

# Appendix 1. Locations and Events

Each location at which samples were collected is listed below by the SiteCode given in the database. The column Location represents the state and county, followed by the SiteCode from the database, then a brief description of the location. The column UTM's gives the coordinates in Universal Transmercator, Datum83, UTM Zone 16 North. Column Lat/Lon gives the geographic coordinates in decimal degree format. The final column Elevation provides the elevation above sea level in meters (m).

Each location was sampled at least once, and several locations were sampled multiple times. Each sampling occasion is called an event and is distinguished from every other event at the same location by its date, or the collection methods used, and/or by the collectors who took the sample. Following each Location record events are listed by date, collection method, and by collector(s). Where additional qualifiers are included in the database field, SampleCode, that information is included in parentheses as Sample ID.

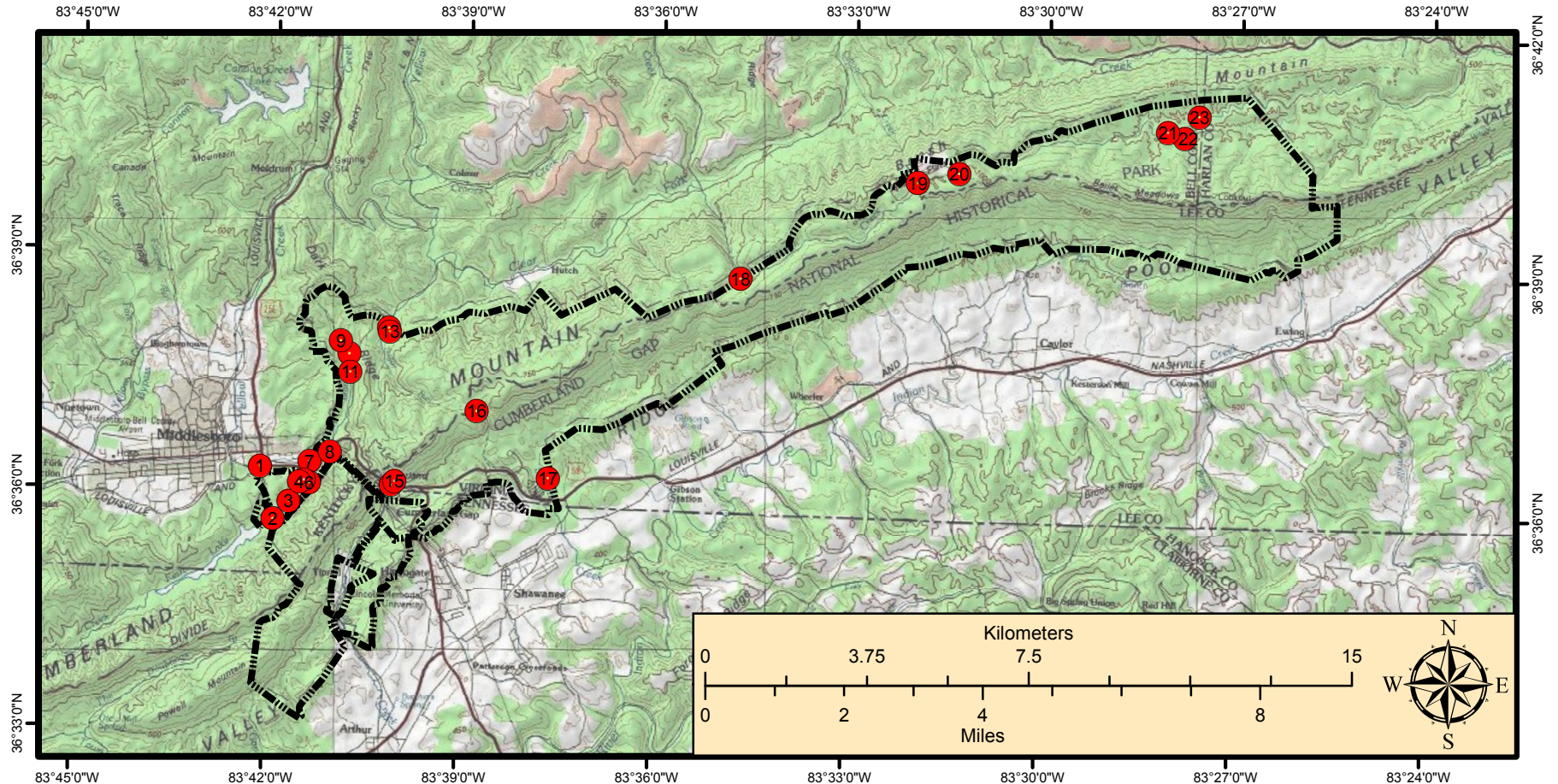
| Cumberland Gap National Historical Park                                                                                                                                                                                                                                                                                                                           |                     |                          |           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|-----------|
| Location                                                                                                                                                                                                                                                                                                                                                          | UTMs                | Lat\Lon                  | Elevation |
| <b>KY: Bell Co., CUGA bog "A", bog "A", Martins Fork</b><br>Event 01: 5 Apr 2007, black light trap, JLRobinson                                                                                                                                                                                                                                                    | 4062553N<br>280121E | 36.68322°N<br>83.46082°W | 740 m     |
| <b>KY: Bell Co., CUGA Dark Ridge Branch Sugar Run picnic area, Dark Ridge Branch near Sugar Run Picnic Area</b><br>Event 01: 13 May 1998, by hand, CRParker, KAParker & SStrugill<br>Event 02: 19-20 Jul 2006, black light trap, CRParker & MGeraghty                                                                                                             | 4057678N<br>261310E | 36.63478°N<br>83.66963°W | 365 m     |
| <b>KY: Bell Co., CUGA Davis Branch at trailer park, Davis Branch above Yellow Creek above trailer park</b><br>Event 01: 20 May 2005, by hand, JLRobinson & CRParker                                                                                                                                                                                               | 4054584N<br>259465E | 36.60645°N<br>83.68928°W | 359 m     |
| <b>KY: Bell Co., CUGA Davis Branch beaver pond bridge, beaver ponds on Davis Branch at bridge on footpath</b><br>Event 01: 19 May 2005, black light trap, CRParker & JLRobinson<br>Event 02: 27-28 Sep 2005, black light trap, CRParker<br>Event 03: 28 Sep 2005, sweeping, RMartinez                                                                             | 4057081N<br>260392E | 36.62917°N<br>83.67971°W | 381 m     |
| <b>KY: Bell Co., CUGA Davis Branch downstream of beaver ponds, Davis Branch dwnstrm of beaver ponds</b><br>Event 01: 21 Jul 2006, black light trap, CRParker & MGeraghty                                                                                                                                                                                          | 4056654N<br>260409E | 36.62533°N<br>83.67938°W | 384 m     |
| <b>KY: Bell Co., CUGA Davis Branch upper beaver pond, upper beaver pond on Davis Branch</b><br>Event 01: 19 May 2005, black light (sheet), JLRobinson & CRParker<br>Event 02: 20 Jul 2006, sweeping, CRParker & MGeraghty<br>Event 03: 20-21 Jul 2006, black light trap, CRParker & MGeraghty<br>Event 04: 28-29 Sep 2005, black light trap, CRParker & RMartinez | 4057377N<br>260193E | 36.63179°N<br>83.68202°W | 389 m     |
| <b>KY: Bell Co., CUGA Davis Run off Pinnacle Road, Davis Run off Pinnacle Rd.</b><br>Event 01: 13 May 1998, by hand, CRParker, KAParker & SStrugill                                                                                                                                                                                                               | 4054802N<br>259931E | 36.60853°N<br>83.68414°W | 380 m     |
| <b>KY: Bell Co., CUGA Gap Creek Cudjo's Cave, Gap Ck at Cudjos Cave</b><br>Event 01: 30 Mar 2006, by hand, JLRobinson & MGeraghty                                                                                                                                                                                                                                 | 4054123N<br>261430E | 36.60280°N<br>83.66719°W | 476 m     |
| <b>KY: Bell Co., CUGA headwaters of Shillalah Creek, headwaters of Shillalah Creek</b><br>Event 01: 4 Apr 2007, black light trap, JLRobinson                                                                                                                                                                                                                      | 4061031N<br>273583E | 36.66798°N<br>83.53348°W | 993 m     |
| <b>KY: Bell Co., CUGA Martins Fork at road, Martins Fk Cumberland R at road access</b><br>Event 01: 18-19 Jul 2006, black light trap, CRParker & MGeraghty<br>Event 02: 5 Apr 2007, black light trap, JLRobinson<br>Event 03: 7 Apr 2007, by hand, JLRobinson                                                                                                     | 4062050N<br>279776E | 36.67860°N<br>83.46454°W | 768 m     |
| <b>KY: Bell Co., CUGA Martins Fork near upper bog, Martins Fk Cumberland R, dwnstrm upper bog</b><br>Event 01: 18-19 Jul 2006, black light trap, CRParker & MGeraghty                                                                                                                                                                                             | 4062190N<br>279390E | 36.67977°N<br>83.46890°W | 735 m     |

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| Location                                                                                                                                                                                                                                                                                                                           | UTMs                | Lat\Lon                  | Elevation |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|-----------|
| <b>KY: Bell Co., CUGA Shillalah Creek at park boundary, Shillalah Creek at park boundary</b>                                                                                                                                                                                                                                       | 4058806N<br>269466E | 36.64694°N<br>83.57884°W | 807 m     |
| Event 01: 18-19 Jul 2006, black light trap, MGeraghty & CRParker<br>Event 02: 28-29 Sep 2005, black light trap, CRParker & RMartinez<br>Event 03: 4 Apr 2007, by hand, JLRobinson                                                                                                                                                  |                     |                          |           |
| <b>KY: Bell Co., CUGA Sugar Run at Picnic Area, Sugar Run at Picnic Area shelter</b>                                                                                                                                                                                                                                               | 4057591N<br>261331E | 36.63400°N<br>83.66937°W | 349 m     |
| Event 01: 19-20 Jul 2006, black light trap, CRParker & MGeraghty<br>Event 02: 30 Mar 2006, beating, JLRobinson & MGeraghty                                                                                                                                                                                                         |                     |                          |           |
| <b>KY: Bell Co., CUGA Tunnel Creek above road, Tunnel Ck above Tunnel Rd</b>                                                                                                                                                                                                                                                       | 4054084N<br>259451E | 36.60195°N<br>83.68928°W | 379 m     |
| Event 01: 13 May 1998, by hand, CRParker, KAParker & SStrugill<br>Event 02: 20 Jul 2006, by hand, CRParker & MGeraghty<br>Event 03: 20-21 Jul 2006, black light trap, CRParker & MGeraghty<br>Event 04: 20-21 Jul 2006, black light trap, MGeraghty & CRParker<br>Event 05: 28-29 Sep 2005, black light trap, CRParker & RMartinez |                     |                          |           |
| <b>KY: Bell Co., CUGA Yellow Creek at KFC, Yellow Creek exit at park boundary in Middlesboro</b>                                                                                                                                                                                                                                   | 4054478N<br>258313E | 36.60521°N<br>83.70211°W | 365 m     |
| Event 01: 20 May 2005, by hand, JLRobinson & CRParker                                                                                                                                                                                                                                                                              |                     |                          |           |
| <b>KY: Bell Co., CUGA Yellow Creek at railroad bridge, Yellow Creek entrance at park boundary above headquarters</b>                                                                                                                                                                                                               | 4053251N<br>258605E | 36.59423°N<br>83.69847°W | 356 m     |
| Event 01: 20 May 2005, by hand, JLRobinson & CRParker                                                                                                                                                                                                                                                                              |                     |                          |           |
| <b>KY: Bell Co., CUGA Yellow Creek at RM offices, Yellow Creek at Resources Management Offices</b>                                                                                                                                                                                                                                 | 4053666N<br>258976E | 36.59615°N<br>83.69469°W | 368 m     |
| Event 01: 20-21 Jul 2006, black light trap, MGeraghty & CRParker<br>Event 02: 28-29 Sep 2005, black light trap, CRParker & RMartinez<br>Event 03: 5 Apr 2007, by hand, JLRobinson                                                                                                                                                  |                     |                          |           |
| <b>KY: Bell Co., CUGA Yellow Creek below Tunnel Creek, Yellow Ck downstream Tunnel Ck</b>                                                                                                                                                                                                                                          | 4054155N<br>259340E | 36.60256°N<br>83.69055°W | 335 m     |
| Event 01: 13 May 1998, by hand, CRParker, KAParker & SStrugill                                                                                                                                                                                                                                                                     |                     |                          |           |
| <b>KY: Bell Co., CUGA Yellow Creek downstream Park entrance road, Yellow Creek downstrm Park entrance road</b>                                                                                                                                                                                                                     | 4054102N<br>259225E | 36.60205°N<br>83.69181°W | 346 m     |
| Event 01: 20 Jul 2006, by hand, CRParker & MGeraghty<br>Event 02: 20-21 Jul 2006, black light trap, CRParker & MGeraghty                                                                                                                                                                                                           |                     |                          |           |
| <b>VA: Lee Co., CUGA Gap Creek at Iron Furnace, Gap Creek upstrm from Iron Furnace</b>                                                                                                                                                                                                                                             | 4054034N<br>261350E | 36.60198°N<br>83.66806°W | 433 m     |
| Event 01: 19 Jul 2006, by hand, CRParker & MGeraghty<br>Event 02: 19-20 Jul 2006, black light trap, CRParker & MGeraghty<br>Event 03: 19-20 Jul 2006, black light trap, MGeraghty & CRParker                                                                                                                                       |                     |                          |           |
| <b>VA: Lee Co., CUGA Hensley Settlement Campsite Spring, Hensley Settlement Campsite spring</b>                                                                                                                                                                                                                                    | 4061239N<br>274544E | 36.67008°N<br>83.52280°W | 1013 m    |
| Event 01: 11 Apr 2007, by hand, JLRobinson<br>Event 02: 4 Apr 2007, by hand, JLRobinson                                                                                                                                                                                                                                            |                     |                          |           |
| <b>VA: Lee Co., CUGA Lewis Hollow, Lewis Hollow</b>                                                                                                                                                                                                                                                                                | 4055744N<br>263341E | 36.61787°N<br>83.64634°W | 646 m     |
| Event 01: 30 Mar 2006, by hand, JLRobinson & MGeraghty                                                                                                                                                                                                                                                                             |                     |                          |           |
| <b>VA: Lee Co., CUGA Station Creek near horse barn, Station Creek near Park Service horse barn</b>                                                                                                                                                                                                                                 | 4054181N<br>264993E | 36.60420°N<br>83.62741°W | 387 m     |
| Event 01: 19 Jul 2006, by hand, MGeraghty & CRParker<br>Event 02: 19-20 Jul 2006, black light trap, MGeraghty & CRParker<br>Event 03: 26 Jul 2006, black light trap, JLRobinson & RMartinez<br>Event 04: 5 Apr 2007, by hand, JLRobinson                                                                                           |                     |                          |           |

# Cumberland Gap National Historical Park



## Legend

- Sample Location
- Boundary

## Site Code

- 1 - CUGA Yellow Creek at KFC
- 2 - CUGA Yellow Creek at railroad bridge
- 3 - CUGA Yellow Creek at RM offices
- 4 - CUGA Yellow Creek downstream Park entrance road
- 5 - CUGA Yellow Creek below Tunnel Creek
- 6 - CUGA Tunnel Creek above road
- 7 - CUGA Davis Branch at trailer park
- 8 - CUGA Davis Run off Pinnacle Road
- 9 - CUGA Davis Branch upper beaver pond
- 10 - CUGA Davis Branch beaver pond bridge
- 11 - CUGA Davis Branch downstream of beaver ponds
- 12 - CUGA Dark Ridge Branch Sugar Run picnic area
- 13 - CUGA Sugar Run at Picnic Area
- 14 - CUGA Gap Creek at Iron Furnace
- 15 - CUGA Gap Creek Cudjo's Cave
- 16 - CUGA Lewis Hollow
- 17 - CUGA Station Creek near horse barn
- 18 - CUGA Shillalah Creek at park boundary
- 19 - CUGA headwaters of Shillalah Creek
- 20 - CUGA Hensley Settlement Campsite Spring
- 21 - CUGA Martins Fork near upper bog
- 22 - CUGA Martins Fork at road
- 23 - CUGA bog "A"

The background map is the USA Topographic Basemap from ESRI's ArcGIS Online Map Services, at <http://www.esri.com/software/arcgis/arcgisonline/services/map-services>

## Appendix 2. Target Species Data

Data for 151 species of Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera are presented below. Each record consists of the order, family, taxon name, and the number and type of specimens, arranged by collecting location and event. Some specimens could not be identified to species and are presented as, for example, “*Baetis* species”. Adult specimens are identified in the table by the ♂ (male) and ♀ (female) symbols, larvae by the words “larva” or “larvae”, pupae by the words “pupa” or “pupae”, and mayfly subimagos by the words “sub.” or “subs.”. The entry “mmt”, which is found for a single caddisfly record, means that the specimen is a metamorphotype. Metamorphotype refers to a pupa of a caddisfly that has developed to the point of being identifiable to species on the basis of the developing adult characters, meaning the genitalia, and which still has present in the pupal cocoon the shed larval sclerites. Because of the absolute association that this represents between the adult and larval stages of the species, metamorphotypes are of considerable significance to students of caddisflies.

| Cumberland Gap National Historical Park                                                      |                   |                                                      |           |
|----------------------------------------------------------------------------------------------|-------------------|------------------------------------------------------|-----------|
| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera                             |                   |                                                      |           |
| Order                                                                                        | Family            | Species                                              | Specimens |
| KY: Bell Co., CUGA bog "A", 5 Apr 2007, black light trap                                     |                   |                                                      |           |
| Plecoptera                                                                                   | Leuctridae        | <i>Leuctra ferruginea</i> (F Walker, 1851)           | 23 ♂      |
| KY: Bell Co., CUGA Dark Ridge Branch Sugar Run picnic area, 13 May 1998, by hand             |                   |                                                      |           |
| Plecoptera                                                                                   | Nemouridae        | <i>Amphinemura nigritta</i> (Provancher, 1876)       | 1 ♂       |
| KY: Bell Co., CUGA Dark Ridge Branch Sugar Run picnic area, 19-20 Jul 2006, black light trap |                   |                                                      |           |
| Ephemeroptera                                                                                | Baetidae          | <i>Baetis</i> species                                | 2 ♂       |
|                                                                                              | Heptageniidae     | <i>Leucrocuta</i> species                            | 5 ♀       |
|                                                                                              |                   | <i>Stenacron carolina</i> (Banks, 1914)              | 2 ♂       |
|                                                                                              |                   | <i>Stenacron gildersleevei</i> (Traver, 1935)        | 2 ♂       |
|                                                                                              |                   | <i>Stenonema femoratum</i> (Say, 1823)               | 1 ♂       |
|                                                                                              | Leptophlebiidae   | <i>Paraleptophlebia guttata</i> (J McDunnough, 1924) | 2 ♂       |
| Plecoptera                                                                                   | Perlidae          | <i>Eccoptura xanthenes</i> (Newman, 1828)            | 5 ♀       |
|                                                                                              |                   | <i>Perlesta decipiens</i> (Walsh, 1862)              | 9 ♂       |
| Trichoptera                                                                                  | Hydropsychidae    | <i>Cheumatopsyche</i> species                        | 12 ♀      |
|                                                                                              |                   | <i>Diplectrona</i> species                           | 6 ♀       |
|                                                                                              |                   | <i>Hydropsyche alhedra</i> Ross, 1939                | 1 ♂       |
|                                                                                              |                   | <i>Hydropsyche cheilonis</i> Ross, 1938              | 15 ♂      |
|                                                                                              |                   | <i>Hydropsyche morosa</i> Hagen, 1861                | 1 ♂       |
|                                                                                              |                   | <i>Hydropsyche sparna</i> Ross, 1938                 | 2 ♂       |
|                                                                                              |                   | <i>Hydropsyche</i> species                           | 118 ♀     |
|                                                                                              | Hydroptilidae     | <i>Neotrichia collata</i> Morton, 1905               | 1 ♂       |
|                                                                                              |                   | <i>Ochrotrichia tarsalis</i> (Hagen, 1861)           | 5 ♂       |
|                                                                                              | Leptoceridae      | <i>Oecetis inconspicua</i> (Walker, 1852)            | 2 ♂       |
|                                                                                              | Philopotamidae    | <i>Dolophiodes distincta</i> (Walker, 1852)          | 9 ♀       |
|                                                                                              | Polycentropodidae | <i>Plectrocnemia cinerea</i> (Hagen, 1861)           | 2 ♂       |
|                                                                                              |                   | <i>Polycentropus carolinensis</i> Banks, 1905        | 1 ♂       |
|                                                                                              |                   | <i>Polycentropus</i> species                         | 9 ♀       |
|                                                                                              |                   | <i>Psychomyia</i> species                            | 1 ♂       |
|                                                                                              | Psychomyiidae     | <i>Lype diversa</i> (Banks, 1914)                    | 1 ♂       |
|                                                                                              | Rhyacophilidae    | <i>Rhyacophila carolina</i> Banks, 1911              | 3 ♂       |
| KY: Bell Co., CUGA Davis Branch at trailer park, 20 May 2005, by hand                        |                   |                                                      |           |
| Ephemeroptera                                                                                | Ephemerellidae    | <i>Ephemerella</i> species                           | 1 larva   |
|                                                                                              | Heptageniidae     | <i>Maccaffertium</i> species                         | 8 larvae  |
|                                                                                              |                   | <i>Stenacron</i> species                             | 2 larvae  |
|                                                                                              | Leptophlebiidae   | Leptophlebiidae species                              | 1 larva   |
| Odonata                                                                                      | Aeshnidae         | <i>Boyeria vinosa</i> (Say, 1839)                    | 1 larva   |
|                                                                                              | Calopterygidae    | <i>Calopteryx</i> species                            | 2 larvae  |

| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera                          |                                                                                      |                                                     |                             |     |
|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------|-----|
| Order                                                                                     | Family                                                                               | Species                                             | Specimens                   |     |
| Plecoptera                                                                                | Leuctridae                                                                           | <i>Leuctra</i> species                              | 1 ♀                         |     |
|                                                                                           | Nemouridae                                                                           | <i>Amphinemura</i> species                          | 1 larva                     |     |
|                                                                                           | Perlodidae                                                                           | <i>Isoperla</i> species                             | 4 larvae                    |     |
|                                                                                           |                                                                                      | <i>Remenus bilobatus</i> (Needham & Claassen, 1925) | 1 larva                     |     |
| Trichoptera                                                                               | Glossosomatidae                                                                      | <i>Agapetus tomus</i> Ross, 1941                    | 1 ♂ pupa                    |     |
|                                                                                           |                                                                                      | <i>Glossosoma nigrior</i> Banks, 1911               | 6 pupa                      |     |
|                                                                                           | Hydropsychidae                                                                       | <i>Cheumatopsyche</i> species                       | 3 larvae                    |     |
|                                                                                           | Philopotamidae                                                                       | <i>Dolophilodes</i> species                         | 3 larvae                    |     |
|                                                                                           | Polycentropodidae                                                                    | <i>Polycentropus</i> species                        | 1 larva                     |     |
|                                                                                           | Psychomyiidae                                                                        | <i>Psychomyia</i> species                           | 1 larva                     |     |
|                                                                                           | Thremmatidae                                                                         | <i>Neophylax concinnus</i> MacLachlan, 1871         | 5 ♂                         |     |
|                                                                                           |                                                                                      | <i>Neophylax etnieri</i> Vineyard and Wiggins, 1987 | 1 pupa                      |     |
| <i>Neophylax</i> species                                                                  |                                                                                      | 2 larvae                                            |                             |     |
| KY: Bell Co., CUGA Davis Branch beaver pond bridge, 19 May 2005, black light trap         |                                                                                      |                                                     |                             |     |
| Ephemeroptera                                                                             | Caenidae                                                                             | <i>Caenis</i> species                               | 3 ♂                         |     |
| Trichoptera                                                                               | Glossosomatidae                                                                      | <i>Agapetus tomus</i> Ross, 1941                    | 1 ♂                         |     |
|                                                                                           | Hydropsychidae                                                                       | <i>Cheumatopsyche analis</i> (Banks, 1903)          | 7 ♂                         |     |
|                                                                                           |                                                                                      | <i>Cheumatopsyche campyla</i> Ross, 1938            | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Cheumatopsyche ela</i> Denning, 1942             | 2 ♂                         |     |
|                                                                                           |                                                                                      | <i>Cheumatopsyche geora</i> Denning, 1948           | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Cheumatopsyche gyra</i> Ross, 1938               | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Cheumatopsyche</i> species                       | 91 ♀                        |     |
|                                                                                           |                                                                                      | Hydroptilidae                                       | <i>Hydroptila</i> species   | 6 ♀ |
|                                                                                           |                                                                                      |                                                     | <i>Orthotrichia</i> species | 1 ♀ |
|                                                                                           |                                                                                      | <i>Stactobiella palmata</i> (Ross, 1938)            | 1 ♂                         |     |
|                                                                                           | Polycentropodidae                                                                    | <i>Plectrocnemia nascotia</i> (Ross, 1941)          | 1 ♂                         |     |
|                                                                                           | Psychomyiidae                                                                        | <i>Psychomyia flavida</i> Hagen, 1861               | 9 ♀                         |     |
|                                                                                           | Rhyacophilidae                                                                       | <i>Rhyacophila carolina</i> Banks, 1911             | 1 ♀                         |     |
|                                                                                           | KY: Bell Co., CUGA Davis Branch beaver pond bridge, 27-28 Sep 2005, black light trap |                                                     |                             |     |
| Plecoptera                                                                                | Leuctridae                                                                           | <i>Leuctra tenuis</i> (Pictet, 1841)                | 1 ♂                         |     |
| Trichoptera                                                                               | Glossosomatidae                                                                      | <i>Glossosoma nigrior</i> Banks, 1911               | 1 ♀                         |     |
|                                                                                           | Hydropsychidae                                                                       | <i>Cheumatopsyche campyla</i> Ross, 1938            | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Hydropsyche</i> species                          | 14 ♀                        |     |
|                                                                                           | Hydroptilidae                                                                        | <i>Hydroptila grandiosa</i> Ross, 1938              | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Hydroptila</i> species                           | 43 ♀                        |     |
|                                                                                           |                                                                                      | <i>Orthotrichia aegerfasciella</i> (Chambers, 1873) | 8 ♂                         |     |
|                                                                                           | Leptoceridae                                                                         | <i>Oecetis inconspicua</i> (Walker, 1852)           | 7 ♂                         |     |
|                                                                                           | Phryganeidae                                                                         | <i>Agrypnia vestita</i> (Walker, 1852)              | 4 ♂                         |     |
|                                                                                           | Polycentropodidae                                                                    | <i>Nyctiophylax</i> species                         | 1 ♀                         |     |
|                                                                                           | KY: Bell Co., CUGA Davis Branch beaver pond bridge, 28 Sep 2005, sweeping            |                                                     |                             |     |
| Odonata                                                                                   | Coenagrionidae                                                                       | <i>Ischnura verticalis</i> (Say, 1839)              | 4 ♀                         |     |
|                                                                                           | Libellulidae                                                                         | <i>Celithemis elisa</i> (Hagen, 1861)               | 2 ♂                         |     |
|                                                                                           |                                                                                      | <i>Libellula vibrans</i> Fabricius, 1793            | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Pachydiplax longipennis</i> (Burmeister, 1839)   | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Plathemis lydia</i> (Drury, 1773)                | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Sympetrum vicinum</i> (Hagen, 1861)              | 2 ♂                         |     |
| KY: Bell Co., CUGA Davis Branch downstream of beaver ponds, 21 Jul 2006, black light trap |                                                                                      |                                                     |                             |     |
| Ephemeroptera                                                                             | Heptageniidae                                                                        | <i>Maccaffertium</i> species                        | 1 ♀                         |     |
|                                                                                           |                                                                                      | <i>Stenacron gildersleevei</i> (Traver, 1935)       | 2 ♂                         |     |
| Trichoptera                                                                               | Helicopsychidae                                                                      | <i>Helicopsyche borealis</i> (Hagen, 1861)          | 1 ♀                         |     |
|                                                                                           | Hydropsychidae                                                                       | <i>Cheumatopsyche analis</i> (Banks, 1903)          | 16 ♂                        |     |
|                                                                                           |                                                                                      | <i>Hydropsyche alhedra</i> Ross, 1939               | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Hydropsyche cheilonis</i> Ross, 1938             | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Hydropsyche</i> species                          | 34 ♀                        |     |
|                                                                                           | Hydroptilidae                                                                        | <i>Hydroptila armata</i> Ross, 1938                 | 1 ♂                         |     |
|                                                                                           |                                                                                      | <i>Hydroptila</i> species                           | 1 ♀                         |     |
|                                                                                           | Leptoceridae                                                                         | <i>Oecetis inconspicua</i> (Walker, 1852)           | 1 ♂                         |     |
|                                                                                           | Polycentropodidae                                                                    | <i>Nyctiophylax</i> species                         | 1 ♀                         |     |
|                                                                                           | KY: Bell Co., CUGA Davis Branch upper beaver pond, 19 May 2005, black light (sheet)  |                                                     |                             |     |
| Ephemeroptera                                                                             | Caenidae                                                                             | <i>Caenis amica</i> Hagen, 1861                     | few ♂                       |     |
| Megaloptera                                                                               | Corydalidae                                                                          | <i>Nigronia fasciatus</i> (Walker, 1853)            | 1 ♂                         |     |
| Plecoptera                                                                                | Nemouridae                                                                           | <i>Amphinemura nigritta</i> (Provancher, 1876)      | 1 ♀                         |     |

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| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera                    |                                                     |                                                   |                                            |       |
|-------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------|--------------------------------------------|-------|
| Order                                                                               | Family                                              | Species                                           | Specimens                                  |       |
| Trichoptera                                                                         | Hydropsychidae                                      | <i>Hydropsyche dicantha</i> Ross, 1938            | 2 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche</i> species                        | 35 ♀                                       |       |
|                                                                                     | Leptoceridae                                        | <i>Ceraclea tarsipunctata</i> (Vorhies, 1909)     | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Oecetis inconspicua</i> (Walker, 1852)         | 3 ♂                                        |       |
|                                                                                     | Polycentropodidae                                   | <i>Nyctiophylax</i> species                       | 2 ♀                                        |       |
|                                                                                     |                                                     | <i>Polycentropus confusus</i> Hagen, 1861         | 1 ♀                                        |       |
| Rhyacophilidae                                                                      | <i>Rhyacophila carolina</i> Banks, 1911             | 1 ♀                                               |                                            |       |
|                                                                                     | <i>Rhyacophila fuscula</i> (Walker, 1852)           | 1 ♀                                               |                                            |       |
| KY: Bell Co., CUGA Davis Branch upper beaver pond, 20 Jul 2006, sweeping            |                                                     |                                                   |                                            |       |
| Odonata                                                                             | Coenagrionidae                                      | <i>Argia fumipennis violacea</i> (Hagen, 1861)    | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Ischnura posita</i> Hagen, 1861                | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Ischnura verticalis</i> (Say, 1839)            | 2 ♀                                        |       |
|                                                                                     | Libellulidae                                        | <i>Libellula cyanea</i> Fabricius, 1775           | 1 ♀                                        |       |
|                                                                                     |                                                     | <i>Libellula incesta</i> Hagen, 1861              | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Pachydiplax longipennis</i> (Burmeister, 1839) | 2 ♀                                        |       |
| Trichoptera                                                                         | Hydropsychidae                                      | <i>Hydropsyche morosa</i> Hagen, 1861             | 1 ♂                                        |       |
| KY: Bell Co., CUGA Davis Branch upper beaver pond, 20-21 Jul 2006, black light trap |                                                     |                                                   |                                            |       |
| Ephemeroptera                                                                       | Baetidae                                            | <i>Baetis</i> species                             | 2 ♀                                        |       |
|                                                                                     | Heptageniidae                                       | <i>Maccaffertium</i> species                      | 6 ♀                                        |       |
|                                                                                     | Isonychiidae                                        | <i>Isonychia</i> species                          | 1 ♀                                        |       |
| Plecoptera                                                                          | Perlidae                                            | <i>Perlesta decipiens</i> (Walsh, 1862)           | 2 ♀                                        |       |
| Trichoptera                                                                         | Glossosomatidae                                     | <i>Protophila</i> species                         | 3 ♀                                        |       |
|                                                                                     | Hydropsychidae                                      | <i>Cheumatopsyche analis</i> (Banks, 1903)        | 6 ♂                                        |       |
|                                                                                     |                                                     | <i>Cheumatopsyche aphantia</i> Ross, 1938         | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Cheumatopsyche campyla</i> Ross, 1938          | 6 ♀                                        |       |
|                                                                                     |                                                     | <i>Cheumatopsyche</i> species                     | 29 ♀                                       |       |
|                                                                                     |                                                     | <i>Hydropsyche betteni</i> Ross, 1938             | 2 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche bronta</i> Ross, 1938              | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche cheilonis</i> Ross, 1938           | 2 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche morosa</i> Hagen, 1861             | 4 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche scalaris</i> Hagen, 1861           | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche sparna</i> Ross, 1938              | 3 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche</i> species                        | 2 ♀                                        |       |
|                                                                                     |                                                     | Hydroptilidae                                     | <i>Hydroptila grandiosa</i> Ross, 1938     | 1 ♂   |
|                                                                                     |                                                     |                                                   | <i>Hydroptila perdita</i> Morton, 1905     | 3 ♂   |
|                                                                                     |                                                     |                                                   | <i>Hydroptila</i> species                  | 118 ♀ |
|                                                                                     |                                                     |                                                   | <i>Hydroptila waubesiana</i> Betten, 1934  | 1 ♂   |
|                                                                                     |                                                     |                                                   | <i>Ochrotrichia tarsalis</i> (Hagen, 1861) | 2 ♂   |
|                                                                                     | <i>Orthotrichia aegerfasciella</i> (Chambers, 1873) |                                                   | 39 ♀                                       |       |
|                                                                                     | <i>Oxyethira forcipata</i> Mosely, 1934             |                                                   | 3 ♂                                        |       |
|                                                                                     | <i>Oxyethira pallida</i> (Banks, 1904)              |                                                   | 1 ♂                                        |       |
|                                                                                     | <i>Oxyethira</i> species                            | 12 ♀                                              |                                            |       |
|                                                                                     | Leptoceridae                                        | <i>Oecetis cinerascens</i> (Hagen, 1861)          | 1 ♀                                        |       |
|                                                                                     |                                                     | <i>Oecetis ditissa</i> Ross, 1966                 | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Oecetis inconspicua</i> (Walker, 1852)         | 24 ♂                                       |       |
|                                                                                     |                                                     | <i>Oecetis persimilis</i> (Banks, 1907)           | 3 ♀                                        |       |
|                                                                                     | Polycentropodidae                                   | <i>Nyctiophylax affinis</i> (Banks, 1897)         | 3 ♂                                        |       |
|                                                                                     | Psychomyiidae                                       | <i>Lype diversa</i> (Banks, 1914)                 | 1 ♀                                        |       |
|                                                                                     |                                                     | <i>Psychomyia flavida</i> Hagen, 1861             | 1 ♀                                        |       |
| KY: Bell Co., CUGA Davis Branch upper beaver pond, 28-29 Sep 2005, black light trap |                                                     |                                                   |                                            |       |
| Trichoptera                                                                         | Glossosomatidae                                     | <i>Glossosoma nigrior</i> Banks, 1911             | 1 ♀                                        |       |
|                                                                                     | Hydropsychidae                                      | <i>Cheumatopsyche analis</i> (Banks, 1903)        | 2 ♂                                        |       |
|                                                                                     |                                                     | <i>Cheumatopsyche campyla</i> Ross, 1938          | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Cheumatopsyche</i> species                     | 7 ♀                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche alhedra</i> Ross, 1939             | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche betteni</i> Ross, 1938             | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydropsyche cheilonis</i> Ross, 1938           | 4 ♂                                        |       |
|                                                                                     | Hydroptilidae                                       | <i>Hydroptila grandiosa</i> Ross, 1938            | 1 ♂                                        |       |
|                                                                                     |                                                     | <i>Hydroptila</i> species                         | 2 ♀                                        |       |
|                                                                                     |                                                     | <i>Oxyethira</i> species                          | 7 ♀                                        |       |
|                                                                                     | Limnephilidae                                       | <i>Limnephilus indivisus</i> Walker, 1852         | 1 ♀                                        |       |
|                                                                                     |                                                     | <i>Pycnopsyche antica</i> (Walker, 1852)          | 1 ♂                                        |       |
|                                                                                     | Phryganeidae                                        | <i>Aarypnia vestita</i> (Walker, 1852)            | 7 ♂                                        |       |

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| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera                             |                   |                                                |           |
|----------------------------------------------------------------------------------------------|-------------------|------------------------------------------------|-----------|
| Order                                                                                        | Family            | Species                                        | Specimens |
| <b>KY: Bell Co., CUGA Davis Run off Pinnacle Road, 13 May 1998, by hand</b>                  |                   |                                                |           |
| Trichoptera                                                                                  | Rhyacophilidae    | <i>Rhyacophila ledra</i> Ross, 1939            | 1 ♂       |
|                                                                                              | Thremmatidae      | <i>Neophylax</i> species                       | 5 larvae  |
| <b>KY: Bell Co., CUGA Gap Creek Cudjo's Cave, 30 Mar 2006, by hand</b>                       |                   |                                                |           |
| Ephemeroptera                                                                                | Baetidae          | <i>Baetis</i> species                          | 12 ♂      |
|                                                                                              | Heptageniidae     | <i>Epeorus pleuralis</i> (Banks, 1910)         | 7 ♂       |
| Trichoptera                                                                                  | Thremmatidae      | <i>Neophylax aniqua</i> Ross, 1947             | 1 larva   |
| <b>KY: Bell Co., CUGA headwaters of Shillalah Creek, 4 Apr 2007, black light trap</b>        |                   |                                                |           |
| Ephemeroptera                                                                                | Ephemerellidae    | <i>Eurylophella macdunnoughi</i> Funk, 1994    | 1 larva   |
| Plecoptera                                                                                   | Leuctridae        | <i>Leuctra ferruginea</i> (F Walker, 1851)     | 25 ♂      |
|                                                                                              | Nemouridae        | <i>Soyedina vallicularia</i> (Wu, 1923)        | 1 ♂       |
|                                                                                              | Perlidae          | <i>Diploperla robusta</i> Stark & Gaufin, 1974 | 4 larvae  |
| Trichoptera                                                                                  | Hydropsychidae    | <i>Diplectrona modesta</i> Banks, 1908         | 5 larvae  |
|                                                                                              | Polycentropodidae | <i>Polycentropus</i> species                   | 6 larvae  |
|                                                                                              | Rhyacophilidae    | <i>Rhyacophila parantra</i> Ross, 1948         | 2 larvae  |
| <b>KY: Bell Co., CUGA Martins Fork at road, 18-19 Jul 2006, black light trap</b>             |                   |                                                |           |
| Ephemeroptera                                                                                | Heptageniidae     | <i>Stenacron gildersleevei</i> (Traver, 1935)  | 3 ♂       |
| Plecoptera                                                                                   | Leuctridae        | <i>Leuctra</i> species                         | 10 ♀      |
|                                                                                              | Nemouridae        | <i>Amphinemura</i> species                     | 2 ♀       |
|                                                                                              | Perlidae          | <i>Eccoptura xanthenes</i> (Newman, 1828)      | 1 ♀       |
|                                                                                              |                   | <i>Perlesta</i> species                        | 2 ♀       |
| Trichoptera                                                                                  | Glossosomatidae   | <i>Glossosoma nigrior</i> Banks, 1911          | 4 ♀       |
|                                                                                              | Hydropsychidae    | <i>Cheumatopsyche</i> species                  | 3 ♀       |
|                                                                                              |                   | <i>Diplectrona</i> species                     | 1 ♂       |
|                                                                                              |                   | <i>Hydropsyche sparna</i> Ross, 1938           | 5 ♂       |
|                                                                                              |                   | <i>Hydropsyche</i> species                     | 10 ♀      |
|                                                                                              | Philopotamidae    | <i>Dolophilodes distincta</i> (Walker, 1852)   | 2 ♂       |
|                                                                                              | Polycentropodidae | <i>Polycentropus maculatus</i> Banks, 1908     | 7 ♂       |
|                                                                                              | Rhyacophilidae    | <i>Rhyacophila carolina</i> Banks, 1911        | 5 ♂       |
| <b>KY: Bell Co., CUGA Martins Fork at road, 5 Apr 2007, black light trap</b>                 |                   |                                                |           |
| Plecoptera                                                                                   | Leuctridae        | <i>Leuctra ferruginea</i> (F Walker, 1851)     | 44 ♂      |
| <b>KY: Bell Co., CUGA Martins Fork at road, 7 Apr 2007, by hand</b>                          |                   |                                                |           |
| Ephemeroptera                                                                                | Ephemerellidae    | <i>Eurylophella</i> species                    | 1 larva   |
| Plecoptera                                                                                   | Leuctridae        | <i>Leuctra ferruginea</i> (F Walker, 1851)     | 16 ♂      |
|                                                                                              |                   | <i>Paraleuctra sara</i> (Claassen, 1937)       | 3 ♂       |
|                                                                                              | Peltoperlidae     | <i>Peltoperla</i> species                      | 2 larvae  |
|                                                                                              | Perlidae          | <i>Isoperla</i> species                        | 1 larva   |
| Trichoptera                                                                                  | Ptilocolepidae    | <i>Palaeagapetus celsus</i> (Ross, 1938)       | 1 larva   |
|                                                                                              | Rhyacophilidae    | <i>Rhyacophila torva</i> Hagen, 1861           | 2 ♂       |
|                                                                                              | Thremmatidae      | <i>Neophylax aniqua</i> Ross, 1947             | 7 larvae  |
| <b>KY: Bell Co., CUGA Martins Fork near upper bog, 18-19 Jul 2006, black light trap</b>      |                   |                                                |           |
| Megaloptera                                                                                  | Corydalidae       | <i>Chauliodes pectinicornis</i> Linnaeus, 1783 | 1 ♀       |
| Plecoptera                                                                                   | Perlidae          | <i>Eccoptura xanthenes</i> (Newman, 1828)      | 1 ♀       |
| Trichoptera                                                                                  | Brachycentridae   | <i>Micrasema</i> species                       | 1 ♀       |
|                                                                                              | Glossosomatidae   | <i>Glossosoma nigrior</i> Banks, 1911          | 6 ♂       |
|                                                                                              |                   | <i>Cheumatopsyche pasella</i> Ross, 1941       | 4 ♂       |
|                                                                                              |                   | <i>Hydropsyche alhedra</i> Ross, 1939          | 4 ♂       |
|                                                                                              |                   | <i>Hydropsyche bronta</i> Ross, 1938           | 6 ♂       |
|                                                                                              |                   | <i>Hydropsyche cheilonis</i> Ross, 1938        | 5 ♂       |
|                                                                                              |                   | <i>Hydropsyche morosa</i> Hagen, 1861          | 21 ♂      |
|                                                                                              |                   | <i>Hydropsyche slossonae</i> Banks, 1905       | 13 ♂      |
|                                                                                              |                   | <i>Hydropsyche sparna</i> Ross, 1938           | 17 ♂      |
|                                                                                              |                   | <i>Hydropsyche</i> species                     | 56 ♀      |
|                                                                                              | Leptoceridae      | <i>Oecetis inconspicua</i> (Walker, 1852)      | 6 ♂       |
|                                                                                              |                   | <i>Oecetis nocturna</i> Ross, 1966             | 1 ♂       |
|                                                                                              | Phryganeidae      | <i>Banksiola dossuaria</i> (Say, 1828)         | 1 ♀       |
|                                                                                              | Polycentropodidae | <i>Polycentropus</i> species                   | 1 ♀       |
|                                                                                              | Rhyacophilidae    | <i>Rhyacophila carolina</i> Banks, 1911        | 1 ♀       |
| <b>KY: Bell Co., CUGA Shillalah Creek at park boundary, 18-19 Jul 2006, black light trap</b> |                   |                                                |           |
| Plecoptera                                                                                   | Leuctridae        | <i>Leuctra ferruginea</i> (F Walker, 1851)     | 14 ♂      |
|                                                                                              | Nemouridae        | <i>Amphinemura wui</i> (Claassen, 1936)        | 1 ♂       |

