Nanocladius alternanterae
Nanocladius balticus grp.
Nanocladius cf rectinervis
Nanocladius crassicornus
Nanocladius distinctus
Nanocladius minimus
Natarsia
Natarsia baltimoreus
Natarsia sp. a roback
Nilodorum
Nilotanytarsus
Nilotanytarsus americanus
Nilotanytarsus fimbriatus
Nilothauma
Nilothauma bicerne
Nimbocera
Nimbocera limnetica
Nimbocera patagonica
Nimbocera pinderi
Omisus
Omisus pica
Orthocladiinae gen. c epler
Orthocladius
Orthocladius annectens
Orthocladius dubitatue
Orthocladius lignicola
Pagastiella
Pagastiella orophila
Pagastiella ostansa
Parachironomus
Parachironomus alatus
Parachironomus carinatus
Parachironomus chaetoalvus complex
Parachironomus directus
Parachironomus frequens
Parachironomus hirtalatus
Parachironomus longistilius
Parachironomus monochromus
Parachironomus pectinatellae
Parachironomus schneideri
Parachironomus sublettei
Parachironomus supparilis
Parachironomus tenuicaudatus complex
Paracladopelma
Paracladopelma doris
Paracladopelma loganae
Paracladopelma nereis
Paracladopelma undine
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Parakiefferiella coronata
Parakiefferiella sp. a epler
Parakiefferiella sp. b epler
Parakiefferiella sp. c epler
Parakiefferiella sp. d epler
Parakiefferiella sp. e epler
Parakiefferiella sp. f epler
Paralauderborniella
Paralauderborniella elachista
Paralauderborniella nigrohalterale
Paralimnophyes
Paramerina
Paramerina anomala
Parametriocnemus
Parametriocnemus lundbecki
Parametriocnemus sp. f epler
Paraphaenocladius
Paraphaenocladius exagittans
Parasmittia
Paratanytarsus
Paratanytarsus dissimilis
Paratanytarsus quadratus
Paratanytarsus sp. a epler
Paratanytarsus sp. b epler
Paratanytarsus sp. c epler
Paratendipes
Paratendipes basidens
Paratendipes connectens
Paratendipes subaequalis
Parorthocladius
Pedionomus beckae
Pentaneura
Pentaneura aequifasciata
Pentaneura auriensis
Pentaneura carnea
Pentaneura inconspicua
Pentaneura inculta
Pentaneura monilis
Pentaneura pilosella
Phaenonotum
Phaenonotum exstriatum
Phaenopsectra
Phaenopsectra dyari
Phaenopsectra flavipes
Phaenopsectra obediens
Phaenopsectra obediens grp.
Phaenopsectra punctipes grp.
Polypedilum
Polypedilum aviceps
Polypedilum beckae
Polypedilum convictum
Polypedilum convictum grp.
Polypedilum fallax
Polypedilum flavum
Polypedilum halterale
Polypedilum halterale grp.
Polypedilum illinoense
Polypedilum illinoense grp.
Polypedilum laetum
Polypedilum ontario
Polypedilum scalaenum
Polypedilum scalaenum grp.
Polypedilum sp. a epler
Polypedilum trigonum
Polypedilum trigonus
Polypedilum triturum
Potthastia
Potthastia longimana
Procadius
Procadius (holotanypus)
Procadius bellus
Procadius bellus var. 1 epler
Procadius bellus var. 2 epler
Procadius culiciformis
Psectrocladius
Psectrocladius elatus
Psectrocladius flavus
Psectrocladius psilopterus gp. sp. 1
Psectrocladius simulans
Psectrocladius vernalis
Psectrotanypus
Pseudochironomus
Pseudochironomus fulviventris
Pseudochironomus richardsoni
Pseudorthocladius
Pseudosmittia
Rheocricotopus
Rheocricotopus robacki
Rheocricotopus tuberculatus
Rheopelopia
Rheosmittia
Rheosmittia arcuata
Rheotanytarsus
Rheotanytarsus distinctissimus
Rheotanytarsus exigus
Rheotanytarsus exigus grp.
Rheotanytarsus pellucidus
Robackia
Robackia claviger
Robackia demejerei
Saetheria hirta
Saetheria tylus
Smittia
Stelechomyia perpulchra
Stempellina
Stempellina sp. a epler
Stempellinella
Stempellinella cf. leptocelloides
Stempellinella fimбриata
Stempellinella leptocelloides
Stempellinella sp. a epler
Stenochironomus
Stenochironomus aestivalis
Stenochironomus hilaris
Stictochironomus
Stictochironomus caffrairis grp.
Stictochironomus devinctus
Stilocladius
Symbiocladius
Sympothastia
Synorthocladius
Tanypus
Tanypus carinatus
Tanypus clavatus
Tanypus neopunctipennis
Tanypus punctipennis
Tanypus stellatus
Tanypus
Tanypus coffmani
Tanypus dentyi
Tanypus dissimilis
Tanypus glabrescens
Tanypus guerlus
Tanypus jucundus
Tanypus limneticus
Tanypus polita
Tanypus sp. a epler
Tanypus sp. b epler
Tanypus sp. c epler
Tanypus sp. d epler
Tanypus sp. e epler
Tanypus sp. f epler
Tanypus sp. g epler
Tanypus sp. i epler
Tanypus sp. j epler
Tanypus sp. k epler
Tanypus sp. l epler
Tanypus sp. m epler
Tanypus sp. n epler
Tanypus sp. o epler
Tanypus sp. p epler
Tanypus sp. q epler
Tanypus sp. r epler
Tanypus sp. s epler
Tanypus sp. t epler
Tanypus sp. u epler
Tanypus sp. v epler
Tanypus sp. w epler
Tanypus sp. y epler
Tendipes (Chironomus)
Tendipes decorus
Thienenniellia
Thienenniellia fusca
Thienenniellia lobapodema
Thienenniellia similis
Thienenniellia sp. a epler
Thienenniellia sp. b epler
Thienenniellia sp. c epler
Thienenniellia sp. d epler
Thienenniellia xena
Thienenniellia yena
Tribelos
Tribelos atrum
Tribelosfuscicornis
Tribelos jucundum
Tribelos quadripunctatus
Trichocladius (Rheocricotopus)
Trichocladius extatus
Trichocladius robacki
Trissocladius
Tvetenia
Tvetenia discoloripipes grp.
Tvetenia pauncuna
Tvetenia vitracies
Unniella
Unniella multivirga
Wyeomyia hayniei
Xenochironomus
Xenochironomus rogersii
Xenochironomus taenionotus
Xenochironomus xenolabis
Xestochnornomus subletti
Xylotopus par
Zalutschia
Zavrelia
Zavreliella
Zavreliella marmorata
Zavrelimyia
Zavrelimyia sinuosa
Zavrelimyia sp. a epler

Diptera (Misc)
Aedes
Anopheles
Anopheles quadrimaculatus
Antocha
Atherix
Atherix lantha
Atherix variegata
Atrichopogon
Atrichopogon websteri
Bezzia
Bezzia setulosa
Bezzia varicolor
Caloparyphus
Ceratopogon
Chaoborus albatus
Chaoborus albipes
Chaoborus punctipennis
Chelifera
Chlorotabanus
Chrysops
Clinocera
Clinohlela
Cnephia pecuarum
Corethrella
Culex
Culex erraticus
Culex salinarius
Culicoides
Dasyhelea
Dixia
Dolichopodidae
Empididae
Eriocera (Hexatoma)
Erioptera
Eristalis
Eulalia (insecta - Odontomyia)
Forcipomyia
Hedriodiscus
Hexatoma
Hydrellia
Hydrometra
Hydrometra australis
Hydrometra barei
Hydrometra martini
Hydrometra wileyae
Limnophila
Limnophora
Limonia
Mallochohelea
Mansonias
Mansonia dyari
Mansonia perturbans
Megistocera
Megistocera longipennis
Myxosargus
Neolepta
Nephrotoma
Niobezzia
Notiphila
Oechlerotatus
Odontomyia
Ormosia
Oxycera
Palpomyia
Palpomyia flavipes
Palpomyia longipennis
Palpomyia tibialis
Palpomyia/bezzia grp.
Pericoma
Pilaria
Prionocera
Probezzia
Psedolimnophila
Psorophora
Ptychoptera
Rhodomastix
Rhaphium
Roederiodes
Roederiodes junctus
Sepedon
Simulium
Simulium congareenarum
Simulium exiguum
Simulium jenningsi
Simulium jonesi
Simulium nyssa
Simulium slossonae
Simulium taxodium
Sphaeromias
Stilobezzia
Stratiomys
Syritta
Tabanus
Telmatoscopus albipunctatus
Tipula
Tipula caloptera
Uranotaenia sapphirina
Oligochaeta
Aeolosoma
Aeolosoma leidyi
Aeolosoma niveum
Aeolosoma tenebrarum
Alloanas
Alloanas inaequalis
Alloanas paraguayensis
Alloanas pectinata
Amphichaeta leydigi
Arcteonais lomondi
Aulodrilus
Aulodrilus americanus
Aulodrilus limnobius
Aulodrilus pigueti
Aulodrilus pluriseta
Aulophorus (Dero)
Aulophorus furcata
Branchiura
Branchiura sowerbyi
Bratislavia
Bratislavia bilongata
Bratislavia unidentata
Chaetogaster
Chaetogaster diaphanus
Chaetogaster diastrophus
Chaetogaster limnaei
Chaoborus
Dero
Dero abranchiata
Dero digitata
Dero digitata complex
Dero dorsalis
Dero flabelliger
Dero furcata
Dero lodeni
Dero nivea
Dero obtusa
Dero pectinata
Dero trifida
Dero vaga
Eclipidrilus
Eclipidrilus palustris
Haber
Haber speciosus
Haemonais
Haemonais waldvogeli
Haplotaxis
Homochaeta naidina
Ilyodrilus
Ilyodrilus templetoni
Isochaetides freyi
Limnodriloides
Limnodrilus
Limnodrilus angustipenis
Limnodrilus hoffmeisteri
Limnodrilus profundicola
Limnodrilus udekemianus
Lumbriculus
Lumbriculus inconstans
Lumbriculus variegatus
Megalonaias
Monopylephorus lacteus
Monopylephorus rubroniveus
Nais barbata
Nais behningi
Nais bretscheri
Nais communis
Nais communis complex
Nais elinguis
Nais magnaseta
Nais pardalis
Nais pseudobtusa
Nais simplex
Nais variabilis
Ophidonais serpentina
Paranais litoralis
Peloscolex
Peloscolex benedeni
Peloscolex carolinensis
Peloscolex ferox
Peloscolex gabriellae
Peloscolex multisetasus
Peloscolex variegatus
Potamothrix
Potamothrix hammoniensis
Potamothrix vejovskyi
Premnodrilus palustris
Pristina
Pristina aequiseta
Pristina americana
Pristina breviseta
Pristina foreli
Pristina idrensis
Pristina leidi
Pristina longiseta
Pristina longiseta leidi
Pristina longisoma
Pristina osborni
Pristina proboscidea
Pristina sima
Pristina synclites
Pristinella
Pristinella jenkinae
Pristinella longisoma
Pristinella osborni
Pristinella sima
Psammoryctides californianus
Psammoryctides convolutus
Quistradrilus multisetasus
Rhizodrilus lacteus
Rhynacodrilus coccineus
Slavina
Slavina appendiculata
Sparanganophilus tamesis
Sparanganophilus
Specaria josinae
Spiroperma
Spiroperma ferox
Stephensoniana
Stephensoniana tandyi
Stephensoniana trivandrana
Stylaria
Stylaria fossularis
Stylaria lacustris
Stylodrilus
Stylodrilus heringianus
Sutroa
Tubifex
Tubifex ignotus
Tubifex tubifex
Varichaetadrilus angustipenis
Varichaetadrilus psammophilus
Vejdovskyella comata