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| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera                      |                                                                          |                                                        |                                            |     |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------|-----|
| Order                                                                                 | Family                                                                   | Species                                                | Specimens                                  |     |
| Trichoptera                                                                           | Peltoperlidae                                                            | <i>Peltoperla arcuata</i> Needham, 1905                | 14 ♂                                       |     |
|                                                                                       | Hydropsychidae                                                           | <i>Cheumatopsyche harwoodi</i> Denning, 1948           | 2 ♂                                        |     |
|                                                                                       |                                                                          | <i>Diplectrona</i> species                             | several ♂                                  |     |
|                                                                                       |                                                                          | <i>Hydropsyche alhedra</i> Ross, 1939                  | 10 ♂                                       |     |
|                                                                                       |                                                                          | <i>Hydropsyche morosa</i> Hagen, 1861                  | 1 ♂                                        |     |
|                                                                                       |                                                                          | <i>Hydropsyche sparna</i> Ross, 1938                   | 6 ♂                                        |     |
|                                                                                       |                                                                          | <i>Hydropsyche</i> species                             | 17 ♀                                       |     |
|                                                                                       |                                                                          | <i>Hydropsyche ventura</i> Ross, 1941                  | 5 ♂                                        |     |
|                                                                                       |                                                                          | Leptoceridae                                           | <i>Oecetis inconspicua</i> (Walker, 1852)  | 1 ♂ |
|                                                                                       | Philopotamidae                                                           | <i>Dolophilodes distincta</i> (Walker, 1852)           | 3 ♂                                        |     |
|                                                                                       | Polycentropodidae                                                        | <i>Nyctiophylax moestus</i> Banks, 1911                | 1 ♂                                        |     |
|                                                                                       |                                                                          | <i>Plectrocnemia cinerea</i> (Hagen, 1861)             | 3 ♂                                        |     |
|                                                                                       |                                                                          | <i>Polycentropus carolinensis</i> Banks, 1905          | 1 ♂                                        |     |
|                                                                                       |                                                                          | <i>Polycentropus maculatus</i> Banks, 1908             | 12 ♂                                       |     |
|                                                                                       |                                                                          | <i>Polycentropus</i> species                           | 9 ♀                                        |     |
|                                                                                       | Psychomyiidae                                                            | <i>Lype diversa</i> (Banks, 1914)                      | 2 ♀                                        |     |
|                                                                                       | Rhyacophilidae                                                           | <i>Rhyacophila carolina</i> Banks, 1911                | 3 ♂                                        |     |
|                                                                                       |                                                                          | <i>Rhyacophila fuscula</i> (Walker, 1852)              | 1 ♂                                        |     |
| KY: Bell Co., CUGA Shillalah Creek at park boundary, 28-29 Sep 2005, black light trap |                                                                          |                                                        |                                            |     |
| Ephemeroptera                                                                         | Heptageniidae                                                            | <i>Maccaffertium</i> species                           | 1 ♂                                        |     |
| Plecoptera                                                                            | Leuctridae                                                               | <i>Leuctra</i> species                                 | 8 ♀                                        |     |
| Trichoptera                                                                           | Hydropsychidae                                                           | <i>Diplectrona</i> species                             | 1 ♀                                        |     |
|                                                                                       |                                                                          | Lepidostomatidae                                       | <i>Lepidostoma etnieri</i> Weaver, 1988    | 1 ♂ |
|                                                                                       | Limnephilidae                                                            | <i>Pycnopsyche antica</i> (Walker, 1852)               | 1 ♂                                        |     |
|                                                                                       |                                                                          | <i>Pycnopsyche flavata</i> (Banks, 1914)               | 1 ♂                                        |     |
|                                                                                       |                                                                          | <i>Pycnopsyche gentilis</i> (McLachlan, 1871)          | 2 ♂                                        |     |
|                                                                                       |                                                                          | <i>Pycnopsyche luculenta</i> (Betten, 1934)            | 8 ♂                                        |     |
|                                                                                       | Philopotamidae                                                           | <i>Dolophilodes distincta</i> (Walker, 1852)           | 2 ♂                                        |     |
|                                                                                       |                                                                          | <i>Wormaldia moesta</i> (Banks, 1914)                  | 1 ♂                                        |     |
|                                                                                       | Polycentropodidae                                                        | <i>Plectrocnemia cinerea</i> (Hagen, 1861)             | 2 ♂                                        |     |
|                                                                                       |                                                                          | <i>Polycentropus maculatus</i> Banks, 1908             | 2 ♂                                        |     |
|                                                                                       |                                                                          | <i>Polycentropus</i> species                           | 1 ♂                                        |     |
|                                                                                       | Rhyacophilidae                                                           | <i>Rhyacophila carolina</i> Banks, 1911                | 9 ♂                                        |     |
|                                                                                       |                                                                          | <i>Rhyacophila fuscula</i> (Walker, 1852)              | 1 ♀                                        |     |
|                                                                                       |                                                                          | <i>Rhyacophila glaberrima</i> Ulmer, 1907              | 1 ♂                                        |     |
|                                                                                       | Thremmatidae                                                             | <i>Neophylax aniqua</i> Ross, 1947                     | 5 ♂                                        |     |
|                                                                                       |                                                                          | <i>Neophylax wigginsi</i> Sykora & Weaver, 1978        | 6 ♂                                        |     |
|                                                                                       | KY: Bell Co., CUGA Shillalah Creek at park boundary, 4 Apr 2007, by hand |                                                        |                                            |     |
|                                                                                       | Plecoptera                                                               | Leuctridae                                             | <i>Leuctra ferruginea</i> (F Walker, 1851) | 3 ♂ |
| Trichoptera                                                                           | Rhyacophilidae                                                           | <i>Rhyacophila glaberrima</i> Ulmer, 1907              | 4 larvae                                   |     |
|                                                                                       |                                                                          | <i>Rhyacophila parantra</i> Ross, 1948                 | 2 larvae                                   |     |
|                                                                                       | Thremmatidae                                                             | <i>Neophylax aniqua</i> Ross, 1947                     | 3 larvae                                   |     |
| KY: Bell Co., CUGA Sugar Run at Picnic Area, 19-20 Jul 2006, black light trap         |                                                                          |                                                        |                                            |     |
| Megaloptera                                                                           | Corydalidae                                                              | <i>Corydalus cornutus</i> (Linnaeus, 1763)             | 3 ♀                                        |     |
| Plecoptera                                                                            | Nemouridae                                                               | <i>Amphinemura wui</i> (Claassen, 1936)                | 3 ♀                                        |     |
|                                                                                       | Perlidae                                                                 | <i>Eccoptura xanthenes</i> (Newman, 1828)              | 15 ♀                                       |     |
|                                                                                       |                                                                          | <i>Perlesta puttmanni</i> Kondratieff & Kirchner, 2003 | 13 ♂                                       |     |
|                                                                                       | Perlodidae                                                               | <i>Isoperla</i> species                                | 2 ♀                                        |     |
|                                                                                       | Glossosomatidae                                                          | <i>Glossosoma nigrior</i> Banks, 1911                  | 2 ♂                                        |     |
| Trichoptera                                                                           | Hydropsychidae                                                           | <i>Cheumatopsyche pasella</i> Ross, 1941               | 4 ♂                                        |     |
|                                                                                       |                                                                          | <i>Diplectrona</i> species                             | several ♂                                  |     |
|                                                                                       | <i>Hydropsyche betteni</i> Ross, 1938                                    | 1 ♀                                                    |                                            |     |
|                                                                                       | <i>Hydropsyche bronta</i> Ross, 1938                                     | 8 ♂                                                    |                                            |     |
|                                                                                       | <i>Hydropsyche cheilonis</i> Ross, 1938                                  | 1 ♂                                                    |                                            |     |
|                                                                                       | <i>Hydropsyche morosa</i> Hagen, 1861                                    | 4 ♂                                                    |                                            |     |
|                                                                                       | <i>Hydropsyche sparna</i> Ross, 1938                                     | 3 ♂                                                    |                                            |     |
|                                                                                       | <i>Hydropsyche</i> species                                               | 296 ♀                                                  |                                            |     |
|                                                                                       | <i>Hydropsyche ventura</i> Ross, 1941                                    | 1 ♂                                                    |                                            |     |
|                                                                                       | Hydroptilidae                                                            | <i>Hydroptila grandiosa</i> Ross, 1938                 | 1 ♂                                        |     |
|                                                                                       |                                                                          | <i>Hydroptila</i> species                              | 20 ♀                                       |     |
|                                                                                       |                                                                          | <i>Neotrichia collata</i> Morton, 1905                 | 3 ♀, 2 ♂                                   |     |
|                                                                                       |                                                                          | <i>Ochrotrichia tarsalis</i> (Hagen, 1861)             | 1 ♂                                        |     |
|                                                                                       |                                                                          | <i>Orthotrichia</i> species                            | 1 ♀                                        |     |

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| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera  |                                                                              |                                                                              |                                       |                          |     |
|-------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------------|--------------------------|-----|
| Order                                                             | Family                                                                       | Species                                                                      | Specimens                             |                          |     |
| Ephemeroptera                                                     | Leptoceridae                                                                 | <i>Oxyethira</i> species                                                     | 2 ♀                                   |                          |     |
|                                                                   |                                                                              | <i>Mystacides sepulchralis</i> (Walker, 1852)                                | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Oecetis cinerascens</i> (Hagen, 1861)                                     | 1 ♀                                   |                          |     |
|                                                                   |                                                                              | <i>Oecetis ditissa</i> Ross, 1966                                            | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Oecetis inconspicua</i> (Walker, 1852)                                    | 3 ♂                                   |                          |     |
|                                                                   | Philopotamidae                                                               | <i>Dolophilodes distincta</i> (Walker, 1852)                                 | several ♂                             |                          |     |
|                                                                   | Polycentropodidae                                                            | <i>Nyctiophylax moestus</i> Banks, 1911                                      | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Plectrocnemia cinerea</i> (Hagen, 1861)                                   | 2 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Polycentropus confusus</i> Hagen, 1861                                    | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Polycentropus elarus</i> Ross, 1944                                       | 1 ♂                                   |                          |     |
|                                                                   | Psychomyiidae                                                                | <i>Polycentropus maculatus</i> Banks, 1908                                   | 3 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Lype diversa</i> (Banks, 1914)                                            | 1 ♂                                   |                          |     |
|                                                                   | Rhyacophilidae                                                               | <i>Rhyacophila carolina</i> Banks, 1911                                      | 2 ♂                                   |                          |     |
| KY: Bell Co., CUGA Sugar Run at Picnic Area, 30 Mar 2006, beating |                                                                              |                                                                              |                                       |                          |     |
| Ephemeroptera                                                     | Leptophlebiidae                                                              | <i>Leptophlebia cupida</i> (Say, 1823)                                       | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Paraleptophlebia adoptiva</i> (J McDunnough, 1929)                        | 4 ♂                                   |                          |     |
| Plecoptera                                                        | Capniidae                                                                    | <i>Paracapnia angulata</i> Hanson, 1961                                      | 4 ♂                                   |                          |     |
|                                                                   | Leuctridae                                                                   | <i>Paraleuctra sara</i> (Claassen, 1937)                                     | 1 ♂                                   |                          |     |
| KY: Bell Co., CUGA Tunnel Creek above road, 13 May 1998, by hand  |                                                                              |                                                                              |                                       |                          |     |
| Trichoptera                                                       | Glossosomatidae                                                              | <i>Glossosoma nigrior</i> Banks, 1911                                        | 4 larvae                              |                          |     |
|                                                                   | Hydropsychidae                                                               | <i>Cheumatopsyche</i> species                                                | 1 larva                               |                          |     |
|                                                                   |                                                                              | <i>Hydropsyche betteni/depravata</i> group                                   | 3 larvae                              |                          |     |
| KY: Bell Co., CUGA Tunnel Creek above road, 20 Jul 2006, by hand  |                                                                              |                                                                              |                                       |                          |     |
| Plecoptera                                                        | Peltoperlidae                                                                | <i>Peltoperla arcuata</i> Needham, 1905                                      | 2 ♂                                   |                          |     |
| Trichoptera                                                       | Hydropsychidae                                                               | <i>Diplectrona</i> species                                                   | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Hydropsyche betteni</i> Ross, 1938                                        | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Hydropsyche</i> species                                                   | 1 ♀                                   |                          |     |
|                                                                   | Philopotamidae                                                               | <i>Chimarra</i> species                                                      | 1 ♀                                   |                          |     |
|                                                                   | Rhyacophilidae                                                               | <i>Rhyacophila torva</i> Hagen, 1861                                         | 1 ♂                                   |                          |     |
|                                                                   | KY: Bell Co., CUGA Tunnel Creek above road, 20-21 Jul 2006, black light trap |                                                                              |                                       |                          |     |
| Trichoptera                                                       | Hydropsychidae                                                               | <i>Cheumatopsyche</i> species                                                | 21 ♀                                  |                          |     |
|                                                                   |                                                                              | <i>Diplectrona</i> species                                                   | many ♂                                |                          |     |
|                                                                   |                                                                              | <i>Hydropsyche betteni</i> Ross, 1938                                        | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Hydropsyche</i> species                                                   | 13 ♀                                  |                          |     |
|                                                                   |                                                                              | <i>Oecetis inconspicua</i> (Walker, 1852)                                    | 1 ♀                                   |                          |     |
|                                                                   | Philopotamidae                                                               | <i>Chimarra aterrima</i> Hagen, 1861                                         | 1 ♂                                   |                          |     |
|                                                                   | Polycentropodidae                                                            | <i>Polycentropus confusus</i> Hagen, 1861                                    | 1 ♂                                   |                          |     |
|                                                                   | Psychomyiidae                                                                | <i>Lype diversa</i> (Banks, 1914)                                            | 1 ♀                                   |                          |     |
|                                                                   | Rhyacophilidae                                                               | <i>Psychomyia flavida</i> Hagen, 1861                                        | 1 ♀                                   |                          |     |
|                                                                   |                                                                              | <i>Rhyacophila carpenteri</i> Milne, 1936                                    | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Rhyacophila torva</i> Hagen, 1861                                         | 5 ♂                                   |                          |     |
|                                                                   |                                                                              | KY: Bell Co., CUGA Tunnel Creek above road, 28-29 Sep 2005, black light trap |                                       |                          |     |
|                                                                   |                                                                              | Ephemeroptera                                                                | Isonychiidae                          | <i>Isonychia</i> species | 1 ♀ |
|                                                                   | Trichoptera                                                                  | Glossosomatidae                                                              | <i>Glossosoma nigrior</i> Banks, 1911 | 6 adult                  |     |
| Hydropsychidae                                                    |                                                                              | <i>Cheumatopsyche analis</i> (Banks, 1903)                                   | 3 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Cheumatopsyche geora</i> Denning, 1948                                    | 8 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Cheumatopsyche oxa</i> Ross, 1938                                         | 23 ♂                                  |                          |     |
|                                                                   |                                                                              | <i>Cheumatopsyche</i> species                                                | 8 ♀                                   |                          |     |
|                                                                   |                                                                              | <i>Diplectrona</i> species                                                   | several ♂                             |                          |     |
|                                                                   |                                                                              | <i>Hydropsyche betteni</i> Ross, 1938                                        | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Hydropsyche depravata</i> Hagen, 1861                                     | 6 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Hydropsyche sparna</i> Ross, 1938                                         | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | <i>Hydropsyche</i> species                                                   | 3 ♀                                   |                          |     |
|                                                                   |                                                                              | Hydroptilidae                                                                | <i>Hydroptila amoena</i> Ross, 1938   | 1 ♂                      |     |
| <i>Hydroptila armata</i> Ross, 1938                               |                                                                              |                                                                              | 2 ♂                                   |                          |     |
| <i>Hydroptila consimilis</i> Morton, 1905                         |                                                                              |                                                                              | 1 ♂                                   |                          |     |
| <i>Hydroptila paramoena</i> Harris, 1985                          |                                                                              |                                                                              | 2 ♂                                   |                          |     |
| <i>Hydroptila</i> species                                         |                                                                              |                                                                              | 6 ♀                                   |                          |     |
| <i>Hydroptila waubesiana</i> Betten, 1934                         |                                                                              |                                                                              | 1 ♂                                   |                          |     |
| Leptoceridae                                                      |                                                                              | <i>Oxyethira</i> species                                                     | 1 ♀                                   |                          |     |
|                                                                   |                                                                              | <i>Oecetis nocturna</i> Ross, 1966                                           | 1 ♂                                   |                          |     |
|                                                                   |                                                                              | Limnephilidae                                                                | <i>Ironoquia lyrata</i> (Ross, 1938)  | 1 ♂                      |     |
|                                                                   |                                                                              | <i>Ironoquia punctatissima</i> (Walker, 1852)                                | 6 ♂                                   |                          |     |

| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera                |                   |                                                     |           |
|---------------------------------------------------------------------------------|-------------------|-----------------------------------------------------|-----------|
| Order                                                                           | Family            | Species                                             | Specimens |
|                                                                                 |                   | <i>Pycnopsyche antica</i> (Walker, 1852)            | 1 ♂       |
|                                                                                 |                   | <i>Pycnopsyche gentilis</i> (McLachlan, 1871)       | 1 ♂       |
|                                                                                 |                   | <i>Pycnopsyche guttifer</i> (Walker, 1852)          | 1 ♂       |
|                                                                                 | Philopotamidae    | <i>Chimarra aterrima</i> Hagen, 1861                | 4 ♂       |
|                                                                                 |                   | <i>Dolophilodes distincta</i> (Walker, 1852)        | 1 ♂       |
|                                                                                 | Phryganeidae      | <i>Agrypnia vestita</i> (Walker, 1852)              | 2 ♂       |
|                                                                                 | Polycentropodidae | <i>Plectrocnemia cinerea</i> (Hagen, 1861)          | 1 ♂       |
|                                                                                 |                   | <i>Polycentropus confusus</i> Hagen, 1861           | 2 ♀       |
|                                                                                 | Psychomyiidae     | <i>Psychomyia flavida</i> Hagen, 1861               | 4 ♀       |
|                                                                                 | Rhyacophilidae    | <i>Rhyacophila carolina</i> Banks, 1911             | 1 ♂       |
|                                                                                 |                   | <i>Rhyacophila glaberrima</i> Ulmer, 1907           | 4 ♂       |
|                                                                                 |                   | <i>Rhyacophila torva</i> Hagen, 1861                | 9 ♂       |
|                                                                                 | Thremmatidae      | <i>Neophylax aniqua</i> Ross, 1947                  | 2 ♂       |
|                                                                                 |                   | <i>Neophylax etnieri</i> Vineyard and Wiggins, 1987 | 8 ♂       |
| KY: Bell Co., CUGA Yellow Creek at KFC, 20 May 2005, by hand                    |                   |                                                     |           |
| Ephemeroptera                                                                   | Baetidae          | Baetidae species                                    | 15 larvae |
|                                                                                 |                   | <i>Baetis</i> species                               | 2 larvae  |
|                                                                                 | Ephemerellidae    | <i>Ephemerella</i> species                          | 1 larva   |
|                                                                                 | Heptageniidae     | <i>Stenonema femoratum</i> (Say, 1823)              | 3 larvae  |
|                                                                                 | Isonychiidae      | <i>Isonychia</i> species                            | 2 larvae  |
| Plecoptera                                                                      | Perlodidae        | <i>Isoperla</i> species                             | 1 larva   |
| Trichoptera                                                                     | Glossosomatidae   | <i>Glossosoma nigrior</i> Banks, 1911               | 4 larvae  |
|                                                                                 | Hydropsychidae    | <i>Cheumatopsyche</i> species                       | 14 larvae |
|                                                                                 |                   | <i>Hydropsyche</i> species                          | 22 larvae |
|                                                                                 | Thremmatidae      | <i>Neophylax consimilis</i> Betten, 1934            | 1 ♂       |
|                                                                                 |                   | <i>Neophylax</i> species                            | 5 larvae  |
| KY: Bell Co., CUGA Yellow Creek at railroad bridge, 20 May 2005, by hand        |                   |                                                     |           |
| Odonata                                                                         | Calopterygidae    | <i>Calopteryx maculata</i> (Beauvois, 1805)         | 1 ♂       |
|                                                                                 | Coenagrionidae    | <i>Enallagma divagans</i> Selys, 1876               | 3 adults  |
|                                                                                 |                   | <i>Ischnura posita</i> Hagen, 1861                  | 1 ♀       |
|                                                                                 | Corduliidae       | <i>Helocordulia uhleri</i> (Selys, 1871)            | 2 ♀       |
|                                                                                 | Libellulidae      | <i>Erythemis simplicicollis</i> (Say, 1839)         | 1 ♂       |
| KY: Bell Co., CUGA Yellow Creek at RM offices, 20-21 Jul 2006, black light trap |                   |                                                     |           |
| Trichoptera                                                                     | Goeridae          | <i>Goera calcarata</i> Banks, 1899                  | 1 ♀       |
|                                                                                 | Hydropsychidae    | <i>Cheumatopsyche</i> species                       | 102 ♀     |
|                                                                                 |                   | <i>Hydropsyche betteni</i> Ross, 1938               | 2 ♂       |
|                                                                                 |                   | <i>Hydropsyche cheilonis</i> Ross, 1938             | 1 ♂       |
|                                                                                 |                   | <i>Hydropsyche depravata</i> Hagen, 1861            | 2 ♂       |
|                                                                                 |                   | <i>Hydropsyche sparna</i> Ross, 1938                | 1 ♂       |
|                                                                                 |                   | <i>Hydropsyche</i> species                          | 25 ♀      |
|                                                                                 | Hydroptilidae     | <i>Hydroptila armata</i> Ross, 1938                 | 1 ♂       |
|                                                                                 |                   | <i>Hydroptila grandiosa</i> Ross, 1938              | 1 ♂       |
|                                                                                 |                   | <i>Hydroptila gunda</i> Milne, 1936                 | 1 ♂       |
|                                                                                 |                   | <i>Hydroptila hamata</i> Morton, 1905               | 2 ♂       |
|                                                                                 |                   | <i>Ochrotrichia tarsalis</i> (Hagen, 1861)          | 2 ♀       |
|                                                                                 | Leptoceridae      | <i>Oecetis inconspicua</i> (Walker, 1852)           | 5 ♂       |
|                                                                                 |                   | <i>Oecetis persimilis</i> (Banks, 1907)             | 1 ♂       |
|                                                                                 | Philopotamidae    | <i>Chimarra aterrima</i> Hagen, 1861                | 9 ♂       |
|                                                                                 |                   | <i>Dolophilodes distincta</i> (Walker, 1852)        | 1 ♂       |
|                                                                                 | Polycentropodidae | <i>Nyctiophylax affinis</i> (Banks, 1897)           | 6 ♀       |
|                                                                                 |                   | <i>Polycentropus confusus</i> Hagen, 1861           | 4 ♂       |
|                                                                                 |                   | <i>Polycentropus</i> species                        | 9 ♀       |
|                                                                                 | Psychomyiidae     | <i>Lype diversa</i> (Banks, 1914)                   | 3 ♂       |
|                                                                                 |                   | <i>Psychomyia flavida</i> Hagen, 1861               | 64 ♀      |
| KY: Bell Co., CUGA Yellow Creek at RM offices, 28-29 Sep 2005, black light trap |                   |                                                     |           |
| Ephemeroptera                                                                   | Heptageniidae     | <i>Stenacron</i> species                            | 1 ♀       |
|                                                                                 | Isonychiidae      | <i>Isonychia bicolor</i> (Walker, 1853)             | 2 ♀       |
|                                                                                 |                   | <i>Isonychia</i> species                            | 1 ♀       |
| Trichoptera                                                                     | Glossosomatidae   | <i>Glossosoma nigrior</i> Banks, 1911               | 6 ♀       |
|                                                                                 | Helicopsychidae   | <i>Helicopsyche borealis</i> (Hagen, 1861)          | 1 ♂       |
|                                                                                 | Hydropsychidae    | <i>Cheumatopsyche analis</i> (Banks, 1903)          | 9 ♂       |
|                                                                                 |                   | <i>Hydropsyche betteni</i> Ross, 1938               | 2 ♂       |
|                                                                                 |                   | <i>Hydropsyche depravata</i> Hagen, 1861            | 4 ♂       |

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| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera                                |                   |                                                   |             |
|-------------------------------------------------------------------------------------------------|-------------------|---------------------------------------------------|-------------|
| Order                                                                                           | Family            | Species                                           | Specimens   |
|                                                                                                 |                   | <i>Hydropsyche sparna</i> Ross, 1938              | 2 ♀         |
|                                                                                                 | Hydroptilidae     | <i>Hydroptila armata</i> Ross, 1938               | 4 ♂         |
|                                                                                                 |                   | <i>Hydroptila paramoena</i> Harris, 1985          | 6 ♂         |
|                                                                                                 |                   | <i>Hydroptila remita</i> Bickel & Morse, 1954     | 1 ♂         |
|                                                                                                 |                   | <i>Hydroptila scolops</i> Ross, 1938              | 15 ♀        |
|                                                                                                 |                   | <i>Oxyethira forcipata</i> Mosely, 1934           | 1 ♂         |
|                                                                                                 | Leptoceridae      | <i>Oecetis inconspicua</i> (Walker, 1852)         | 2 ♀         |
|                                                                                                 | Limnephilidae     | <i>Ironoquia punctatissima</i> (Walker, 1852)     | 1 ♂         |
|                                                                                                 | Philopotamidae    | <i>Chimarra aterrima</i> Hagen, 1861              | 7 ♂         |
|                                                                                                 |                   | <i>Chimarra</i> species                           | 1 ♀         |
|                                                                                                 | Phryganeidae      | <i>Agrypnia vestita</i> (Walker, 1852)            | 1 ♂         |
|                                                                                                 | Polycentropodidae | <i>Cynellus fraternus</i> (Banks, 1905)           | 1 ♂         |
|                                                                                                 |                   | <i>Plectrocnemia cinerea</i> (Hagen, 1861)        | 1 ♂         |
|                                                                                                 | Psychomyiidae     | <i>Psychomyia flavida</i> Hagen, 1861             | 3 ♀         |
|                                                                                                 | Rhyacophilidae    | <i>Rhyacophila glaberrima</i> Ulmer, 1907         | 1 ♂         |
|                                                                                                 | Thremmatidae      | <i>Neophylax concinnus</i> MacLachlan, 1871       | 4 ♂         |
| KY: Bell Co., CUGA Yellow Creek at RM offices, 5 Apr 2007, by hand                              |                   |                                                   |             |
| Ephemeroptera                                                                                   | Heptageniidae     | <i>Maccaffertium</i> species                      | 3 ♀ subs.   |
|                                                                                                 |                   | <i>Stenacron</i> species                          | 1 ♂ sub.    |
| Plecoptera                                                                                      | Nemouridae        | <i>Amphinemura nigritta</i> (Provancher, 1876)    | 1 ♂         |
|                                                                                                 | Perlodidae        | <i>Diploperla robusta</i> Stark & Gauvin, 1974    | 1 ♂         |
| Trichoptera                                                                                     | Brachycentridae   | <i>Micrasema rusticum</i> (Hagen, 1868)           | 1 ♂         |
|                                                                                                 | Philopotamidae    | <i>Chimarra aterrima</i> Hagen, 1861              | 3 ♂         |
| KY: Bell Co., CUGA Yellow Creek below Tunnel Creek, 13 May 1998, by hand                        |                   |                                                   |             |
| Trichoptera                                                                                     | Glossosomatidae   | <i>Agapetus</i> species                           | 3 larvae    |
|                                                                                                 |                   | <i>Glossosoma nigrior</i> Banks, 1911             | 3 larvae    |
|                                                                                                 | Hydropsychidae    | <i>Diplectrona modesta</i> Banks, 1908            | 1 larva     |
| KY: Bell Co., CUGA Yellow Creek downstream Park entrance road, 20 Jul 2006, by hand             |                   |                                                   |             |
| Trichoptera                                                                                     | Hydropsychidae    | <i>Hydropsyche etnieri</i> Schuster & Talak, 1977 | 1 ♂         |
|                                                                                                 |                   | <i>Hydropsyche</i> species                        | 1 ♀         |
| KY: Bell Co., CUGA Yellow Creek downstream Park entrance road, 20-21 Jul 2006, black light trap |                   |                                                   |             |
| Trichoptera                                                                                     | Hydropsychidae    | <i>Cheumatopsyche analis</i> (Banks, 1903)        | 19 ♂        |
|                                                                                                 |                   | <i>Cheumatopsyche campyla</i> Ross, 1938          | 1 ♂         |
|                                                                                                 |                   | <i>Cheumatopsyche oxa</i> Ross, 1938              | 6 ♂         |
|                                                                                                 |                   | <i>Cheumatopsyche</i> species                     | 1 ♀         |
|                                                                                                 |                   | <i>Diplectrona</i> species                        | 4 ♂         |
|                                                                                                 |                   | <i>Hydropsyche betteni</i> Ross, 1938             | 1 ♂         |
|                                                                                                 |                   | <i>Hydropsyche bronta</i> Ross, 1938              | 1 ♂         |
|                                                                                                 |                   | <i>Hydropsyche depravata</i> Hagen, 1861          | 1 ♂         |
|                                                                                                 |                   | <i>Hydropsyche sparna</i> Ross, 1938              | 1 ♂         |
|                                                                                                 | Hydroptilidae     | <i>Hydroptilidae</i> species                      | 26 ♀        |
|                                                                                                 | Leptoceridae      | <i>Mystacides sepulchralis</i> (Walker, 1852)     | 8 ♂         |
|                                                                                                 |                   | <i>Oecetis inconspicua</i> (Walker, 1852)         | 22 adults   |
|                                                                                                 | Molannidae        | <i>Molanna blenda</i> Sibley, 1926                | 1 ♂         |
|                                                                                                 | Rhyacophilidae    | <i>Rhyacophila carolina</i> Banks, 1911           | 1 ♂         |
| VA: Lee Co., CUGA Gap Creek at Iron Furnace, 19 Jul 2006, by hand                               |                   |                                                   |             |
| Trichoptera                                                                                     | Hydropsychidae    | <i>Hydropsyche alhedra</i> Ross, 1939             | 1 ♂         |
|                                                                                                 |                   | <i>Hydropsyche etnieri</i> Schuster & Talak, 1977 | 67 ♂        |
|                                                                                                 |                   | <i>Hydropsyche sparna</i> Ross, 1938              | 1 ♂         |
|                                                                                                 |                   | <i>Hydropsyche ventura</i> Ross, 1941             | 1 ♂         |
| VA: Lee Co., CUGA Gap Creek at Iron Furnace, 19-20 Jul 2006, black light trap                   |                   |                                                   |             |
| Plecoptera                                                                                      | Peltoperlidae     | <i>Peltoperla arcuata</i> Needham, 1905           | 1 ♂         |
| Trichoptera                                                                                     | Glossosomatidae   | <i>Glossosoma nigrior</i> Banks, 1911             | 1 ♂         |
|                                                                                                 | Hydropsychidae    | <i>Cheumatopsyche oxa</i> Ross, 1938              | 3 ♂         |
|                                                                                                 |                   | <i>Cheumatopsyche</i> species                     | 1 ♀         |
|                                                                                                 |                   | <i>Diplectrona</i> species                        | many adults |
|                                                                                                 |                   | <i>Homoplectra doringa</i> (Milne, 1936)          | 5 ♂         |
|                                                                                                 |                   | <i>Hydropsyche alhedra</i> Ross, 1939             | 4 ♂         |
|                                                                                                 |                   | <i>Hydropsyche cheilonis</i> Ross, 1938           | 1 ♂         |
|                                                                                                 |                   | <i>Hydropsyche etnieri</i> Schuster & Talak, 1977 | 68 ♂        |
|                                                                                                 |                   | <i>Hydropsyche</i> species                        | 1 ♀         |
|                                                                                                 | Philopotamidae    | <i>Dolophilodes distincta</i> (Walker, 1852)      | 3 ♂         |
|                                                                                                 |                   | <i>Wormaldia moesta</i> (Banks, 1914)             | 2 ♂         |

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| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera                 |                                                                               |                                                            |                                          |          |
|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------|----------|
| Order                                                                            | Family                                                                        | Species                                                    | Specimens                                |          |
|                                                                                  | Polycentropodidae                                                             | <i>Plectrocnemia cinerea</i> (Hagen, 1861)                 | 11 ♂                                     |          |
|                                                                                  |                                                                               | <i>Polycentropus carolinensis</i> Banks, 1905              | 1 ♂                                      |          |
|                                                                                  |                                                                               | <i>Polycentropus</i> species                               | 2 ♀                                      |          |
|                                                                                  | Psychomyiidae                                                                 | <i>Lype diversa</i> (Banks, 1914)                          | 1 ♀                                      |          |
|                                                                                  | Rhyacophilidae                                                                | <i>Rhyacophila carolina</i> Banks, 1911                    | 2 ♂                                      |          |
|                                                                                  |                                                                               | <i>Rhyacophila carpenteri</i> Milne, 1936                  | 27 ♂                                     |          |
|                                                                                  |                                                                               | <i>Rhyacophila fuscula</i> (Walker, 1852)                  | 1 ♂                                      |          |
|                                                                                  |                                                                               | <i>Rhyacophila glaberrima</i> Ulmer, 1907                  | 2 ♂                                      |          |
|                                                                                  |                                                                               | <i>Rhyacophila torva</i> Hagen, 1861                       | 30 ♂                                     |          |
|                                                                                  | VA:Lee Co., CUGA Hensley Settlement Campsite Spring, 11 Apr 2007, by hand     |                                                            |                                          |          |
| Trichoptera                                                                      | Rhyacophilidae                                                                | <i>Rhyacophila parantra</i> Ross, 1948                     | 1 ♂                                      |          |
| VA:Lee Co., CUGA Hensley Settlement Campsite Spring, 4 Apr 2007, by hand         |                                                                               |                                                            |                                          |          |
| Plecoptera                                                                       | Leuctridae                                                                    | <i>Leuctra ferruginea</i> (F Walker, 1851)                 | 1 ♂                                      |          |
| Trichoptera                                                                      | Limnephilidae                                                                 | <i>Pseudostenophylax uniformis</i> (Betten, 1934)          | 5 larvae                                 |          |
|                                                                                  | Rhyacophilidae                                                                | <i>Rhyacophila invaria</i> group                           | 3 larvae                                 |          |
|                                                                                  |                                                                               | <i>Rhyacophila parantra</i> Ross, 1948                     | 1 ♂ mmt                                  |          |
| VA:Lee Co., CUGA Lewis Hollow, 30 Mar 2006, by hand                              |                                                                               |                                                            |                                          |          |
| Ephemeroptera                                                                    | Ameletidae                                                                    | <i>Ameletus</i> species                                    | 2 larvae                                 |          |
| Plecoptera                                                                       | Capniidae                                                                     | <i>Allocaenia nivicola</i> (Fitch, 1847)                   | 6 ♂                                      |          |
|                                                                                  | Nemouridae                                                                    | <i>Ostrocerca</i> species                                  | 5 larvae                                 |          |
|                                                                                  | Trichoptera                                                                   | Hydropsychidae                                             | <i>Homoplectra doringa</i> (Milne, 1936) | 4 larvae |
| Limnephilidae                                                                    |                                                                               | <i>Pycnopsyche</i> species                                 | 1 larva                                  |          |
| Thremmatidae                                                                     |                                                                               | <i>Neophylax</i> species                                   | 4 larvae                                 |          |
| VA:Lee Co., CUGA Station Creek near horse barn, 19 Jul 2006, by hand             |                                                                               |                                                            |                                          |          |
| Trichoptera                                                                      | Thremmatidae                                                                  | <i>Neophylax etnieri</i> Vineyard and Wiggins, 1987        | 8 larvae                                 |          |
| VA:Lee Co., CUGA Station Creek near horse barn, 19-20 Jul 2006, black light trap |                                                                               |                                                            |                                          |          |
| Ephemeroptera                                                                    | Ephemeridae                                                                   | <i>Ephemera blanda</i> Traver, 1932                        | ~20 adults                               |          |
|                                                                                  | Isonychiidae                                                                  | <i>Isonychia arida</i> (Say, 1839)                         | 19 ♀                                     |          |
| Megaloptera                                                                      | Corydalidae                                                                   | <i>Corydalus cornutus</i> (Linnaeus, 1763)                 | 1 ♀                                      |          |
| Odonata                                                                          | Gomphidae                                                                     | <i>Stylogomphus albistylus</i> (Hagen in Selys, 1878)      | 1 ♂                                      |          |
| Plecoptera                                                                       | Leuctridae                                                                    | <i>Leuctra</i> species                                     | 1 ♀                                      |          |
|                                                                                  | Nemouridae                                                                    | <i>Amphinemura</i> species                                 | 1 ♀                                      |          |
|                                                                                  | Perlidae                                                                      | <i>Perlesta</i> species                                    | several ♀                                |          |
| Trichoptera                                                                      | Glossosomatidae                                                               | <i>Glossosoma nigrior</i> Banks, 1911                      | 1 ♀                                      |          |
|                                                                                  |                                                                               | <i>Cheumatopsyche analis</i> (Banks, 1903)                 | 1 ♂                                      |          |
|                                                                                  | Hydropsychidae                                                                | <i>Cheumatopsyche harwoodi</i> Denning, 1948               | 1 ♂                                      |          |
|                                                                                  |                                                                               | <i>Cheumatopsyche oxa</i> Ross, 1938                       | 3 ♂                                      |          |
|                                                                                  |                                                                               | <i>Cheumatopsyche</i> species                              | 19 ♀                                     |          |
|                                                                                  |                                                                               | <i>Diplectrona</i> species                                 | several ♂                                |          |
|                                                                                  |                                                                               | <i>Hydropsyche betteni</i> Ross, 1938                      | 1 ♂                                      |          |
|                                                                                  |                                                                               | <i>Hydropsyche cheilonis</i> Ross, 1938                    | 1 ♂                                      |          |
|                                                                                  |                                                                               | <i>Hydropsyche morosa</i> Hagen, 1861                      | 2 ♂                                      |          |
|                                                                                  |                                                                               | <i>Hydropsyche sparna</i> Ross, 1938                       | 9 ♂                                      |          |
|                                                                                  |                                                                               | <i>Hydropsyche</i> species                                 | 28 ♀                                     |          |
|                                                                                  | Leptoceridae                                                                  | <i>Ceraclea</i> species                                    | 1 ♀                                      |          |
|                                                                                  | Philopotamidae                                                                | <i>Dolophilodes distincta</i> (Walker, 1852)               | 1 ♀                                      |          |
|                                                                                  | Polycentropodidae                                                             | <i>Plectrocnemia cinerea</i> (Hagen, 1861)                 | 2 ♂                                      |          |
|                                                                                  | Rhyacophilidae                                                                | <i>Rhyacophila carolina</i> Banks, 1911                    | 1 ♂                                      |          |
|                                                                                  | VA:Lee Co., CUGA Station Creek near horse barn, 26 Jul 2006, black light trap |                                                            |                                          |          |
|                                                                                  | Ephemeroptera                                                                 | Ephemeridae                                                | <i>Ephemera blanda</i> Traver, 1932      | 1 ♂      |
|                                                                                  |                                                                               |                                                            | <i>Ephemera</i> species                  | 4 ♀      |
|                                                                                  |                                                                               | Heptageniidae                                              | <i>Leucrocuta</i> species                | 7 ♀      |
| <i>Stenacron interpunctatum</i> (Say, 1839)                                      |                                                                               |                                                            | 1 ♂                                      |          |
|                                                                                  |                                                                               | <i>Stenacron</i> species                                   | 5 ♀                                      |          |
| Plecoptera                                                                       | Perlidae                                                                      | <i>Perlesta teaysia</i> Kirchner & Kondratieff, 1997       | 2 ♂                                      |          |
| Trichoptera                                                                      | Calamoceratidae                                                               | <i>Heteroplectron americanum</i> (Walker, 1852)            | 1 ♀                                      |          |
|                                                                                  | Glossosomatidae                                                               | <i>Agapetus kirchneri</i> Parker, Etnier, and Baxter, 2010 | 1 ♂                                      |          |
|                                                                                  |                                                                               | <i>Glossosoma nigrior</i> Banks, 1911                      | 3 larva                                  |          |
|                                                                                  | Hydropsychidae                                                                | <i>Cheumatopsyche</i> species                              | 6 ♀                                      |          |
|                                                                                  |                                                                               | <i>Diplectrona</i> species                                 | 4 ♀                                      |          |
|                                                                                  |                                                                               | <i>Hydropsyche depravata</i> Hagen, 1861                   | 1 ♂                                      |          |
|                                                                                  | Hydroptilidae                                                                 | <i>Hydroptila decia</i> Etnier & Way, 1973                 | 3 ♂                                      |          |

**Cumberland Gap National Historical Park**

## Survey of Aquatic Insects of the Cumberland Piedmont and Appalachian Highlands Monitoring Networks

| Ephemeroptera, Odonata, Plecoptera, Megaloptera, and Trichoptera           |                          |                                                            |           |
|----------------------------------------------------------------------------|--------------------------|------------------------------------------------------------|-----------|
| Order                                                                      | Family                   | Species                                                    | Specimens |
|                                                                            |                          | <i>Hydroptila</i> species                                  | 4 ♀       |
|                                                                            | <b>Leptoceridae</b>      | <i>Ceraclea</i> species                                    | 1 ♀       |
|                                                                            |                          | <i>Oecetis nocturna</i> Ross, 1966                         | 1 ♂       |
|                                                                            | <b>Philopotamidae</b>    | <i>Dolophilodes distincta</i> (Walker, 1852)               | 6 ♂       |
|                                                                            | <b>Polycentropodidae</b> | <i>Nyctiophylax affinis</i> (Banks, 1897)                  | 2 ♂       |
|                                                                            |                          | <i>Nyctiophylax moestus</i> Banks, 1911                    | 4 ♂       |
|                                                                            |                          | <i>Plectrocnemia cinerea</i> (Hagen, 1861)                 | 2 ♂       |
|                                                                            |                          | <i>Polycentropus maculatus</i> Banks, 1908                 | 1 ♂       |
|                                                                            |                          | <i>Polycentropus</i> species                               | 6 ♀       |
|                                                                            | <b>Psychomyiidae</b>     | <i>Lype diversa</i> (Banks, 1914)                          | 2 ♀       |
|                                                                            | <b>Rhyacophilidae</b>    | <i>Rhyacophila carolina</i> Banks, 1911                    | 6 ♂       |
|                                                                            |                          | <i>Rhyacophila fuscula</i> (Walker, 1852)                  | 1 ♂       |
| <b>VA:Lee Co., CUGA Station Creek near horse barn, 5 Apr 2007, by hand</b> |                          |                                                            |           |
| <b>Plecoptera</b>                                                          | <b>Leuctridae</b>        | <i>Leuctra</i> species                                     | 1 ♀       |
| <b>Trichoptera</b>                                                         | <b>Glossosomatidae</b>   | <i>Agapetus kirchneri</i> Parker, Etnier, and Baxter, 2010 | 3 pupae   |
|                                                                            | <b>Hydropsychidae</b>    | <i>Diplectrona</i> species                                 | 2 larvae  |
|                                                                            | <b>Rhyacophilidae</b>    | <i>Rhyacophila parantra</i> Ross, 1948                     | 1 larva   |

# Appendix 3. Non-Target Species Data

The records for non-target taxa from Cumberland Gap National Historical Park (CUGA) are presented in the table below, organized by collection location and event. All non-target specimens collected during this survey are listed, except those that remain unsorted and unidentified. Those reported here represent 2 phyla, 3 classes, 7 orders, 15 families, and 23 species. Some taxa are included in catchall groups that represent specimens that the authors did not identify to species. These are indicated in the table by entries such as “Chironomidae species”. Terrestrial species are highlighted in the table by a tan background.

| Cumberland Gap National Historical Park                                                                               |            |                   |               |                                                   |                                           |
|-----------------------------------------------------------------------------------------------------------------------|------------|-------------------|---------------|---------------------------------------------------|-------------------------------------------|
| Non-Target Species                                                                                                    |            |                   |               |                                                   |                                           |
| Phylum                                                                                                                | Class      | Order             | Family        | Taxon                                             | Specimens                                 |
| KY: Bell Co., CUGA Davis Branch upper beaver pond, 20-21 Jul 2006, black light trap, CRParker & MGeraghty             |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Orthoptera        | Gryllidae     | <i>Allonemobius socius</i> (Scudder)              | 1 ♂                                       |
| KY: Bell Co., CUGA Martins Fork at road, 18-19 Jul 2006, black light trap, CRParker & MGeraghty                       |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Orthoptera        | Gryllidae     | <i>Allonemobius socius</i> (Scudder)              | 1 ♀                                       |
| KY: Bell Co., CUGA Martins Fork near upper bog, 18-19 Jul 2006, black light trap, CRParker & MGeraghty                |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Orthoptera        | Tettigoniidae | <i>Scudderia septentrionalis</i> (Serville, 1839) | 1 ♂                                       |
| KY: Bell Co., CUGA Shillalah Creek at park boundary, 28-29 Sep 2005, black light trap, CRParker & RMartinez           |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Orthoptera        | Tettigoniidae | <i>Neoconocephalus triops</i> (Linnaeus, 1758)    | 1 ♂                                       |
| KY: Bell Co., CUGA Sugar Run at Picnic Area, 19-20 Jul 2006, black light trap, CRParker & MGeraghty                   |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Orthoptera        | Gryllidae     | <i>Allonemobius socius</i> (Scudder)              | 1 ♀                                       |
| KY: Bell Co., CUGA Tunnel Creek above road, 28-29 Sep 2005, black light trap, CRParker & RMartinez                    |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Coleoptera        | Hydrophilidae | <i>Berosus infuscatus</i> LeConte, 1855           | 1 adult                                   |
| KY: Bell Co., CUGA Yellow Creek at KFC, 20 May 2005, by hand, JLRobinson & CRParker                                   |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Diptera           | Chironomidae  | Chironomidae species                              | 26 larvae                                 |
| KY: Bell Co., CUGA Yellow Creek at RM offices, 20-21 Jul 2006, black light trap, MGeraghty & CRParker                 |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Coleoptera        | Carabidae     | <i>Dyschirius haemorrhoidalis</i> (Dejean, 1831)  | 1 adult                                   |
|                                                                                                                       |            |                   | Coleoptera    | Coleoptera species                                | 1 adult                                   |
|                                                                                                                       |            |                   | Dryopidae     | <i>Helichus lithophilus</i> (Germar, 1824)        | 1 adult                                   |
|                                                                                                                       |            |                   | Haliplidae    | <i>Pelodytes lengi</i> Roberts, 1913              | 1 adult                                   |
|                                                                                                                       |            |                   | Hydrophilidae | <i>Berosus aculeatus</i> LeConte, 1855            | 1 ♀                                       |
|                                                                                                                       |            |                   |               | <i>Berosus exiguus</i> (Say, 1825)                | 1 ♀                                       |
|                                                                                                                       |            |                   |               | <i>Berosus sayi</i> Hansen, 1999                  | 1 ♀                                       |
|                                                                                                                       |            |                   |               | <i>Enochrus cinctus</i> (Say, 1824)               | 1 adult                                   |
|                                                                                                                       |            |                   |               | <i>Hydrochara soror</i> Smetana, 1980             | 1 adult                                   |
|                                                                                                                       |            |                   |               | <i>Nicrophorus tomentosus</i> Weber, 1801         | 1 adult                                   |
|                                                                                                                       |            |                   |               | Silphidae                                         | <i>Nicrophorus tomentosus</i> Weber, 1801 |
|                                                                                                                       | Hemiptera  | Hemiptera species | 1 adult       |                                                   |                                           |
| KY: Bell Co., CUGA Yellow Creek at RM offices, 28-29 Sep 2005, black light trap, CRParker & RMartinez                 |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Hemiptera         | Reduviidae    | <i>Gardena poppaea</i> McAtee & Malloch, 1925     | 1 ♂                                       |
|                                                                                                                       |            | Orthoptera        | Gryllidae     | <i>Neoxabea bipunctata</i> (DeGeer, 1773)         | 1 ♀                                       |
| KY: Bell Co., CUGA Yellow Creek downstream Park entrance road, 20 Jul 2006, by hand, CRParker & MGeraghty             |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Diptera           | Chironomidae  | Chironomidae species                              | 4 larvae                                  |
| Mollusca                                                                                                              | Bivalvia   | Veneroida         | Corbiculidae  | <i>Corbicula fluminea</i> (OF Müller, 1774)       | 1 indiv.                                  |
|                                                                                                                       | Gastropoda | Basommatophora    | Physidae      | Physidae species                                  | 1 indiv.                                  |
|                                                                                                                       |            | Neotaenioglossa   | Pleuroceridae | <i>Elimia</i> species                             | 1 indiv.                                  |
| KY: Bell Co., CUGA Yellow Creek downstream Park entrance road, 20-21 Jul 2006, black light trap, CRParker & MGeraghty |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Coleoptera        | Heteroceridae | <i>Tropicus pusillus</i> (Say, 1823)              | 1 adult                                   |
| VA: Lee Co., CUGA Gap Creek at Iron Furnace, 19-20 Jul 2006, black light trap, CRParker & MGeraghty                   |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Orthoptera        | Gryllidae     | <i>Allonemobius socius</i> (Scudder)              | 1 ♀                                       |
| VA: Lee Co., CUGA Station Creek near horse barn, 26 Jul 2006, black light trap, JLRobinson & RMartinez                |            |                   |               |                                                   |                                           |
| Arthropoda                                                                                                            | Insecta    | Coleoptera        | Hydrophilidae | <i>Hydrobius melaenus</i> (Germar, 1824)          | 1 adult                                   |

## Appendix 4. Species Lists

All taxa found to occur in Cumberland Gap National Historical Park (CUGA) during this study are listed below. We found 165 taxa, of which 158 are aquatic. Of the aquatic species, 150 are target species, including 13 Ephemeroptera, 17 Odonata, 16 Plecoptera, 3 are Megaloptera, and 97 Trichoptera.

Common names are provided in the list for those taxa that have common names. The Odonata and Plecoptera have “official” common names that are in wide use and are generally widely accepted. These names are used for those orders. Most insects and other invertebrate groups do not have “official” common names for different species. For those groups, only a few species have assigned common names. For a separate project, we created common names for some mayflies and caddisflies. These names are included here. The names provided for the rest of the taxa are names that apply to genera, families, orders, or in some cases to higher taxonomic categories.

The species are those names that include the genus, the species epithet, and the author, such as “*Dyschirius haemorrhoidalis* (Dejean, 1831)”. Taxa include those entries such as “*Leucrocuta* species”, in a genus not identified to species, that was collected, but that could not be identified to species. No other representatives of the genus *Leucrocuta* were collected that could be identified to species. Since the genus *Leucrocuta* is clearly present in CUGA, this entry is included to recognize the occurrence of the genus in the park.

The majority of taxa listed are aquatic. A small number of taxa are terrestrial. These species are indicated in the lists by a tan background.

### Cumberland Gap National Historical Park

| Phylum <b>Arthropoda</b> |                        | Class <b>Insecta</b>                                  |                              |
|--------------------------|------------------------|-------------------------------------------------------|------------------------------|
| Order                    | Family                 | Taxon                                                 | Common Name                  |
| COLEOPTERA               | <b>Carabidae</b>       | <i>Dyschirius haemorrhoidalis</i> (Dejean, 1831)      | Ground Beetle                |
|                          | <b>Dryopidae</b>       | <i>Helichus lithophilus</i> (Germar, 1824)            | Long-toed Water Beetle       |
|                          | <b>Halipilidae</b>     | <i>Peltodytes lengi</i> Roberts, 1913                 | Crawling Water Beetle        |
|                          | <b>Heteroceridae</b>   | <i>Tropicus pusillus</i> (Say, 1823)                  | Variegated Mud-loving Beetle |
|                          | <b>Hydrophilidae</b>   | <i>Berosus aculeatus</i> LeConte, 1855                | Water Scavenger Beetle       |
|                          |                        | <i>Berosus exiguus</i> (Say, 1825)                    | Water Scavenger Beetle       |
|                          |                        | <i>Berosus infuscatus</i> LeConte, 1855               | Water Scavenger Beetle       |
|                          |                        | <i>Berosus sayi</i> Hansen, 1999                      | Water Scavenger Beetle       |
|                          |                        | <i>Enochrus cinctus</i> (Say, 1824)                   | Water Scavenger Beetle       |
|                          |                        | <i>Hydrobius melaenus</i> (Germar, 1824)              | Water Scavenger Beetle       |
|                          |                        | <i>Hydrochara soror</i> Smetana, 1980                 | Water Scavenger Beetle       |
|                          | <b>Silphidae</b>       | <i>Nicrophorus tomentosus</i> Weber, 1801             | Tomentose Burying Beetle     |
| EPHEMEROPTERA            | <b>Caenidae</b>        | <i>Caenis amica</i> Hagen, 1861                       | Small Squaregill Mayfly      |
|                          | <b>Ephemerellidae</b>  | <i>Eurylophella macdunnoughi</i> Funk, 1994           | Spiny Crawler Mayfly         |
|                          | <b>Ephemeridae</b>     | <i>Ephemera blanda</i> Traver, 1932                   | Common Burrowing Mayfly      |
|                          | <b>Heptageniidae</b>   | <i>Epeorus pleuralis</i> (Banks, 1910)                | Flat-headed Mayfly           |
|                          |                        | <i>Leucrocuta</i> species                             | Flat-headed Mayfly           |
|                          |                        | <i>Maccaffertium</i> species                          | Flat-headed Mayfly           |
|                          |                        | <i>Stenacron carolina</i> (Banks, 1914)               | Flat-headed Mayfly           |
|                          |                        | <i>Stenacron gildersleevei</i> (Traver, 1935)         | Flat-headed Mayfly           |
|                          |                        | <i>Stenacron interpunctatum</i> (Say, 1839)           | Flat-headed Mayfly           |
|                          |                        | <i>Stenonema femoratum</i> (Say, 1823)                | Flat-headed Mayfly           |
|                          | <b>Isonychiidae</b>    | <i>Isonychia arida</i> (Say, 1839)                    | Brushy-legged Minnow Mayfly  |
|                          |                        | <i>Isonychia bicolor</i> (Walker, 1853)               | Brushy-legged Minnow Mayfly  |
|                          | <b>Leptophlebiidae</b> | <i>Leptophlebia cupida</i> (Say, 1823)                | Pronggill Mayfly             |
|                          |                        | <i>Paraleptophlebia adoptiva</i> (J McDunnough, 1929) | Pronggill Mayfly             |

| Phylum <b>Arthropoda</b> |                        | Class <b>Insecta</b>                                       |                              |
|--------------------------|------------------------|------------------------------------------------------------|------------------------------|
| Order                    | Family                 | Taxon                                                      | Common Name                  |
| <b>HEMIPTERA</b>         | <b>Reduviidae</b>      | <i>Paraleptophlebia guttata</i> (J McDunnough, 1924)       | Prongbill Mayfly             |
|                          |                        | <i>Gardena poppaea</i> McAtee & Malloch, 1925              | Thread-legged Assassin Bug   |
| <b>MEGALOPTERA</b>       | <b>Corydalidae</b>     | <i>Chauliodes pectinicornis</i> Linnaeus, 1783             | Fishfly                      |
|                          |                        | <i>Corydalus cornutus</i> (Linnaeus, 1763)                 | Dobsonfly, Hellgrammite      |
| <b>ODONATA</b>           | <b>Aeshnidae</b>       | <i>Nigronia fasciatus</i> (Walker, 1853)                   | Fishfly                      |
|                          |                        | <i>Boyeria vinosa</i> (Say, 1839)                          | Fawn Darner                  |
|                          | <b>Calopterygidae</b>  | <i>Calopteryx maculata</i> (Beauvois, 1805)                | Ebony Jewelwing              |
|                          |                        | <i>Argia fumipennis violacea</i> (Hagen, 1861)             | Violet Dancer                |
|                          | <b>Coenagrionidae</b>  | <i>Enallagma divagans</i> Selys, 1876                      | Turquoise Bluet              |
|                          |                        | <i>Ischnura posita</i> Hagen, 1861                         | Fragile Forktail             |
|                          | <b>Corduliidae</b>     | <i>Ischnura verticalis</i> (Say, 1839)                     | Eastern Forktail             |
|                          |                        | <i>Helocordulia uhleri</i> (Selys, 1871)                   | Uhlers Sundragon             |
|                          | <b>Gomphidae</b>       | <i>Stylogomphus albistylus</i> (Hagen in Selys, 1878)      | Least Clubtail               |
|                          |                        | <i>Celithemis elisa</i> (Hagen, 1861)                      | Calico Pennant               |
|                          | <b>Libellulidae</b>    | <i>Erythemis simplicicollis</i> (Say, 1839)                | Eastern Pondhawk             |
|                          |                        | <i>Libellula cyanea</i> Fabricius, 1775                    | Spangled Skimmer             |
|                          | <b>Libellulidae</b>    | <i>Libellula incesta</i> Hagen, 1861                       | Slaty Skimmer                |
|                          |                        | <i>Libellula vibrans</i> Fabricius, 1793                   | Great Blue Skimmer           |
|                          | <b>Libellulidae</b>    | <i>Pachydiplax longipennis</i> (Burmeister, 1839)          | Blue Dasher                  |
|                          |                        | <i>Plathemis lydia</i> (Drury, 1773)                       | Common Whitetail             |
|                          | <b>Libellulidae</b>    | <i>Sympetrum vicinum</i> (Hagen, 1861)                     | Yellow-legged Meadowhawk     |
|                          |                        | <i>Allonemobius socius</i> (Scudder)                       | Ground Cricket               |
| <b>ORTHOPTERA</b>        | <b>Gryllidae</b>       | <i>Neoxabea bipunctata</i> (DeGeer, 1773)                  | White Tree Cricket           |
|                          |                        | <i>Neoconocephalus triops</i> (Linnaeus, 1758)             | Broad-tipped Conehead        |
|                          | <b>Tettigoniidae</b>   | <i>Scudderella septentrionalis</i> (Serville, 1839)        | Northern Bush Katydid        |
|                          |                        | <i>Allocapnia nivicola</i> (Fitch, 1847)                   | Brook Snowfly                |
| <b>PLECOPTERA</b>        | <b>Capniidae</b>       | <i>Paracapnia angulata</i> Hanson, 1961                    | Angulate Snowfly             |
|                          |                        | <i>Leuctra ferruginea</i> (F Walker, 1851)                 | Eastern Needelfly            |
|                          | <b>Leuctridae</b>      | <i>Leuctra tenuis</i> (Pictet, 1841)                       | Narrow-lobed Needelfly       |
|                          |                        | <i>Paraleuctra sara</i> (Claassen, 1937)                   | Appalachian Needelfly        |
|                          | <b>Nemouridae</b>      | <i>Amphinemura nigrata</i> (Provancher, 1876)              | Little Black Forestfly       |
|                          |                        | <i>Amphinemura wui</i> (Claassen, 1936)                    | Spiked Forestfly             |
|                          | <b>Nemouridae</b>      | <i>Ostrocerca</i> species                                  | Forestfly                    |
|                          |                        | <i>Soyedina vallicularia</i> (Wu, 1923)                    | Valley Forestfly             |
|                          | <b>Peltoperlidae</b>   | <i>Peltoperla arcuata</i> Needham, 1905                    | Eastern Roachfly             |
|                          |                        | <i>Eccoptura xanthenes</i> (Newman, 1828)                  | Yellow Stone                 |
|                          | <b>Perlidae</b>        | <i>Perlesta decipiens</i> (Walsh, 1862)                    | Widespread Stone             |
|                          |                        | <i>Perlesta puttmanni</i> Kondratieff & Kirchner, 2003     | Anna Stone                   |
|                          | <b>Perlidae</b>        | <i>Perlesta teaysia</i> Kirchner & Kondratieff, 1997       | Teays Stone                  |
|                          |                        | <i>Diploperla robusta</i> Stark & Gauvin, 1974             | Robust Springfly             |
|                          | <b>Perlodidae</b>      | <i>Isoperla</i> species                                    | Stripetail                   |
|                          |                        | <i>Remenus bilobatus</i> (Needham & Claassen, 1925)        | Lash Springfly               |
| <b>TRICHOPTERA</b>       | <b>Brachycentridae</b> | <i>Micrasema rusticum</i> (Hagen, 1868)                    | Short-horned Caddisfly       |
|                          |                        | <i>Heteroplectron americanum</i> (Walker, 1852)            | Thick-horned Caddisfly       |
|                          | <b>Glossosomatidae</b> | <i>Agapetus kirchneri</i> Parker, Etnier, and Baxter, 2010 | Saddle-case Making Caddisfly |
|                          |                        | <i>Agapetus tomus</i> Ross, 1941                           | Saddle-case Making Caddisfly |
|                          | <b>Glossosomatidae</b> | <i>Glossosoma nigrilor</i> Banks, 1911                     | Saddle-case Making Caddisfly |
|                          |                        | <i>Protophila</i> species                                  | Saddle-case Making Caddisfly |
|                          | <b>Goeridae</b>        | <i>Goera calcarata</i> Banks, 1899                         | Armored Caddisfly            |
|                          |                        | <i>Helicopsyche borealis</i> (Hagen, 1861)                 | Snail-case Making Caddisfly  |
|                          | <b>Helicopsychidae</b> | <i>Cheumatopsyche analis</i> (Banks, 1903)                 | Retreat-making Caddisfly     |
|                          |                        | <i>Cheumatopsyche aphantia</i> Ross, 1938                  | Retreat-making Caddisfly     |
|                          | <b>Hydropsychidae</b>  | <i>Cheumatopsyche campyla</i> Ross, 1938                   | Retreat-making Caddisfly     |
|                          |                        | <i>Cheumatopsyche ela</i> Denning, 1942                    | Retreat-making Caddisfly     |
|                          | <b>Hydropsychidae</b>  | <i>Cheumatopsyche geora</i> Denning, 1948                  | Retreat-making Caddisfly     |
|                          |                        | <i>Cheumatopsyche gyra</i> Ross, 1938                      | Retreat-making Caddisfly     |
|                          | <b>Hydropsychidae</b>  | <i>Cheumatopsyche harwoodi</i> Denning, 1948               | Retreat-making Caddisfly     |
|                          |                        | <i>Cheumatopsyche oxa</i> Ross, 1938                       | Retreat-making Caddisfly     |
|                          | <b>Hydropsychidae</b>  | <i>Cheumatopsyche pasella</i> Ross, 1941                   | Retreat-making Caddisfly     |
|                          |                        | <i>Diplectrona modesta</i> Banks, 1908                     | Retreat-making Caddisfly     |
|                          | <b>Hydropsychidae</b>  | <i>Homoplectra doringa</i> (Milne, 1936)                   | Retreat-making Caddisfly     |
|                          |                        | <i>Hydropsyche alhedra</i> Ross, 1939                      | Retreat-making Caddisfly     |
|                          | <b>Hydropsychidae</b>  | <i>Hydropsyche betteni</i> Ross, 1938                      | Retreat-making Caddisfly     |
|                          |                        | <i>Hydropsyche</i> species                                 | Retreat-making Caddisfly     |