Crustacea
Asellus (Caecidotea)
Asellus attenuatus
Asellus communis
Asellus intermedius
Asellus laticaudatus
Asellus militaris
Asellus obtusus
Asellus occidentlis
Asellus racovitzae
Asellus racovitzae australis
Cambarellus schmitti
Cambarus
Chlamydotheca (ostracod)
Cragononyx
Cragononyx floridanus
Cragononyx richmondensis
Cragononyx serratus
Gammarus
Gammarus fasciatus
Gammarus mucronatus
Gammarus palustris
Gammarus tigrinus
Hyalella
Hyalella azteca
Lirceus
Lirceus fontinalis
Macrobrachium
Macrobrachium acanthurus
Macrobrachium carcinus
Macrobrachium ohione
Macrobrachium offersii
Melita nitida
Orconectes
Palaemonetes
Palaemonetes kadiakensis
Palaemonetes paludosus
Potimiri potimirim
Procambarus
Procambarus allenii
Procambarus fallax
Procambarus paeninsulanus
Procambarus pygmaeus
Procambarus spiculifer
Synurella

Mollusca
Amblema
Amnicola
Amnicola dalli
Amnicola dalli johnsoni
Amnicola limosa
Amnicola rhombostoma
Amphigyra (Planorbid)
Anodonta
Anodonta cooperiana
Anodonta imbecillls
Aphaenostoma
Arcidens
Biomphalaria
Biomphalaria glabrata
Biomphalaria havanensis
Byssanodonta
Byssanodonta cubensis
Campeloma
Campeloma floridense
Campeloma geniculum
Campeloma lewisi
Carunculina parva
Cincinnatia
Cincinnati floridana
Clappia (mollusk)
Congeria leucophaeta
Corbicula
Corbicula fluminea
Corbicula manilensis
Elimia
Elimia athearni
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<tr>
<th>Taxonomy</th>
<th>Scientific Name</th>
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<td>Elimia albanyensis</td>
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**Other**

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Batracobdella
Batracobdella paludosa
Batracobdella phalera
Batracobdella picta
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Belostoma flumineum
Belostoma lutarium
Belostoma testaceum
Centrolimnesia
Clathrosperchon
Climacea
Climacia areolaris
Cordylophora
Cordylophora lacustris
Cura foremanii
Desserobdella
Desserobdella phalera
Dina
Dina microstoma
Dugesia
Dugesia tigrina
Eoparargyractis
Eoparargyractis floridalis
Erpobdella
Erpobdella punctata
Euparyphus
Eylais (acari)
Forelia (acari)
Forelia floridensis
Frontipoda
Geayia (acari)
Gerris
Gerris buenoi
Gerris canicularus
Gerris nebularis
Girardia (Dugesia)
Gloiobdella elongata
Glossiphonia
Haemopis
Hebrus
Hebrus consolidus
Helobdella
Helobdella elongata
Helobdella fusca
Helobdella lineata
Helobdella papillata
Helobdella punctatolineata
Helobdella stagnalis
Helobdella triserialis
Hemerodromia
Hemerodromia seguiy
Hesperocorixa
Hydra
Hydra americana
Hydrachna (acari)
Hydrochoreutes ungulatus
Hydrodroma
Hydryphantes (mite)
Hymanella retenuova
Koenikea
Koenikea angulata
Koenikea aaphrasta
Koenikea elaphra
Koenikea floridensis
Krendowska
Krendowska similis
Lebertia
Lebertia sp. 1 pluchino
Lebertia sp. 4 pluchino
Lethocerus
Lethocerus americanus
Lethocerus uhleri
Limnesia
Limnochares
Limnogonus
Limnognous (Neogerris) hesione
Limnogonus
Limnogonus (Neogerris) hesione
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Macrobdella ditetra
Macrovelia hornii
Marragata
Marragata brunnea
Marragata hebroides
Mesovelia
Mesovelia amoena
Mesovelia mulsanti
Metrobates anomalus
Metrobates hesperius
Metrobates hesperius
Micronecta
Micronecta ludibunda
Microvelia
Microvelia austrina
Microvelia hinei
Microvelia pulchella
Mideopsis
Momonia
Mooreobdella
Mooreobdella microstoma
Mooreobdella tetragon
Munroessa
Munroessa gyralis
Myzobdella
Myzobdella lugubris
Neargyractis slossonalis
Neogerris
Neogerris hesione
Neoplea
Neoplea striola
Neumania
Neumania distincta
Notonecta
Notonecta indica
Notonecta uhleri
Nymphula
Ochterus
Oligobdella biannulata
Ostrinia nubilalis
Oxus
Palmacorixa buenoi
Paragordius
Parargyractis
Paraplela
Paraponyx
Paraponyx maculalis
Parargyractis
Paravelia
Paravelia brachialis
Pectinatella
Pectinatella magnifica
Pelocoris
Pelocoris carolinensis
Pelocoris femoratus
Pelophila
Philobdella gracilis
Philobdella floridana
Piona (acari)
Piscicolaria reducta
Placobdella
Placobdella multilineata
Placobdella nuchalis
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Placobdella parasitica
Placobdella pediculata
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Appendix V. Taxa located in Kentucky Traditionally Navigable Waters.