| Phylum <b>Arthropoda</b> |                          | Class <b>Insecta</b>                                |                          |
|--------------------------|--------------------------|-----------------------------------------------------|--------------------------|
| Order                    | Family                   | Taxon                                               | Common Name              |
|                          |                          | <i>Hydropsyche bronta</i> Ross, 1938                | Retreat-making Caddisfly |
|                          |                          | <i>Hydropsyche cheilonis</i> Ross, 1938             | Retreat-making Caddisfly |
|                          |                          | <i>Hydropsyche depravata</i> Hagen, 1861            | Retreat-making Caddisfly |
|                          |                          | <i>Hydropsyche dicantha</i> Ross, 1938              | Retreat-making Caddisfly |
|                          |                          | <i>Hydropsyche etnieri</i> Schuster & Talak, 1977   | Retreat-making Caddisfly |
|                          |                          | <i>Hydropsyche morosa</i> Hagen, 1861               | Retreat-making Caddisfly |
|                          |                          | <i>Hydropsyche scalaris</i> Hagen, 1861             | Retreat-making Caddisfly |
|                          |                          | <i>Hydropsyche slossonae</i> Banks, 1905            | Retreat-making Caddisfly |
|                          |                          | <i>Hydropsyche sparna</i> Ross, 1938                | Retreat-making Caddisfly |
|                          |                          | <i>Hydropsyche ventura</i> Ross, 1941               | Retreat-making Caddisfly |
|                          | <b>Hydroptilidae</b>     | <i>Hydroptila amoena</i> Ross, 1938                 | Micro-caddisfly          |
|                          |                          | <i>Hydroptila armata</i> Ross, 1938                 | Micro-caddisfly          |
|                          |                          | <i>Hydroptila consimilis</i> Morton, 1905           | Micro-caddisfly          |
|                          |                          | <i>Hydroptila decia</i> Etnier & Way, 1973          | Micro-caddisfly          |
|                          |                          | <i>Hydroptila grandiosa</i> Ross, 1938              | Micro-caddisfly          |
|                          |                          | <i>Hydroptila gunda</i> Milne, 1936                 | Micro-caddisfly          |
|                          |                          | <i>Hydroptila hamata</i> Morton, 1905               | Micro-caddisfly          |
|                          |                          | <i>Hydroptila paramoena</i> Harris, 1985            | Micro-caddisfly          |
|                          |                          | <i>Hydroptila perdita</i> Morton, 1905              | Micro-caddisfly          |
|                          |                          | <i>Hydroptila remita</i> Blickle & Morse, 1954      | Micro-caddisfly          |
|                          |                          | <i>Hydroptila scolops</i> Ross, 1938                | Micro-caddisfly          |
|                          |                          | <i>Hydroptila waubesiana</i> Betten, 1934           | Micro-caddisfly          |
|                          |                          | <i>Neotrichia collata</i> Morton, 1905              | Micro-caddisfly          |
|                          |                          | <i>Ochrotrichia tarsalis</i> (Hagen, 1861)          | Micro-caddisfly          |
|                          |                          | <i>Orthotrichia aegerfasciella</i> (Chambers, 1873) | Micro-caddisfly          |
|                          |                          | <i>Oxyethira forcipata</i> Mosely, 1934             | Micro-caddisfly          |
|                          |                          | <i>Oxyethira pallida</i> (Banks, 1904)              | Micro-caddisfly          |
|                          |                          | <i>Stactobiella palmata</i> (Ross, 1938)            | Micro-caddisfly          |
|                          | <b>Lepidostomatidae</b>  | <i>Lepidostoma etnieri</i> Weaver, 1988             | Scale-mouthed Caddisfly  |
|                          | <b>Leptoceridae</b>      | <i>Ceraclea tarsipunctata</i> (Vorhies, 1909)       | Long-horned Caddisfly    |
|                          |                          | <i>Mystacides sepulchralis</i> (Walker, 1852)       | Long-horned Caddisfly    |
|                          |                          | <i>Oecetis cinerascens</i> (Hagen, 1861)            | Long-horned Caddisfly    |
|                          |                          | <i>Oecetis ditissa</i> Ross, 1966                   | Long-horned Caddisfly    |
|                          |                          | <i>Oecetis inconspicua</i> (Walker, 1852)           | Long-horned Caddisfly    |
|                          |                          | <i>Oecetis nocturna</i> Ross, 1966                  | Long-horned Caddisfly    |
|                          |                          | <i>Oecetis persimilis</i> (Banks, 1907)             | Long-horned Caddisfly    |
|                          |                          | <i>Trienodes ignitus</i> (Walker, 1852)             | Long-horned Caddisfly    |
|                          |                          | <i>Trienodes marginatus</i> Sibley, 1926            | Long-horned Caddisfly    |
|                          | <b>Limnephilidae</b>     | <i>Ironoquia lyrata</i> (Ross, 1938)                | Northern Caddisfly       |
|                          |                          | <i>Ironoquia punctatissima</i> (Walker, 1852)       | Northern Caddisfly       |
|                          |                          | <i>Limnephilus indivisus</i> Walker, 1852           | Northern Caddisfly       |
|                          |                          | <i>Pseudostenophylax uniformis</i> (Betten, 1934)   | Northern Caddisfly       |
|                          |                          | <i>Pycnopsyche antica</i> (Walker, 1852)            | Stickbait Caddisfly      |
|                          |                          | <i>Pycnopsyche flavata</i> (Banks, 1914)            | Stickbait Caddisfly      |
|                          |                          | <i>Pycnopsyche gentilis</i> (McLachlan, 1871)       | Stickbait Caddisfly      |
|                          |                          | <i>Pycnopsyche luculenta</i> (Betten, 1934)         | Stickbait Caddisfly      |
|                          | <b>Molannidae</b>        | <i>Molanna blenda</i> Sibley, 1926                  | Molannid Caddisfly       |
|                          | <b>Philopotamidae</b>    | <i>Chimarra aterrima</i> Hagen, 1861                | Finger-net Caddisfly     |
|                          |                          | <i>Dolophilodes distincta</i> (Walker, 1852)        | Winter Caddisfly         |
|                          |                          | <i>Wormaldia moesta</i> (Banks, 1914)               | Finger-net Caddisfly     |
|                          | <b>Phryganeidae</b>      | <i>Agrypnia vestita</i> (Walker, 1852)              | Phryganeid Caddisfly     |
|                          |                          | <i>Banksiola dossuaria</i> (Say, 1828)              | Phryganeid Caddisfly     |
|                          | <b>Polycentropodidae</b> | <i>Cymellus fraternus</i> (Banks, 1905)             | Fine-net Caddisfly       |
|                          |                          | <i>Nyctiophylax affinis</i> (Banks, 1897)           | Fine-net Caddisfly       |
|                          |                          | <i>Nyctiophylax moestus</i> Banks, 1911             | Fine-net Caddisfly       |
|                          |                          | <i>Plectrocnemia cinerea</i> (Hagen, 1861)          | Fine-net Caddisfly       |
|                          |                          | <i>Plectrocnemia nascotia</i> (Ross, 1941)          | Fine-net Caddisfly       |
|                          |                          | <i>Polycentropus carolinensis</i> Banks, 1905       | Fine-net Caddisfly       |
|                          |                          | <i>Polycentropus confusus</i> Hagen, 1861           | Fine-net Caddisfly       |
|                          |                          | <i>Polycentropus elarus</i> Ross, 1944              | Fine-net Caddisfly       |
|                          |                          | <i>Polycentropus maculatus</i> Banks, 1908          | Fine-net Caddisfly       |
|                          | <b>Psychomyiidae</b>     | <i>Lype diversa</i> (Banks, 1914)                   | Fine-net Caddisfly       |
|                          |                          | <i>Psychomyia flavida</i> Hagen, 1861               | Fine-net Caddisfly       |
|                          | <b>Ptilocolepidae</b>    | <i>Palaeagapetus celsus</i> (Ross, 1938)            | Micro-caddisfly          |

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| Phylum <b>Arthropoda</b> |                       | Class <b>Insecta</b>                                |                       |
|--------------------------|-----------------------|-----------------------------------------------------|-----------------------|
| Order                    | Family                | Taxon                                               | Common Name           |
|                          | <b>Rhyacophilidae</b> | <i>Rhyacophila carolina</i> Banks, 1911             | Free-living Caddisfly |
|                          |                       | <i>Rhyacophila carpenteri</i> Milne, 1936           | Free-living Caddisfly |
|                          |                       | <i>Rhyacophila fuscata</i> (Walker, 1852)           | Free-living Caddisfly |
|                          |                       | <i>Rhyacophila glaberrima</i> Ulmer, 1907           | Free-living Caddisfly |
|                          |                       | <i>Rhyacophila ledra</i> Ross, 1939                 | Free-living Caddisfly |
|                          |                       | <i>Rhyacophila parantra</i> Ross, 1948              | Free-living Caddisfly |
|                          |                       | <i>Rhyacophila torva</i> Hagen, 1861                | Free-living Caddisfly |
|                          | <b>Thremmatidae</b>   | <i>Neophylax aniqua</i> Ross, 1947                  | Dog-faced Caddisfly   |
|                          |                       | <i>Neophylax concinnus</i> MacLachlan, 1871         | Dog-faced Caddisfly   |
|                          |                       | <i>Neophylax consimilis</i> Betten, 1934            | Dog-faced Caddisfly   |
|                          |                       | <i>Neophylax etnieri</i> Vineyard and Wiggins, 1987 | Dog-faced Caddisfly   |
|                          |                       | <i>Neophylax wigginsi</i> Sykora & Weaver, 1978     | Dog-faced Caddisfly   |
| Phylum <b>Mollusca</b>   |                       | Class <b>Bivalvia</b>                               |                       |
| Order                    | Family                | Taxon                                               | Common Name           |
| <b>VENEROIDA</b>         | <b>Corbiculidae</b>   | <i>Corbicula fluminea</i> (OF Müller, 1774)         | Asiatic Clam          |
| Phylum <b>Mollusca</b>   |                       | Class <b>Gastropoda</b>                             |                       |
| Order                    | Family                | Taxon                                               | Common Name           |
| <b>NEOTAENIOGLOSSA</b>   | <b>Pleuroceridae</b>  | <i>Elimia</i> species                               | Snail                 |

## Appendix 5. Species of Interest

Many of the species found during this survey are of particular interest because of their rarity, conservation ranking, sensitivity to contamination and disturbance, or unique habitat requirements. These taxa may warrant special attention in management considerations affecting aquatic habitats, and thus are presented in the tables below with additional information about their biology, distribution, and sensitivity, that might be helpful to managers.

The 77 species included in the tables were selected on the basis of the following criteria: (1) they are known from only one, two, or three parks, and thus are considered rare for this study; (2) they have a NatureServe global rank of G1, G2, or G3, or a state conservation rank of S1, S2, or S3 for any one of the seven states in the Appalachian Highlands and Cumberland Piedmont Monitoring Networks area; (3) they have a tolerance value of 3.0 or less; or (4) they have special habitat requirements that may result in their being potentially at risk in the parks.

(1) Number of parks - One of the purposes of the larger study is to assess the role of the parks as conservation reserves for aquatic species in the region, and species that are found in three or fewer of the parks (less than 17 percent) are potentially more at risk than species that occur in a larger number of parks. Therefore, highlighting those species and the parks in which they occur may serve to alert managers to the possible need for greater scrutiny of the environmental concerns connected with those species and their habitats. The parks and their official National Park Service (NPS) acronyms are listed here. Of course, the occurrence of species in the parks is partially a function of the number of samples that have been collected in each park (for example, the number of collecting trips, monitoring programs, historic interest by scientists, and so on). Thus, because many more samples have been collected in GRSM, including a long history of visits by aquatic entomologists dating back decades, many species are recorded from there that are not known in any other park. Some of these species have widespread distributions in the study area and almost certainly occur in other parks. Only further sampling will overcome this problem. We know some records of species in the parks from the literature, and where such records are known for a park, a superscript (L) is appended to the park's acronym. Thus, CUGA<sup>(L)</sup> indicates that a record for CUGA is based, at least in part or perhaps entirely, on a literature reference.

(2) Conservation rankings - Conservation rankings are coded systems in which species' vulnerability to extinction are assessed and rated on large geographic scales, such as global, which covers the entire range of a species, or national, which assess the species'

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### Appalachian Highlands Monitoring Network

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|        |                                                   |
|--------|---------------------------------------------------|
| • BISO | Big South Fork National River and Recreation Area |
| • BLRI | Blue Ridge Parkway                                |
| • GRSM | Great Smoky Mountains National Park               |
| • OBRI | Obed Wild and Scenic River                        |

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### Cumberland Piedmont Monitoring Network

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|        |                                                    |
|--------|----------------------------------------------------|
| • ABLI | Abraham Lincoln Birthplace National Historic Site  |
| • CARL | Carl Sandburg Home National Historic Site          |
| • CHCH | Chickamauga and Chattanooga National Military Park |
| • COWP | Cowpens National Battlefield                       |
| • CUGA | Cumberland Gap National Historic Park              |
| • FODO | Fort Donelson National Battlefield                 |
| • GUCO | Guilford Courthouse National Military Park         |
| • KIMO | Kings Mountain National Military Park              |
| • LIRI | Little River Canyon National Preserve              |
| • MACA | Mammoth Cave National Park                         |
| • NISI | Ninety Six National Historic Site                  |
| • RUCA | Russell Cave National Monument                     |
| • SHIL | Shiloh National Military Park                      |
| • STRI | Stones River National Battlefield                  |

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vulnerability to extinction within a country. NatureServe (<http://www.natureserve.org/index.jsp>) maintains a list of species that have been evaluated in a standardized and objective manner, and assigned a rank that reflects each species' vulnerability. In this system, species are assigned ranks according to the criteria given in Table 6–1. Many state conservation agencies have adopted a very similar system of ranking the conservation status of state species. In the tables below, state ranks are presented as, for example, ALS2 or TNS1 for Alabama state ranking of S2 and Tennessee state ranking of S1, respectively. The evaluation by NatureServe or any of the states in the study area that a species' rank is 1, 2, or 3 is justification for that species to be listed in the tables below.

**Table 6–1. The three most critical ranks in the NatureServe global system used in this study. Other ranks are included in the NatureServe system, but those are not used here.**

| Rank      | Definition                                                                                                                                                                                                                                                                                                                  |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>G1</b> | <b>Critically imperiled</b> — Critically imperiled globally because of extreme rarity or because of some factor(s) making it extremely vulnerable to extinction. Typically five or fewer occurrences or very few remaining individuals (<1,000) or acres (<2,000) or linear miles (<10).                                    |
| <b>G2</b> | <b>Imperiled</b> — Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction or elimination. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000) or acres (2,000 to 10,000) or linear miles (10 to 50).                                             |
| <b>G3</b> | <b>Vulnerable</b> — Vulnerable globally because very rare and local throughout its range, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals. |

(3) Tolerance values - Tolerance values are numbers assigned to taxa on the basis of empirical assessments of how sensitive different taxa are to various forms of pollution or habitat disturbance (Barbour and others, 1999; Blocksom and Winters, 2006; Klemm and others, 2003; Lenat, 1988). Most systems use values in the range of 0–10, in which 0 represents those taxa that are highly sensitive to pollution and tend to be the first taxa to be eliminated from a polluted system, and 10 represents those taxa which are most tolerant of pollution and become the most common taxa in heavily polluted systems. Tolerance values are considered valuable when biologists sample communities, and assess the species found in each community as a function of the tolerance values and the relative abundances of the species encountered. This normally leads to an index of biotic integrity which is taken as a direct measure of how healthy, or stressed, a community is at the time it was sampled. Various rating systems are in use in the study region, so we have adopted the system used by the North Carolina Department of Environment and Natural Resources (Biological Assessment Unit, 2006) wherever possible. Some taxa are not represented in the North Carolina (NC) system. For those species, we examined the tolerance values listed by the Tennessee Division of Water Pollution Control (Arnwine, 2006) or the Kentucky Division of Water (Kentucky Division of Water, 2009), and if a taxon was listed in one of those two sources, we used that tolerance value. If a taxon was not found in those sources, we searched the U.S. Environmental Protection Agency (EPA) biomonitoring protocol manual (Barbour and others, 1999), which lists tolerance values for several regions, including NC. If that list included a value for a taxon not found in the NC, Tennessee (TN), or Kentucky (KY) systems we accepted the tolerance value in the following preference sequence: Mid-

Atlantic (MACS), Midwest (OH), Upper Midwest (WI). In the case of *Leptocerus americanus* we used the tolerance value cited by the state of Pennsylvania (Department of Environmental Protection, 2007), which is indicated in the table by “PA” following the value. Taxa not having any tolerance value from one of these sources are indicated in the tables with an entry of n/a.

(4) Special habitat requirements - Unique habitat requirements include isolated springs and bogs, madicolous and hydropetric habitats, and semi-terrestrial habitats. Some of these habitats are on the peripheries of more readily recognized aquatic habitats, and thus may not be seen as unique or vulnerable habitats. For example, small rock face seeps, often found along roadways, are unique habitats for a number of species specialized on the madicolous habitat in which the larvae (rarely the adult) live in a thin film of water flowing over the nearly vertical face of the rocks. Such habitats, particularly if found along a roadway, are subject to loss of shading because of the open nature of roadways, roadside mowing operations, and paving of the drainage ditches they flow into. Other organisms live not in streams or seeps, but rather along the periphery of such habitats in the leaf litter and under or among the rocks and soils around the edges. These species are vulnerable to trampling by visitors and park employees, exotic animals such as European wild boars that root in these places, and other activities that may open up the habitats and lead to excessive drying of the edges. Species that have special habitat requirements therefore are also included in the tables, with entries in the Comments row below the species' entry row.