**Ephemeroptera**
- Acentrella ampla
- Acentrella sp
- Acentrella turbida
- Acercpenna macdunnoughi
- Anthopotamus myops
- Anthopotamus sp
- Anthopotamus verticis
- Antocha saxicola
- Baetis brunneicolor
- Baetis flavistriga
- Baetis intercalaris
- Baetis sp
- Baetis tricaudatus
- Baetisca gibbera
- Caenis amica
- Caenis anceps
- Caenis diminuta
- Caenis hilaris
- Caenis latipennis
- Caenis punctata
- Caenis sp
- Callibaetis sp
- Centroptilum sp
- Choroterpes sp
- Cloeon sp
- Ephemerella simulans
- Ephemerella sp
- Ephemerella sp
- Ephemorita abnormis
- Ephemorita frisoni
- Ephemerella sp
- Eurylophella bicolor
- *Eurylophella sp
- Fallceon sp
- Habrobrachyta sp
- Heptagenia marginalis
- Heptagenia sp
- Heterocloeon curiosum
- Heterocloeon frivolus
- Hexagenia sp
- Leucrocuta aphrodite
- Leucrocuta maculipennis
- Leucrocuta sp
- Merragata sp
- Paraleptophlebia sp
- Plauidius dubius
- Plauidius sp
- Procloeon sp
- Pseudocentrotiloides sp
- Pseudocloeon ephippatus
- Pseudocloeon longipalpus
- Pseudocloeon propinquus
- Pseudocloeon sp
- Serratella deficiens
- Serratella sp
- Siphlonurus sp
- Stenacron candidum
- Stenacron interpunctatum
- Stenacron sp
- Stenonema exiguum
- Stenonema femoratum
- Stenonema mediopunctatum
- *Stenonema meririvulanum
- Stenonema modestum
- Stenonema pulchellum
- Stenonema sp
- Stenonema terminatum
- Stenonema vicarium
- Timpanoga lita
- Tricorythodes sp
- Agraylea multipunctata
- Agraylea sp
- Brachycerentus nigrosoma
- Brachycerentus numerosus
- Brachycerentus sp
- Brachycercus sp
- Ceraclea ancyllus
- Ceraclea cancellata
- Ceraclea flava
- Ceraclea maculata
- Ceraclea neffi
- Ceraclea punctata
- Ceraclea sp
- Ceraclea tarsipunctata
- Ceraclea transversa
- Ceratopsyche bifida
- Ceratopsyche bronta
- Ceratopsyche cheilonis
- Ceratopsyche sllossonae
- Ceratopsyche sp
- Ceratopsyche sparna
- Cernotina sp
- Cheumatopsyche sp
- Chimarra sp
- Cymnellus fraternus
- Dibus angata
- Glossosoma sp
- Helicopsyche borealis
- Helicopsyche sp
- Hydatophylax argus
- Hydropsyche betteni gp
- Hydropsyche demora
- Hydropsyche dicantha
- Hydropsyche frisoni
- Hydropsyche hageni
- Hydropsyche orris
- Hydropsyche phalerata
- Hydropsyche simulans
- Hydropsyche sp
- Hydropsyche valanis
- Hydropsyche valanis
- Hydroptila sp
- *Lepidostoma sp
- Leucotrichia pictipes
- Lype diversa
- Macrosternum sp
- Macrosternum zebratum

**Plecoptera**
- Acronuria abnormis
- Acronuria frisoni
- Acronuria internata
- Acronuria sp
- Agnetina capitata
- Agnetina sp
- Haploperla sp
- Isoperla sp
- Leuctra sp
- Neoperla sp
- Perlesta sp
- Pteronarcyd dorsata
- Pteronarcyd proteus
- Pteronarcyd sp
- Remenis bilobatus
- Taeniopteryx sp

**Trichoptera**
Micrasema charonis
Micrasema sp
Mystacides sepulchralis
Mystacides sp
Nectopsyche candida
Nectopsyche exquisita
Nectopsyche pavia
Nectopsyche sp
Neophylax acutus
Neophylax ayanus
Neophylax concinnus
Neophylax consimilis
Neophylax fuscus
Neophylax sp
Neotrichia sp
Neureclipsis crepuscularis
Neureclipsis parvulus
Neureclipsis sp
Nyctiophylax sp
Ochrotrichia sp
Oecetis avara
Oecetis cinerascens
Oecetis inconspicua
Oecetis nocturna
Oecetis persimilis
Oecetis sp
Orthotrichia sp
Oxyethira sp
Paraspyche cardis
Phryganea sp
Polycentropus sp
Polycentropus sp1 (short tarsus)
Polycentropus sp2 (long tarsus)
Protoptila maculata
Protoptila sp
Psychomyia flavida
Psychomyia sp
Ptilostomis sp
Pycnopsyche sp
Rhacophila carolina
Rhacophila lobifera
Rhacophila sp
Setodes sp
Triaenodes flavescens
Triaenodes ignitus
Triaenodes injustus
Triaenodes pema
Triaenodes pema/helo
Triaenodes sp
Triaenodes tardus
*Wormaldia sp

Misc Diptera
Anopheles sp
Antocha sp
Atherix lantha
Atherix sp
Atrichopogon sp
Bezzia sp
Bezzia/Palpomyia gp
Chaoborus punctipennis
Cheliferia sp
Chlororhabanus sp
Chrysops sp
Culicoide sp
Dicrotendipes sp
Dixella sp
Hemerodromia sp
Limnophila sp
Limnophora sp
Palpomyia sp
Pedicia sp
Pilaria sp
Probezzia sp
Prosimulium sp
Simulium sp
Simulium tuberosum
Simulium vittatum
Sphaeromias sp
Stilobezzia sp
Stratiomy sp
Tabanus reinwardtii
Tabanus sp
Tipula abdominalis
Tipula sp
Tipula strepens

Diptera (Chironomidae)
Ablabesmyia (Karelia) sp
Ablabesmyia annulata
Ablabesmyia janta
Ablabesmyia mallochi
Ablabesmyia parajanta
Ablabesmyia peleensis
Ablabesmyia rhamphe
Ablabesmyia sp
Alluadomyia sp
Apedilum elachistum
Brillia sp
Cardiocladius obscurus
Cardiocladius sp
Chironomus riparius
Chironomus sp
Cladotanytarsus sp
Clinotanytus sp
Coelotanytus scapularis
Conchapelopia sp
Corynoneura sp
Corynoneura sp C (Epler)
Corynoneura taris
Cricotopus annulator complex
Cricotopus bicinctus gp
Cricotopus luciae
Cricotopus sp
Cricotopus trifascia
Cricotopus/Orthocladius sp
Cryptochironomus sp
Cryptotendipes sp
Demicryptochironomus sp
Diamesa sp
Dicrotendipes fumidus
Dicrotendipes lucifer
Dicrotendipes modestus
Dicrotendipes neomodestus
Dicrotendipes nervosus
Dicrotendipes sp
Djalmabatista pulcher
Endochironomus sp
Endochironomus subtendens
Endotribelos sp
Eukiefferiella gracei gp
Eukiefferiella sp
Glyptotendipes lobiferus
Glyptotendipes meridionalis
Glyptotendipes sp
Glyptotendipes sp B (Epler)
Harnischia sp
Hayesomyia sp
Krenopelopia sp
Labrundinia pilosella
Larsia sp
Meropelopia sp
Microspectra sp
Microtendipes pedellus gp
Microtendipes sp
Nanocladius branchiculus
Nanocladius downesi
Nanocladius rectinervis
Nanocladius sp
Natarsia sp
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Argia tibialis
Argia translata
Basiaeschna janata
Boyeria grafiana
Boyeria sp
Boyeria vinosa
Calopteryx angustipennis
Calopteryx maculata
Calopteryx sp
Celithemis amanda
Cordulegaster maculata
Cordulegaster sp
Didymops sp
Didymops transversa
Dromogomphus sp
Dromogomphus spinosus
Dromogomphus spoliatus
Enallagma divagans
Enallagma exsulans
Enallagma sp
Enallagma sulcatum
Enallagma traviatum
Epicordulia princeps
Erythmis simplicicollis
Gomphus dilatatus
Gomphus externus
Gomphus fraternus
Gomphus lineatifrons
Gomphus lividus
Gomphus notatus
Gomphus quadricolor
Gomphus sp
Gomphus spiniceps
Gomphus vastus
Gomphus viridifrons
Hagenius brevistylus
Hagenius sp
Hetaerina americana
Hetaerina sp
Hetaerina titia
Ischnura posita
Ischnura sp
Isonychia sp
Lestes sp
Libellula auripennis
Libellula sp
Macromia alleghaniensis
Macromia annulata
Macromia illinoiensis/illinoiensis
Macromia sp
Macromia taeniolata
Nasiaeschna pentacantha
Neurocordulia alabamensis
Neurocordulia molesta
Neurocordulia obsoleta
Neurocordulia sp
Neurocordulia virginiensis
Ophiogomphus rupinsulensis
Ophiogomphus sp
Perithemis sp
Platthemis lydia
Progomphus obscurus
Progomphus sp
Somatochlora sp
Stylogomphus albistylus
Stylurus sp
Stylurus spiniceps
Oligochaeta
Aulodrilus pigueti
Branchiura sowerbyi
Chaetogaster sp
Dero digitata
Dero nivea
Eclipidrilus sp
Ilyodrilus templetoni
Limnodrillus hoffmeisteri
Limnodrillus sp
Lumbriculus sp
Nais sp
Nais variabilis
Ophidonais serpentina
Pristina obsborni
Pristina sp
Slavina appendiculata
Stephensoniana trivandrana
Stylaria fossularis
Stylaria laeustris
Tubifex sp
Megaloptera
Chauliodes rastricornis
Corydalus cornutus
Nigronia serricornis
Nigronia sp
Sialis infumata
Sialis sp
Sialis velata
Crustacea
*Caecidotea sp
Cambarus cumberlandensis
Cambarus distans
Cambarus rusticiformis
Cambarus sp
Cambarus tenebrosus
*Crangonyx sp
Gammarus lacustris
Gammarus sp
Hyalella azteca
Lirceus fontinalis
Lirceus sp
Orconectes cristavarius
Orconectes juvelinii
Orconectes kentuckiensis
Orconectes placidus
Orconectes putnami
Orconectes rusticus
Orconectes sp
Palaemonetes kadiakensis
Mollusca
Actinonaias ligamentina (LV)
Actinonaias pectorosa (LV)
Amblera plicata (LV)
Amnicola sp
Campelomal crassulum
Campeloma decimus
Campeloma sp
Corbiculo fluminea
Cyclonaias tuberculata (LV)
Cyprigenia stegaria (LV)
Dreissena polymorpha
Elimia costifera
Elimia ebenum
Elimia laqueata laqueata
Elimia livescens
Elimia plicatastriata
Elimia semicarinata
Elimia sp
Elliptio dilatata (LV)
Ferrissia rivalaris
Ferrissia sp
Fossaria sp
Helisoma ances ances
Helisoma sp
Laevapex fuscus
Lampsilis cardium (LV)
Lampsilis fasciola (LV)
Lampsilis ovata (LV)
Lampsilis siliquoidea (LV)
Lasmigona complanata complanata (LV)
Lasmigona costata (LV)
Leptodea fragilis (LV)
Leptoxis praerosa
Leptoxis sp
Ligumia recta (LV)
Lithasia obovata
Lithasia sp
Lymnaea sp
*Micromenetus sp
Musculium transversum
Physa sp
Pisidium sp
Planorbella sp
Pleurocera acuta
Pleurocera canaliculata
Pleurocera sp
Potamilus alatus (LV)
Promenetus exacuous
Pseudosuccinea columella
Ptychobranchus fasciolaris (LV)
Quadrula pustulosa (LV)
Sphaerium fabale
Sphaerium simil
Sphaerium sp
Villosa taeniata (LV)