Additional information is provided in the tables, as well. This includes the elevation range at which each species was found during our surveys. We did not have elevations for a small number of localities, and therefore a small number of species do not have elevations reported in the tables. The list of United States and Mexican states and Canadian provinces in which each species has been recorded is presented, as far as is known. Adult flight periods are reported for adult specimens collected during this study, followed in parentheses by flight periods reported in the literature. Specimens collected during this study only as immatures do not have a flight period, although, wherever possible a flight period is reported on the basis of literature records. Some species in the tables are based on literature records that did not include any additional information, and for those species some of the entries are listed as n/a.

Following each species record is a Comments record, which contains biological and ecological information about the species based on the authors' knowledge and reports in the literature. Information in this row may include details on food, growth, habitat, behavior, mating, egg laying, parasites, rarity, endemism, and points of interest.

For each genus, the first listing in square brackets [] is the summary Habitat, Habit, and Trophic Relationships from the summary tables at the end of each taxon chapter in Merritt and others (2008). These summaries are valuable, concise statements of the basic known ecological characteristics of each genus. The meanings of the entries are explained in the tables below, which are from Tables 6A, 6B, and 6C of Cummins and others (2008).

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**Table 6–2. Aquatic habitat classification system. From Table 6A of Cummins and others, (2008).**

| General Category                                                | Specific Category    | Description                                                                                                                                                                                                     |
|-----------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Lotic erosional<br/>(running-water riffles)</b>              | Sediments            | Coarse sediments (cobbles, pebbles, gravel) typical of stream riffles.                                                                                                                                          |
|                                                                 | Vascular hydrophytes | Vascular plants growing on (e.g., moss <i>Fontinalis</i> ) or among (e.g., pondweed <i>Potamogeton pectinatus</i> ) coarse sediments in riffles.                                                                |
|                                                                 | Detritus             | Leaf packs (accumulations of leaf litter and other coarse particulate detritus at leading edge or behind obstructions such as logs or large cobbles and boulders) and debris (e.g., logs, branches) in riffles. |
| <b>Lotic depositional</b>                                       | Sediments            | Fine sediments (sand and silt) typical of stream pools and margins.                                                                                                                                             |
|                                                                 | Vascular hydrophytes | Vascular plants growing in fine sediments (e.g., <i>Elodea</i> , broad-leaved species of <i>Potamogeton</i> , <i>Ranunculus</i> ).                                                                              |
|                                                                 | Detritus             | Leaf litter and other particulate detritus in pools and alcoves (backwaters).                                                                                                                                   |
| <b>Lentic limnetic<br/>(standing water)</b>                     | Open water           | On the surface or in the water column of lakes, bogs, ponds.                                                                                                                                                    |
| <b>Lentic littoral<br/>(standing water, shallow shore area)</b> | Erosional            | Wave-swept shore area of coarse (cobbles, pebbles, gravel) sediments.                                                                                                                                           |
|                                                                 | Vascular hydrophytes | Rooted or floating (e.g., duckweed <i>Lemna</i> ) aquatic vascular plants (usually with associated macroscopic filamentous algae).                                                                              |
|                                                                 | Emergent zone        | Plants on the immediate shore area, e.g., <i>Typha</i> (cattail), with most of the leaves above water.                                                                                                          |
|                                                                 | Floating zone        | Rooted plants with large floating leaves, e.g., <i>Nymphaea</i> (pond lily), and non-rooted plants (e.g., <i>Lemna</i> ).                                                                                       |
|                                                                 | Submerged zone       | Rooted plants with most leaves beneath the surface.                                                                                                                                                             |
|                                                                 | Sediments            | Fine sediments (sand and silt) of the vascular plant beds.                                                                                                                                                      |
| <b>Lentic profundal<br/>(standing water, basin)</b>             | Sediments            | Fine sediments (fine sand, silt and clay) mixed with organic matter of the deeper basins of lakes.                                                                                                              |
| <b>Beach zone</b>                                               | Freshwater lakes     | Moist sand beach areas of large lakes.                                                                                                                                                                          |

**Table 6–3. Categorization of aquatic insect habits (mode of existence). From Table 6B of Cummins and others, (2008).**

| Category         | Description                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Skaters</b>   | Adapted for “skating” on the surface where they feed as scavengers on organisms trapped in the surface film (example: Hemiptera: Gerridae - water striders).                                                                                                                                                                                                                                   |
| <b>Swimmers</b>  | Adapted for “fishlike” swimming in lotic or lentic habitats. Individuals usually cling to submerged objects, such as rocks (lotic riffles) or vascular plants (lentic), between short bursts of swimming (examples: Ephemeroptera: Siphonuridae, Leptophlebiidae).                                                                                                                             |
| <b>Clingers</b>  | Representatives have behavioral (e.g., fixed retreat construction) and morphological (e.g., long, curved tarsal claws, dorsoventral flattening, and ventral gills arranged as a sucker) adaptations for attachment to surfaces in stream riffles and wave-swept rocky littoral zones of lakes (examples: Ephemeroptera: Heptageniidae; Trichoptera: Hydropsychidae; Diptera: Blephariceridae). |
| <b>Sprawlers</b> | Inhabiting the surface of floating leaves of vascular hydrophytes or fine sediments, usually with modification for staying on top of the substrate and maintaining the respiratory surfaces free of silt (examples: Ephemeroptera: Caenidae; Odonata: Libellulidae).                                                                                                                           |

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|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Climbers</b>  | Adapted for living on vascular hydrophytes or detrital debris (e.g., overhanging branches, roots and vegetation along streams, and submerged brush in lakes) with modifications for moving vertically on stem-type surfaces (examples: Odonata: Aeshnidae).                                                                                                                                                                    |
| <b>Burrowers</b> | Inhabiting the fine sediments of streams (pools) and lakes. Some construct discrete burrows which may have sand grain tubes extending above the surface of the substrate or individuals may ingest their way through the sediments (examples: Ephemeroptera: Ephemeridae - burrowing mayflies; Diptera: most Chironominae, Chironomini- "blood worm" midges). Some burrow (tunnel) into plant stem, leaves, or roots (miners). |

**Table 6-4. General classification system for aquatic insect trophic relations. (Applicable only to immature and adult stages that occur in the water.) From Table 6C of Cummins and others, (2008).**

| Functional Group<br>(General category based on feeding mechanism) | SUBDIVISION OF FUNCTIONAL GROUP                                                                  |                                                                                                  | General Particle Size Range of Food (microns) |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------|
|                                                                   | Dominant Food                                                                                    | Feeding Mechanism                                                                                |                                               |
| <b>Shredders</b>                                                  | Living vascular hydrophyte tissue                                                                | Herbivores - chewers and miners of live macrophytes                                              |                                               |
|                                                                   | Decomposing vascular plant tissue - coarse particulate organic matter (CPOM)                     | Detritivores - chewers of CPOM                                                                   | $>10^3$                                       |
|                                                                   | Wood                                                                                             | Gougers - excavate and gallery, wood                                                             |                                               |
| <b>Collectors</b>                                                 | Decomposing fine particulate organic matter (FPOM)                                               | Detritivores - filterers or suspension feeders                                                   |                                               |
|                                                                   |                                                                                                  | Detritivores - gatherers or deposit (sediment) feeders (includes feeders on loose surface films) | $<10^3$                                       |
| <b>Scrapers</b>                                                   | Periphyton - attached algae and associated material                                              | Herbivores - grazing scrapers of mineral and organic surfaces                                    | $<10^3$                                       |
| <b>Macrophyte Piercers</b>                                        | Living vascular hydrophyte cell and tissue fluids or filamentous (macroscopic) algal cell fluids | Herbivores - pierce tissues or cells and suck fluids                                             | $>10^{-2}$ - $>10^3$                          |
| <b>Predators</b>                                                  | Living animal tissue                                                                             | Engulfers - carnivores, attach prey and ingest whole animals or parts                            | $>10^3$                                       |
|                                                                   |                                                                                                  | Piercers - carnivores, attack prey, pierce tissues and cells, and suck fluids                    |                                               |

Two letter abbreviations are used in the columns labeled States. These are based on the standard US Postal Service and Canadian Postal Service abbreviations. Mexican states and Central American country abbreviations follow those used in various publications. The complete list of abbreviations is given in the table below.

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**Table 6–5. Postal codes used in the Species of Interest tables.**

| States of United States of America                                |                                                                                                                          |      |                                               |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------|
| Code                                                              | State                                                                                                                    | Code | State                                         |
| AL                                                                | Alabama                                                                                                                  | MT   | Montana                                       |
| AK                                                                | Alaska                                                                                                                   | NE   | Nebraska                                      |
| AZ                                                                | Arizona                                                                                                                  | NV   | Nevada                                        |
| AR                                                                | Arkansas                                                                                                                 | NH   | New Hampshire                                 |
| CA                                                                | California                                                                                                               | NJ   | New Jersey                                    |
| CO                                                                | Colorado                                                                                                                 | NM   | New Mexico                                    |
| CT                                                                | Connecticut                                                                                                              | NY   | New York                                      |
| DE                                                                | Delaware                                                                                                                 | NC   | North Carolina                                |
| DC                                                                | District of Columbia                                                                                                     | ND   | North Dakota                                  |
| FL                                                                | Florida                                                                                                                  | OH   | Ohio                                          |
| GA                                                                | Georgia                                                                                                                  | OK   | Oklahoma                                      |
| HI                                                                | Hawaii                                                                                                                   | OR   | Oregon                                        |
| ID                                                                | Idaho                                                                                                                    | PA   | Pennsylvania                                  |
| IL                                                                | Illinois                                                                                                                 | RI   | Rhode Island                                  |
| IN                                                                | Indiana                                                                                                                  | SC   | South Carolina                                |
| IA                                                                | Iowa                                                                                                                     | SD   | South Dakota                                  |
| KS                                                                | Kansas                                                                                                                   | TN   | Tennessee                                     |
| KY                                                                | Kentucky                                                                                                                 | TX   | Texas                                         |
| LA                                                                | Louisiana                                                                                                                | UT   | Utah                                          |
| ME                                                                | Maine                                                                                                                    | VT   | Vermont                                       |
| MD                                                                | Maryland                                                                                                                 | VA   | Virginia                                      |
| MA                                                                | Massachusetts                                                                                                            | WA   | Washington                                    |
| MI                                                                | Michigan                                                                                                                 | WV   | West Virginia                                 |
| MN                                                                | Minnesota                                                                                                                | WI   | Wisconsin                                     |
| MS                                                                | Mississippi                                                                                                              | WY   | Wyoming                                       |
| MO                                                                | Missouri                                                                                                                 |      |                                               |
| States of Mexico - only those actually used below are listed here |                                                                                                                          |      |                                               |
| Code                                                              | State                                                                                                                    | Code | State                                         |
| AG                                                                | Aguascalientes                                                                                                           | MX   | Unspecified location in the country of Mexico |
| BN                                                                | Baja California Norte (Official code is BC. This conflicts with British Columbia, Canada, and is here replaced with BN.) | OA   | Oaxaca                                        |
| BS                                                                | Baja California Sur                                                                                                      | PU   | Puebla                                        |
| CH                                                                | Chihuahua                                                                                                                | QT   | Queretaro                                     |

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|                                   |                                                                                                                                 |             |                      |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------|
| CL                                | Colima                                                                                                                          | SI          | Sinaloa              |
| CS                                | Chiapas                                                                                                                         | SL          | San Luis Potosi      |
| DF                                | Distrito Federal                                                                                                                | SO          | Sonora               |
| DG                                | Durango                                                                                                                         | TM          | Tamaulipas           |
| JA                                | Jalisco                                                                                                                         | VE          | Veracruz             |
| ML                                | Morelos (The official code is MO, which conflicts with Missouri. We have replaced it here with ML.)                             |             |                      |
| <b>Provinces of Canada</b>        |                                                                                                                                 |             |                      |
| <b>Code</b>                       | <b>Province</b>                                                                                                                 | <b>Code</b> | <b>Province</b>      |
| AB                                | Alberta                                                                                                                         | NS          | Nova Scotia          |
| BC                                | British Columbia                                                                                                                | NU          | Nunavut              |
| LB                                | Labrador (Politically, Labrador is part of Newfoundland. However, for biogeographic reasons, we list it separately here as LB.) | ON          | Ontario              |
| MB                                | Manitoba                                                                                                                        | PE          | Prince Edward Island |
| NB                                | New Brunswick                                                                                                                   | QC          | Quebec               |
| NL                                | Newfoundland (This refers to the island portion of Newfoundland.)                                                               | SK          | Saskatchewan         |
| NT                                | Northwest Territories                                                                                                           | YT          | Yukon                |
| <b>Central American Countries</b> |                                                                                                                                 |             |                      |
| BE                                | Belize                                                                                                                          | HO          | Honduras             |
| CR                                | Costa Rica                                                                                                                      | MR          | Montserrat           |
| GU                                | Guatemala                                                                                                                       | NI          | Nicaragua            |

### On-Line Resources

Much useful information incorporated into the tables below came from web sites maintained by various authorities. These include:

- Barber-James, H., M. Sartori, J.-L. Gattolliat, and J. Webb. 2013. World checklist of freshwater Ephemeroptera species. <http://FADA.biodiversity.be/group/show/35> Accessed on 17 Dec 2010.
- DeWalt, R. E., U. Neu-Becker and G. Stueber. 2010. Plecoptera Species File Online. Version 1.1/4.0. <http://Plecoptera.SpeciesFile.org> Accessed on 17 Dec 2010.
- Freshwater Animal Diversity Assessment (FADA) Project. 2010. <http://FADA.biodiversity.be> Accessed on 17 Dec 2010.
- McCafferty, P. W. (Editor). 2010. Mayfly Central. <http://www.entm.purdue.edu/mayfly/index.php> Accessed on 17 Dec 2010.
- Morse, John C. (Editor). 2010. Trichoptera World Checklist. <http://entweb.clemson.edu/database/trichopt/> Accessed on 17 Dec 2010.
- National Museum of Natural History, The Netherlands, <http://www.odonata.info/odonata/odonata/tree.html> Accessed on 17 Dec 2010.
- Oswald, J. D. (chief editor). Lacewing Digital Library. <http://lacewing.tamu.edu/> Accessed on 17 Dec 2010.

## ORDER EPHEMEROPTERA HYATT & ARMS

### MAYFLIES

Mayflies are cosmopolitan, being found on every continent except Antarctica. Slightly more than 3,300 species are known, distributed in 42 families, and more than 430 genera (Barber-James and others, 2008). The highest numbers of species are found in the Palearctic region (790), followed by the Nearctic (650), and the Neotropical (607). It is likely that the tropical component of the order is underrepresented in this compilation as a result of the historical bias in systematic surveys that have emphasized the Northern Hemisphere (Balian and others, 2008). In the Western Hemisphere, mayflies are found from near the Arctic Circle south through Mexico, and on into Central and South America. With approximately 650 species in 20 or more families and more than 100 genera in North America (Canada, the United States, and the non-tropical portions of Mexico), the Nearctic has one of the richest faunas described to this point. During this survey, we found 163 species in 50 genera and 14 families. In BLRI, we found 70 species in 32 genera and 11 families.

Mayfly adults are delicate, small to medium size, two or four winged insects with two or three long caudal filaments (tails), and, usually, with long legs. Adults often are seen flying about streams, rivers, ponds, and lakes. Mayflies are unable to fold their wings, which, therefore, are held vertically over the insect's back when at rest. Many species have sexually dimorphic eyes, with the males having the upper facets enlarged, sometimes extremely so, and differently colored than the lower facets. Females never have the eyes modified in this manner. The larvae are aquatic and live in the habitats near where the adults are seen flying. Like the adults, the larvae have two or three caudal filaments, although the larva may have three while the adult of the same species has only two. The larval stage may last 3-4 weeks, or as long as 2½ years, but typically lasts one year. Mayflies grow through a process called hemimetabolous development, which means that they do not pass through a pupal stage before becoming an adult. This type of development is found in many groups of insects including the Odonata and Plecoptera, which are also aquatic insects and are considered below. Larvae pass through many instars (10-50) before finally emerging as a subimago (sub adult), a flying stage that exists between the larval and the full adult stages. Ephemeroptera are unique in that they are the only insects that have a flying stage before becoming sexually mature. The subimago stage may last from a few minutes to several days before molting to the reproductive imago (adult) stage. Subimagos are recognized by the opaque or cloudy condition of the wings, whereas the imago stage has transparent or hyaline wings. In a few species, the females mate and lay eggs as subimagos, and never molt to the true adult stage (Waltz and Burian, 2008). Approximately 50 species of mayflies are known to be parthenogenetic, although only about half a dozen are obligately so. In facultatively parthenogenetic species, fertilized eggs mature more quickly and more successfully than unfertilized eggs (Brittain, 1982). In obligately parthenogenetic species, eggs mature as rapidly and successfully as do fertilized eggs in sexual species. Mating normally occurs in the air, but a few species mate on a surface. Adults live just 1-2 hours or as long as 14 days. Adults do not feed. Eggs are always laid in water. Hatching may take place within minutes, or may be delayed for many months. Excellent general accounts of mayflies are found in Edmunds and others (1976), Brittain (1982), Unzicker and Carlson (1982), Berner and Pescador (1998), and Waltz and Burian (2008).

Mayflies play essential roles in aquatic ecosystems. Many species are herbivores or detritivores as nymphs, converting energy captured by plants and fungi into animal biomass, and they themselves are an important food source for other animals, both invertebrates and vertebrates. A few genera have carnivorous species that feed on small, soft-bodied invertebrates. Feeding usually stops in the penultimate (next to last) instar. Many mayflies are highly intolerant of human-caused pollutants and habitat disturbance, which makes them valuable indicators of the health of aquatic ecosystems.

## Suborder Furcatergalia Kluge

### forked-gill mayflies

## Infraorder Lanceolata McCafferty

### pronggills

## Family Leptophlebiidae Banks

### pronggills

This is one of the largest families of mayflies, having more than 600 species in more than 130 genera throughout the world (Barber-James and others, 2008). In North America 87 species in 10 genera are known. We found 12 species in five genera in the study area. As the common name suggests, the larvae are characterized by having the abdominal gills variously divided into forks or prongs, either simply or elaborately but always distinctively.

**Genus *Leptophlebia* Westwood** - [Habitat — Lotic erosional (sediments and detritus): Habit — Swimmers, clingers, sprawlers: Trophic — Collectors-gatherers (fine particles)] The genus *Leptophlebia* contains 10 species in North America, and approximately three in the Oriental and two in the Palearctic Realms. Berner (1975) reported six species from the Southeast, and two species were found in the parks.

| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Parks       | States                                                                                                                                                                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|--------------------|
| <i>Leptophlebia cupida</i> (T Say, 1823)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>CUGA</b> | AB, AL, AR, BC, CA, CO, CT, DE, FL, IA, ID, IL, IN, KY, LB, MA, MB, MD, ME, MI, MN, MO, MT, NB, NC, NE, NF, NH, NJ, NS, NY, OA, OH, OK, ON, PA, PQ, SC, TN, TX, VA, VT, WA, WI, WV, WY | 349 m           | G5       | 1.0             | n/a<br>(May – Jun) |
| Comments — Clifford et al. (1979) studied this species in Alberta. Larvae are found on soft, small particle substrates in lakes and slow-moving streams. They are detritivores, have univoltine populations, and the rate of growth is closely related to the number of degree-days. The number of larval instars was approximately 34. In the spring of each year larvae move toward the shore and migrate up stream, moving into the smaller tributaries and marshy areas as they go. This migratory pattern also has been reported by Traver (1925). We recorded a single male from Sugar Run. |             |                                                                                                                                                                                        |                 |          |                 |                    |

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**Genus *Paraleptophlebia* Lestage** - [Habitat — Lotic erosional (sediments and detritus): Habit — Swimmers, clingers, sprawlers: Trophic — Collectors-gatherers (coarse detritus, diatoms), facultative shredders--detritivores] This is one of the larger genera of mayflies, having more than 50 species in the Oriental and Holarctic Realms. About 35 species are known from the Nearctic, and we collected 8 species in the parks. *Paraleptophlebia* species are assigned a genus-level tolerance value of 0.9.

| Species                                                                                                                                                                                                                              | Parks                                   | States                                                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------------------------------------------|-----------------|----------|-----------------|----------------------------|
| <i>Paraleptophlebia adoptiva</i> (McDunnough, 1929)                                                                                                                                                                                  | BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> | GA, IN, KY, MI, NC, NH, NY, OH, OK, QC, SC, SD, VA, ON, QC                 | 349-867 m       | G5       | 0.9             | 6 Mar - 30 Apr             |
| Comments — Berner (1975) considered <i>P. adoptiva</i> to be rare in the Southeast. We have 4 collections and 15 specimens of this species, including 7 specimens from CUGA. Forewing up to 8 mm in length.                          |                                         |                                                                            |                 |          |                 |                            |
| <i>Paraleptophlebia guttata</i> (McDunnough, 1924)                                                                                                                                                                                   | BISO, BLRI, <b>CUGA</b> , GRSM          | AR, GA, IN, KY, MI, MN, MO, NC, NH, NY, OH, OK, ON, QC, SC, TN, VA, WI, WV | 290-1130 m      | G5       | 0.9             | 1 Jun - 27 Oct (Apr - Oct) |
| Comments — This species is fairly common in mountain streams in the region (Berner 1975). We have 22 collections and 59 specimens of this species. Of these, 2 were collected from Dark Ridge Branch. Forewing up to 6 mm in length. |                                         |                                                                            |                 |          |                 |                            |

## Infraorder Scapphodonta McCafferty tusked burrowing mayflies

### Family Ephemeridae Leach common burrowers

This family of moderate to large mayflies consists of species that burrow in the sediments of streams, rivers, lakes, and ponds as larvae. They often occur in enormous numbers, and historically (before water pollution became a serious problem) emergences near large water bodies were so large as to create nuisances for home-owners and drivers (Burks, 1953). Even today, as water pollution abatement programs have taken effect, large emergences of burrowing mayflies show up on radar systems along Lake Erie (based on the work of E. Masteller: see Anonymous, 2003). The emergence of the mayflies along the lakeshore can be seen and tracked by weather radar, as the mayflies move ashore and later move back over the lake.