**Other**

- Aquarius sp
- Climacia areolaris
- Climacia sp
- Corixini sp
- Dugesia sp
- Gerris marginatus
- Gerris nebularis
- Helobdella elongata
- Helobdella papillata
- Helobdella triserialis
- Hesperocorixa sp
- Hydra sp
- Hydrometra martini
- Hydrometra sp
- Hydrometra wileyae
- Mesovelia amoena
- Mesovelia mulsanti
- Mesovelia mulsanti
- Mesovelia sp
- Metrobates hesperius
- Microvelia americana
- Microvelia sp
- Orendytes sp
- Parapoxynx obscuralis
- Parapoxynx sp
- Pectinatella magnifica
- Petrophila confusalis
- Petrophila sp
- Phagocata sp
- Piscicola punctata
- Piscicolaria reducta
- Placobdella papillifera
- Planaria sp
- Plumatella emarginata
- Plumatella repens
- Prostoma sp
- Protoplasa fitchii
- Ranatra australis
- Ranatra buenoi
- Ranatra kirkaldyi
- Ranatra nigra
- Ranatra sp
- Rhagovelia obesa
- Rhagovelia sp
- Rheumatobates rileyi
- Rheumatobates sp
- Sigara sp
- Sperchopsis tessellatta
- Spongia sp
- Stactobiella sp
- Trebophates imermis
- Trebophates sp
- Trichocorixa sp
Appendix VI. Taxa located in South Carolina Traditionally Navigable Waters.

**Ephemeroptera**
- Acentrella carolina
- Acentrella sp.
- Acerpenna pygmaea
- Baetidae
- Baetis brunneicolor
- Baetis dubium
- Baetis intercalaris
- Baetis pluto
- Baetis punctiventris
- Baetis sp.
- Baetisca gibbera
- Baetisca sp.
- Caenis diminuta
- Caenis hilaris
- Caenis latipennis
- Caenis punctata
- Caenis sp.
- Callibaetis sp.
- Centroptilum sp.
- Choroperpes sp.
- Dannella simplex
- Ephemera catawba
- Ephemera dorothea
- Ephemera inconstans
- Ephemera needhami
- Ephemera septentrionalis
- Ephemera sp.
- Eurylophella bicolor
- Eurylophella prudentialis
- Eurylophella sp.
- Heptagenia sp.
- Heptageniidae
- Hexagenia sp.
- Isonychia sp.
- Leptophyes dolangi
- Leptophyes robacki
- Leptophyes sp.
- Leptophlebiidae
- Maccaffertium exiguum
- Maccaffertium integrum
- Maccaffertium modestum
- Maccaffertium sp.
- Maccaffertium terminatum
- Neoephemera purpurea
- Paraleptophlebia sp.
- Plauditus sp.
- Procloeon sp.
- Pseudocloeon ephippiatum
- Pseudocloeon frondale
- Pseudocloeon propinquum
- Pseudocloeon sp.
- Serratella serratoide
- Stenacron interpunctatum
- Stenacron sp.
- Tricorythodes sp.

**Plecoptera**
- Acronyrmia abnormis
- Acronyrmia carolinensis
- Acronyrmia mela
- Acronyrmia sp.
- Acronyrmia/Eccoptura.
- Agnetina sp.
- Allocapnia sp.
- Amphinemura delosa
- Amphinemura sp.
- Capniidae
- Cloperla clio
- Helopelis subvarians
- Isoperla bilineata
- Isoperla clio
- Isoperla dicala
- Isoperla sp.
- Leuctra sp.
- Neoperla sp.
- Paragnetina fumosa
- Paragnetina kansensis
- Paragnetina sp.
- Perlesta placida
- Perlesta sp.
- Perlidae
- Pteroneurys dorsata
- Pteroneurys sp.
- Shipsa rotunda
- Strophopteryx sp.
- Taeniopygyma metequis
- Taeniopygyma sp.

**Trichoptera**
- Anisocentropus pyraloides
- Brachycentrus numerosus
- Brachycentrus sp.
- Ceraclea sp.
- Cheumatopsyche sp.
- Chimarra aeterrima
- Chimarra obscura
- Chimarra socia
- Chimarra sp.
- Hydropsyche betteni
- Hydropsyche incommoda
- Hydropsyche rossi
- Hydropsyche simulans
- Hydropsyche sp.
- Hydropsyche venularis
- Hydropsychidae
- Hydroleuca sp.
- Lepidostoma sp.
- Leptoceridae
- Lype diversa
- Macrocentrus carolina
- Macrocentrus sp.
- Micrasema rusticum
- Micrasema sp.
- Micrasema wataga
- Molanna tryphena
- Nectopsyche candia
- Nectopsyche exquisita
- Nectopsyche pavidula
- Nectopsyche sp.
- Neophylax sp.
- Neureclipsis sp.
- Nycitophylax moestus
- Nycitophylax sp.
- Ochrotrichia sp.
- Oecetis cinerascens
- Oecetis morsel/sphyra
- Oecetis nocturna
- Oecetis persimilis
- Oecetis sp.
- Phylocentropus sp.
- Polycentropus sp.
- Polycentropus/Cernotina
- Pycnopsyche antica
- Pycnopsyche antica/gutifer
- Pycnopsyche gutifer
- Pycnopsyche lepida
- Pycnopsyche luculenta
- Pycnopsyche sp.
- Rhyacophila ledra
- Triaenodes ignitus
- Triaenodes injusta
- Triaenodes penna
- Triaenodes sp.
**Coleoptera**  
Agabus sp.  
Agasicles hygrophila  
Anchytaurus bicolor  
Ancyronyx variegatus  
Berosus sp.  
Coptotomus interrogatus  
Coptotomus sp.  
Cyphon sp.  
Dineutus discolor  
Dineutus sp.  
Dubiraphia bivittata  
Dubiraphia quadrinotata  
Dubiraphia sp.  
Dubiraphia vittata  
Ectopia sp.  
Elmidae  
Enochrus sp.  
Gyrinus sp.  
Haliplus sp.  
Helichus basalis  
Helichus lithophilus  
Helichus sp.  
Helobata striata  
Helocombus sp.  
Helophorus sp.  
Hydaticus bimarginatus  
Hydrobiomorpha casta  
Hydrobius sp.  
Hydrochus sp.  
Hydrometopus sp.  
Hydroporus undulatus  
Hydroporus vittipennis  
Macronychus glabratus  
Microcylloepus pusillus  
Neoporus sp.  
Optioservus sp.  
Paracymus sp.  
Peltodytes duodicimpunctatus  
Peltodytes muticus  
Peltodytes oppositus  
Peltodytes sexmaculatus  
Peltodytes sp.  
Phaenonotum sp.  
Promoresia elegans  
Promoresia tardella  
Psephenus herricki  
Sperchopsis tessellatus  
Staphylinidae  
Stenelmis hungerfordi  
Stenelmis sp.  
Stenus sp.  
Theronectus sp.  
Tropisternus glaber  
Tropisternus sp.  
**Diptera (Chironomidae)**  
Ablabesmyia hauberi  
Ablabesmyia janata  
Ablabesmyia mallochi  
Ablabesmyia rhamphe GR  
Ablabesmyia sp.  
Apsectrotanypus johnsoni  
Brilla sp.  
Chaetocladius sp.  
Chironomidae  
Chironominae  
Chironomus sp.  
Cladopelma sp.  
Cladotanytarsus sp.  
Clinotanytarsus pinguis  
Clinotanytarsus sp.  
Conchapelopia Group  
Corynoneura sp.  
Cricotopus bicinctus  
Cricotopus sp.  
Cricotopus/Orthocladius  
Cryptochironomus fulvus  
Cryptochironomus sp.  
Cryptotendipes sp.  
Dicrotendipes sp.  
Diplociades cultriger  
Diplociades sp.  
Djmalabatista sp.  
Eukiefferiella brevicalcar GR  
Eukiefferiella claripennis GR  
Eukiefferiella sp.  
Hydrobaenus sp.  
Labrundinia neopilosella  
Labrundinia sp.  
Lopescladius sp.  
Microtendipes pedellus GR  
Microtendipes rydalensis GR  
Microtendipes sp.  
Nilotanytarsus fimbriatus  
Nilotanytarsus sp.  
Orthocladius sp.  
Paracladopelma loganea  
**Diptera (misc)**  
Anopheles sp.  
Antocha sp.  
Atherix sp.  
Bessia  
Ceratopogonidae
Chrysops sp.
Culex sp.
Ephydridae
Erioptera
Limnophila sp.
Palpomyia (Complex)
Pilaria sp.
Psychoda sp.
Simuliidae
Simulium jonesi
Simulium podostemi
Simulium sp.
Simulium tuberosum
Simulium verecundum
Tabanidae
Tipula sp.
Uranotaenia sp.

Odonata
Argia sedula
Argia sp.
Argia translata
Basiaeschna janata
Boyeria sp.
Boyeria vinosa
Calopteryx dimidiata
Calopteryx maculata
Calopteryx sp.
Coenagrionidae
Cordulegaster sp.
Dromogomphus spinosus
Enallagma divigens
Enallagma sp.
Epicordulia sp.
Erpetogomphus designatus
Gomphus sp.
Hagenius brevistylus
Hetaerina tittia
Ischnura/Anomalagrion
Lanthus vernalis
Lestes sp.
Libellula sp.
Libellulidae
Macromia illinoense
Macromia sp.
Macromia taeniolata
Nasiaeschna pentacantha
Neurocordulia sp.
Ophiogomphus mainensis
Pachydiplax longipennis
Pentaneura inconspicua
Pentaneura sp.
Perithemis sp.
Plathemis lydia
Pogomphus sp.
Somatochlora sp.
Stylurus sp.

Oligochaeta
Branchiura sowerbyi
Dero digitata
Lumbriculidae
Oligochaeta
Tubifex tubifex
Tubificidae

Megaloptera
Chauliodes pectinicornis
Corydalus cornutus
Nigronia serricornis
Sialis sp.

Crustacea
Caecidotea sp.
Cambaridae
Cambarus sp.
Crangonyx sp.
Gammarus sp.
Hyalella azteca
Lirceus sp.
Palaemonetes paludosus
Palaemonetes sp.
Procambarus sp.

Mollusca
Ancyliidae
Campeloma sp.
Corbicula fluminea
Elimia sp.
Elliptio angustata
Elliptio complanata
Elliptio icterina
Elliptio sp.
Ferrissia sp.
Gastropoda
Helisoma anceps
Helisoma trivolvis
Hydrobiidae
Menetus dilittus
Physella sp.
Planorbella sp.
Planorbidae
Pseudosuccinea columella
Sphaerium sp.
Unionidae
Villosa delumbis

Other
Belostoma sp.
Belostomatidae
Collembola
Corixidae
Gerridae
Gerris conformis
Gerris sp.
Hemerodromia sp.
Hirudinea
Hydracarina
Lepidoptera
Mesovelia mulsanti
Mesovelia sp.
Metrobates hesperus
Metrobates sp.
Noctuidae
Notonecta sp.
Notonectidae
Paravelia sp.
Placobdella sp.
Pyralidae
Ramphocorixa sp.
Ranatra buenoi
Ranatra sp.
Ragovelia obesa
Rheumatobates sp.
Trepobates sp.
Trichocorixa sp.
## Appendix VII. Taxa located in Mississippi Traditionally Navigable Waters.

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### Odonata

- Argia
- Boyeria
- Didymops
- Enallagma
- Erpetogomphus
- Gomphus
- Hetaerina
- Ischnura
- Macromia
- Nasiaeschna pentacantha
- Neurocordulia
- Progomphus
- Stylurus
- Tetragoneuria

### Oligochaeta

- Aeolosoma
- Aulodrilus
- Bratislavia

### Dero

- Haemonais waldvogeli
- Limnodrilus
- Nais
- Pristina
- Slavina appendiculata
- Stylaria lacustris

### Megaloptera

- Corydalus cornutus
- Sialis

### Crustacea

- Caecidotea
- Hyalella azteca
- Orconectes

### Mollusca

- Corbicula

### Other

- Belostoma
- Climacia
- Dugesia tigrina
- Gelastocoris
- Gerris
- Hemerodromia
- Hydracarina
- Metrobates
- Neoplea
- Paraponyx
- Petrophila
- Ranatra
- Rheumatobates
- Trepobates
- Trichocorixa
- Urnatella
# Appendix VIII. Taxa located in Tennessee Traditionally Navigable Waters.

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Dolichopodidae
Empididae
Ephyridae
Erioptera
Forcipomyia
Goniomyia
Hemerodromia
Hexatoma
Limnaphila
Limonia
Molophilus
Nemotulus
Odontomyia
Ormosia
Pedicia
Pilaria
Probezzia
Prosimulium
Protoplasa
Pseudolimnaphila
Psychoda
Rhabdomastix
Scionymyidae
Seledon
Seromyia
Simulium
Sphaeromias
Stilobezzia
Stratiomys
Syrphidae
Tabanus
Tipula

Diptera (Chironomidae)
Ablabesmyia
Alluaudomyia
Alotanytarsus
Antillocladius
Apedilum
Apsectrotanytarsus
Axarus
Brilia
Brundiniella
Cardiocladius
Chaetocladius
Chironomus
Cladopelma
Cladotanytarsus
Clinotanytarsus
Conchapelopia
Constempellina
Corynoneura
Cricotopus
Cryptochironomus
Cryptendipes
Demicryptochironomus
Diamesa
Dicrotendipes
Diplocladius
Djalmabatista
Einfeldia
Endochironomus
Endotribelos
Eukiefferiella
Glyptotendipes
Goeldichironomus
Harnischia
Hayesomyia
Heleniella
Helopectella
Heterotrisocladius
Hydrobaenus
Kiefferulus
Krenopelopia
Labruninia
Larsia
Limnophyes
Lojeadus
Merosopelopia
Mesosmittia
Mesostoma
Micropsectra
Microtendipes
Meroptera
Merosmittia
Metriocnemus
Microtendipes
Mikrocladius
Natarsia
Nilotanytarsus
Nilothauma
Orthocladius
Pagastia
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Paramerina
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Polypedilum
Potthastia
Procladius
Psectrocladius
Pseudochironomus
Pseudorthocladius
Pseudosmittia
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Rheocricotopus
Rheopelopia
Rheosmittia
Rheotanytarsus
Robackia
Saetheria
Smitia
Stecheomyia
Stempellina
Stempellinella
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Sublettea
Symbiocladius
Symposiocladius
Sympotthastia
Synorthocladius
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Tanytarsus
Thienemanniella
Thienemannimyia
Tribelos
Trissopelopia
Tvetenia
Unniella
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Xestochironomus
Xylotopus
Zavrelia
Zavreliella
Zavrelimyia

Coleoptera
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Anchytaurus
Anctonymyx
Berosus
Copelatus
Coptotomus
Cyphon
Desmopachria
Dineutus
Dubiraphia
Ectopria
Elodes
Enochrus
Gonielmis
Gyrinus
Haliplus
Helocharaes
Helophorus
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Hydraena
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Hydrobius
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Hydrocanthus
Hydrochus
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Hydroporus
Hydrovatus
Hygrotus
Laccobius
Laccodytes
Laccophilus
Macronychus
Microcylopoeps
Optioservus
Oulimnius
Paracymus
Peltodytes
Ponocypophen
Promoresia
Psephenus
Rhantus
Scirtes
Sperchopsis
Stenelmis
Stenus
Suphisellus
Tropistemus
Uvarus
Odonata
Argia
Arigomphus
Basiaeschna
Boyeria
Calopteryx
Chromagrion
Cordulegaster
Dromogomphus
Enallagma
Epithetica
Erythemis
Gomphus
Hetaerina
Ischnura
Lanthus
Libellula
Macromia
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Ophiogomphus
Perithemis
Progomphus
Somatochlora
Stylomorphus
Stylurus
Oligochaeta
Brasilavie
Dero
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Limnodrilus
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Crustacea
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Gammarus
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Cambarus
Orconectes
Palaemontes
Procambarus
Mysis
Mollusca
Campeloloma
Corbicula
Elimia
Eupera
Fernissia
Fossaria
Gyraulus
Hydrobiidae
Laevapex
Leptotis
Lymnaea
Menetes
Physella*
Pisidium
Planorbella
Pseudosuccinea
Sphaerium
Stagnicola
Viviparus
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Belostoma
Caecidotea
Cura
Dugesia
Gelastocoris
Gerris
Hebrus
Hydra
Hydrometra
Isotomurus (Collembola)
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Limnophorus
Lipogomphus
Lirceus
Mesovelia
Metrabates
Microvelia
Mooreobdella
Neoplea
Notonecta
Palmacorixa
Petrophila
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Rheumatobates
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Trichocorixa