**Genus *Ephemera* Linnaeus** - [Habitat — Lotic and lentic depositional (sand, gravel): Habit — Burrowers: Trophic — Collectors-gatherers, predators (engulfers), filterers] Some 40 species of these large burrowing insects are found in the Oriental, Palearctic, and Nearctic Realms, and a single species is found in Australia. Seven species are recognized in North America, four of which we found in the parks. It is likely that each of the species we encountered is univoltine (Unzicker and Carlson, 1982). Species in this genus are assigned a tolerance value of 2.0.

| Species                                                                                                                                              | Parks                          | States                 | Elevation Range | Rankings | Tolerance Value | Flight Dates               |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------|-----------------|----------|-----------------|----------------------------|
| <i>Ephemera blanda</i> JR Traver, 1932                                                                                                               | BISO, BLRI, <b>CUGA</b> , GRSM | KY, NC, OH, SC, TN, VA | 236-867 m       | G5       | 2.0             | 1 Jun - 27 Jul (May - Aug) |
| Comments — Restricted to the study area. We have 10 collections and 96 specimens of this species, including 21 specimens from Station Creek in CUGA. |                                |                        |                 |          |                 |                            |

## Family Ephemerellidae Klapálek

### spiny crawlers

This moderately sized family of about 18 genera and 155 species is restricted to the Nearctic, Palearctic, and Oriental Realms. More than 70 species in about 10 genera are known from North America (Barber-James and others, 2008). The larvae are distinctive and often ubiquitous in streams in the study region, feeding as collector-gatherers or scrapers on detritus, algae, and diatoms. In a series of papers Jacobus and McCafferty (Jacobus, 2009, 2010; Jacobus and Fleek, 2010; Jacobus and McCafferty, 2000, 2001, 2003a, b, 2004; Jacobus and McCafferty, 2007, 2008; Jacobus and others, 2002) revised the family over the past decade, greatly enhancing understanding and identification of all life stages.

**Genus *Eurylophella* Tiensuu** - [Habitat — Lotic erosional and depositional; Lentic, vascular hydrophytes: Habit — Clingers, sprawlers: Trophic — Collectors-gatherers] This genus consists of 14 Nearctic and two Palearctic species. Funk and Sweeney (1994) described the larvae and provided a key to eastern United States species.

| Species                                        | Parks       | States                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates |
|------------------------------------------------|-------------|----------------------------------------|-----------------|----------|-----------------|--------------|
| <i>Eurylophella macdunnoughi</i> DH Funk, 1974 | <b>CUGA</b> | AR, IN, KY, ME, NY, PA, TN, VA, VT, WV | 993 m           | G5       | 4.0             | n/a          |

Comments — Larvae are found in medium to large streams and rivers. Larva up to 8.9 mm in length, male forewing up to 7.7 mm, and female forewing up to 8.6 mm. We found one specimen at Shillalah Creek in CUGA.

## Suborder Pisciforma McCafferty

### minnow, brush-legged, and flat-headed mayflies

## Family Ameletidae McCafferty

### painted minnows

The Ameletidae are a small family of fewer than 60 species in two genera, found in the Nearctic, Palearctic, and Oriental Realms. Only one genus with 35 species is found in the Nearctic. We found four species in the parks.

**Genus *Ameletus* Eaton** - [Habitat — Lotic erosional and depositional: Habit — Swimmers, clingers: Trophic — Scrapers, Collectors-gatherers (detritus and diatoms)] This is a Northern Hemisphere genus having about 52 species in the Palearctic, Oriental and Nearctic Realms. Thirty-five species occur in North America, most of them in the West, only about 8 species are found in the East. We found 4 species in the parks. Several species of *Ameletus* are parthenogenetic, with no recognized males known. Zloty (1996) revised the bisexual North American species, and presented separate keys to the adults of the six species found in the East (2 parthenogenetic species were excluded), as well as a key to the western species. The larvae of the 4 species found in the parks are known. Carle (1978) provided information to separate the adults and larvae of *A. cryptostimulus* and *A. lineatus*.

| Species | Parks | States | Elevation Range | Rankings | Tolerance Value | Flight Dates |
|---------|-------|--------|-----------------|----------|-----------------|--------------|
|---------|-------|--------|-----------------|----------|-----------------|--------------|

Comments — This record is included here because it represents the presence of this genus in CUGA. We did not collect any identifiable specimens, just 2 larvae from Lewis Hollow.

## Family Baetidae Leach

### small minnow mayflies

This is the largest family of mayflies, having about 900 species in 100 genera worldwide (Gattolliat and Nieto, 2009). The greatest diversity of baetids occurs in the Afrotropical and Neotropical realms. Still, more than 150 species in more than 20 genera are known from the Nearctic. Most larvae are streamlined and are active swimmers, even in swift water. Most also are collector-gatherers, feeding on organic detritus. A limited number of species are carnivorous. A great deal of taxonomic work has been published over the past 30 years in North America, much of it by McCafferty and his students. At present, more than 60 species in at least a dozen genera are known from the study area. We found nearly half of those in the parks.

**Genus *Baetis* Leach** — [Habitat — Lotic erosional and depositional, lentic – littoral, vascular hydrophytes: Habit — Swimmers; clingers and climbers at rest: Trophic — Collectors-gatherers (detritus, diatoms), facultative scrapers] This is the largest genus of Ephemeroptera, having approximately 150 species distributed across the globe, absent only from Antarctica and remote Pacific islands. Approximately 100 species are found in the Palearctic, 20 in the Nearctic, but only a single *Baetis* species is recognized from the Neotropics. Morihara and McCafferty (1979) published a key to 21 *Baetis* species of the then known 39 species. Since that time many taxonomic changes have occurred resulting in the creation of new genera, various realignments, and the development of new characters (see, for example Lugo-Ortiz and McCafferty, 1998; Lugo-Ortiz and others, 1999; McCafferty and others, 2005), resulting in the more restricted understanding of Nearctic *Baetis* that now includes just 20 species. Mature larvae are identifiable, with experience.

| Species                                                                                                                                              | Parks | States | Elevation<br>Range | Rankings | Tolerance<br>Value | Flight Dates |
|------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------|--------------------|----------|--------------------|--------------|
| Comments — This genus is included here to indicate that we collected only unidentifiable specimens that represent the presence of the genus in CUGA. |       |        |                    |          |                    |              |

## Family Heptageniidae Needham in Needham & Betten

### flat-headed mayflies, or flatheads

The flat-headed mayflies are a large family of nearly 600 species. Half of all known species are found in the Palaearctic Region, about 140 species are found in the Oriental Region, and nearly as many are found in the Nearctic Region. About 20 species are known from the Afrotropical Region, fewer than 5 are known from the Neotropical Region, and none are known from Australia. In the Southeast, 67 species are known (McCafferty and others, 2010). We collected 41 species in 8 genera in the parks, including 23 species in 7 genera in BLRI.

As the common name implies, these insects are very flat dorsoventrally in the larval stages. This form allows the insects to live in very high current flows on substrates in riffles because they actually are within a narrow boundary layer of slow current that is formed when fast moving water flows over a solid substrate. The dorsoventrally compressed nature of their bodies, and the orientation of the legs out to the side of the body rather than underneath the body, gives them the freedom to move actively over the substrate without facing the strongest current just fractions of a millimeter above. In many streams in the study area, larvae of flatheads can be seen scooting rapidly about on rocks, even when the rocks have been just removed from the water. In certain genera, some species have the plate-like abdominal gills modified so that they form a disc-like attachment mechanism that further enhances their ability to live in fast currents.

Mature larvae are often quite large, up to 20 mm in length, excluding the caudal filaments. They feed by scraping diatoms, algae, and organic matter from the substrate surface.

**Genus *Epeorus* Eaton** - [Habitat — Lotic erosional; Habit — Clingers; Trophic — Scrapers; facultative collectors-gatherers] A large genus of flat-headed mayflies with nearly 90 described species. Approximately 52 species are known from the Palearctic, 18 from the Nearctic, 14 from the Oriental, and two from the Neotropical Realms. The larvae are easily recognizable in the field because they are the only heptageniids in the study area that have just two tails. Four species were found in the parks.

| Species                                  | Parks                                   | States                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates                  |
|------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------|-----------------|----------|-----------------|-------------------------------|
| <i>Epeorus pleuralis</i> (N Banks, 1910) | BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> | GA, IN, KY, LB, MA, MD, NB, NC, NF, NH, NS, NY, OH, ON, PA, PE, QC, SC, TN, VA, WV | 429-1575 m      | G4       | 1.8             | 1 Mar - 31 Jun<br>(May - Jun) |

Comments — Minshall (1967) has shown the life cycle to be univoltine in Kentucky. Eggs hatch in Sep, and continue hatching through May. Nymphs are most abundant in Apr and May. Huryn and Wallace (1987) found populations in Coweeta, North Carolina, were synchronized fast-seasonal, similar to populations in Kentucky. In the Adirondacks, adults were seen to swarm above small to medium-size streams and rivers in the evening (Myers and others, 2011). In a stream in Prince Edward Island in which *E. pleuralis* and *E. fragilis* were present, Dobrin and Giberson (2003) found that *E. pleuralis* adults were found in late Jun and those of *E. fragilis* were found from late Jul to early Aug. Larva up to 9 mm in length. We have 140 collections and 1984 specimens of this species, including 15 adults from Cudjos Cave in CUGA.

**Genus *Maccaffertium* Bednarik** — [Habitat — Lotic and lentic erosional (depositional); Habit — Clingers (under loose cobbles and boulders); Trophic — Scraper; facultative collectors-gatherers] This is a Nearctic genus of 17 species, one of which extends into the Neotropics. For many years these species were treated as *Stenonema*, and many older records of *Stenonema* now refer to *Maccaffertium*.

| Species                                                                                                                                              | Parks | States | Elevation Range | Rankings | Tolerance Value | Flight Dates |
|------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------|-----------------|----------|-----------------|--------------|
| Comments — This genus is included here to indicate that we collected only unidentifiable specimens that represent the presence of the genus in CUGA. |       |        |                 |          |                 |              |

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**Genus *Stenacron* Jensen** - [Habitat — Lotic and lentic erosional: Habit — Clingers: Trophic — Scrapers; facultative collectors-gatherers] This is a North American endemic genus of seven species. We found four species in the parks. *Stenacron* species are very sensitive to pollution, particularly acid mine drainage (Pond and others, 2008).

| Species                                                                                                                                  | Parks                                                                                           | States                                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates   |
|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------|----------|-----------------|----------------|
| <i>Stenacron carolina</i> (N Banks, 1914)                                                                                                | BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> , KIMO, MACA <sup>(L)</sup> , NISI, OBRI <sup>(L)</sup> | AL, GA, IA, IN, KY, MS, NC, NY, OH, PA, QC, SC, TN, VA, WV | 150-1786 m      | G5       | 1.1             | 1 May - 31 Sep |
| Comments — Larva up to 12 mm in length; adult forewing up to 12 mm. We collected 2 specimens from Dark Ridge Branch picnic area in CUGA. |                                                                                                 |                                                            |                 |          |                 |                |
| <i>Stenacron gildersleevei</i> (JR Traver, 1935)                                                                                         | <b>CUGA</b>                                                                                     | IL, IN, KY, NY, OH, VA                                     | 365-768 m       | G4       | 3.58            | 19 - 21 Jul    |
| Comments — This species is included here because we only found it in one park. We collected 37 specimens from 3 locations in CUGA.       |                                                                                                 |                                                            |                 |          |                 |                |

## Family Isonychiidae Burks the brush-legged minnow mayflies

This is a widespread Northern Hemisphere family that consists of a single genus and about 40 species. The larvae are characterized by a double fringe of filtering setae on the front legs, which they use to strain particulate matter from the water current. They are, therefore, restricted to flowing water.

**Genus *Isonychia* Eaton** — [Habitat — Lotic erosional: Habit — Swimmers; clingers: Trophic — Collectors—filterers (very fine particles); predators (engulfers)] This genus consists of approximately 40 species, 27 of which are Nearctic. The rest are Palearctic, Oriental, or Neotropical (Kondratieff & Voshell 1983). Larvae are fast-swimming, generally dark brown, medium-sized mayflies that feed by filtering particles from the water using the elongate setae on their front legs. All species in the genus are assigned a tolerance value of 3.5. We found 2 species of *Isonychia* in CUGA. The following is a species of interest.

| Species                                                                                                                                                                                                                     | Parks       | States                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------|-----------------|----------|-----------------|-----------------------|
| <i>Isonychia arida</i> (T Say, 1839)                                                                                                                                                                                        | <b>CUGA</b> | AL, FL, GA, IL, IN, MS, NC, NY, SC, TX, VA | 387 m           | G5, VAS2 | 3.5             | 20 Jul<br>(Jun - Oct) |
| Comments — This species is considered imperiled in Virginia. Larva up to 15 mm in length, female forewing up to 13 mm, male forewing up to 10 mm. We collected 19 specimens in a single sample from CUGA during this study. |             |                                            |                 |          |                 |                       |

## ORDER ODONATA FABRICIUS

### DRAGONFLIES AND DAMSELFLIES

The larvae are less well known than the adults, but are no less fascinating. All odonate larvae are predaceous, and have a unique “lower lip” (labium) that functions as a prey grabbing instrument. This lower lip is hinged and has highly modified components armed with teeth, spines, and setae. Larvae hunt either actively by climbing about looking for prey, or by hiding in the substrate and ambushing prey when they pass close by. When a larva attacks a prey item, it juts its labium forward toward the prey at great speed. The palps of the labium grab the prey, securing it with the spines and teeth, and then jerking it back to the mouth to be eaten. In some larvae the labium is flat and held under the head, whereas in others it is cupped and held in front of the face, resembling a toothed mask.

Odonata are integral parts of their ecosystems. In many habitats, the larvae are the top predators in freshwater ecosystems, feeding on virtually anything that moves and is smaller than they are. In turn, many fish feed on dragonfly and damselfly larvae. Larvae also have specific habitat requirements, and thus have the potential to be important indicator species. They are generally more tolerant of pollution and habitat disturbance than are mayflies, as is reflected in the tolerance values assigned in the tables below. As adults, dragonflies and damselflies are persistent predators of other adult aquatic and terrestrial insects, feeding frequently over an adult life span that may last many weeks. They also become the prey of larger hunters, such as birds.

Many field guides and books are available to aid in identifying odonates in both the larval and adult stages, and provide valuable information on habitats, habits, and other biological details. The following references were used in developing these tables: Abbott (2005), Beaton (2007), Huggins and Brigham (1982), Needham and others (2000), Tennessen (2008), Westfall and May (1996).

Muise and others (2007) published a checklist of odonates from GRSM, which includes a number of species not found in the other parks. The records in that list do not include data about elevations or flight dates. Therefore, many of the records below have n/a entries for those fields.

### Suborder Anisoptera Selys

#### dragonflies

Adult dragonflies are easily distinguishable from adult damselflies by their larger size and stouter bodies; their close-set, very large eyes; and their broad hind wings that are shaped differently from the forewings. Dragonfly larvae are easily distinguished from damselfly larvae by the absence of three large, external gills at the end of the abdomen. Dragonflies have gills internally in the rectum, and live specimens can be seen “inhaling” and “exhaling” when observed carefully. If disturbed, the larvae can rapidly expel water from the rectum and jet away by the hydraulic force of this expulsion.

The taxonomic arrangement used here treats Corduliidae, Libellulidae, and Macromiidae as separate families. This differs from the treatment in Needham and others (2000), the most comprehensive manual for dragonfly identification for North America, in which Corduliinae and Macromiinae are considered as subfamilies of Libellulidae. Most North American workers today follow the arrangement given by Paulson and Dunkle (2012).

During this study, we found 22 species, 18 genera, and 6 families of dragonflies in CUGA. The 1 listed below is considered species of interest for this study.

## Family Aeshnidae Rambur

### darners

Darners are cosmopolitan, and include some of the largest dragonflies in the study area. The adults have very large eyes that meet at the top of the head. Most species are quite colorful, having green, blue, red, and brown body markings. Adults tend to fly high above the ground or water when feeding. Some species are known to migrate, generally from northern areas southward as the days cool and shorten. The larvae are slender and have limited setae (hairs) on the body. They crawl about the habitat, climbing over vegetation and debris, looking for prey. Larger individuals will feed on smaller individuals of the same species. The labium is flat in all species, never cupped into a mask. Prey of aeshnids sometimes includes tadpoles.

Worldwide more than 430 species are known, representing more than 50 genera. Approximately 47 species of darners are found in the Nearctic, distributed among 13 genera (Kalkman and others, 2008). We found 7 species in 6 genera in the parks.

### Genus *Boyeria* McLachlan -

### Spotted Darners

[Habitat — Lotic erosional and depositional (detritus, vascular hydrophytes): Habit — Climbers—sprawlers (clingers under rocks): Trophic — Predators (engulfers)] *Boyeria* is a northern genus. Two species are found in North America, and one each is found in Japan and Europe. We found both North American species in the parks.

| Species                                            | Parks                                                                                                                             | States                                                                                                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates            |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|-------------------------|
| <i>Boyeria vinosa</i> (T Say, 1839)<br>Fawn Darner | BISO <sup>(L)</sup> , BLRI, CARL, COWP, <b>CUGA</b> , GRSM <sup>(L)</sup> , GUCO, LIRI, MACA <sup>(L)</sup> , OBRI <sup>(L)</sup> | AL, AR, CT, DC, DE, FL, GA, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NB, NC, NE, NH, NJ, NS, NY, OH, OK, ON, PA, PE, QC, RI, SC, TN, TZ, VA, VT, WI, WV | 259-987 m       | G5, NCS3 | 5.9             | 1-31 Aug<br>(May - Oct) |

Comments — Larvae live in small to medium-sized forested streams and in some localities are quite common in these habitats, hiding under rocks, logs, and similar large objects. It is ranked vulnerable in North Carolina. Larva up to 37 mm in length, adult up to 71 mm. We have 140 collections and 556 specimens of this species, including 1 larva from Davis Branch in CUGA.

## Suborder Zygoptera Selys

### damselflies

Damselflies are delicate and small in comparison with their robust and large cousins, the dragonflies. Their bodies, in both larval and adult stages are elongate and slender. The larvae generally have long legs that in some groups are stilt like. The wings are narrow at the bases and the front and hind wings are similar in shape, in contrast with those of dragonflies. Like dragonflies, the damselflies are carnivorous. The larvae have a hinged labium with a grasping mentum and palps for securing prey. Unlike dragonflies, they breathe with the aid of three external bladelike caudal gills. The gills make an excellent character for the recognition of damselfly larvae in the field. They are variable among and within groups, and often are very helpful in identification. The heads of adults are transverse, with prominent eyes. Many species are beautifully marked with bright, sometimes metallic colors. In some species the wings may be banded or have other markings. We found 7 species in 4 genera and 2 families in CUGA, none of which is considered a species of interest for this study.

## ORDER PLECOPTERA BURMEISTER

### STONEFLIES

The stoneflies, Order Plecoptera, are hemimetabolous aquatic insects distributed worldwide. Approximately 3,500 species are known, distributed among 16 families and about 270 genera. As with virtually all insects, much more study has occurred in the Northern Hemisphere than in the Southern Hemisphere and more in the Temperate than in the Tropical realms. This, therefore, considerably biases our knowledge and understanding of the distribution, ecology, and biology of stoneflies. Current information indicates that stoneflies are largely restricted to cold, running waters. Only a relative handful is found in lakes or other lentic waters, and arid lands are virtually devoid of stoneflies (Fochetti and Tierno de Figueroa, 2008). Stoneflies are weak fliers and poor dispersers—some adults lack functional wings—and coupled with their ecological limitations, tend to be highly restricted in distribution and to display a relatively high degree of endemism. Very few species are found on more than one continent or biogeographic region, and within regions distributions often are restricted to smaller geographic subdivisions. The greatest numbers of species are found in Asia (approximately 1,500 species [Fochetti and Tierno de Figueroa, 2008]), the Nearctic (650 species), and Europe (420 species). It is likely that further study in the coming decades will almost double the number of known species of Plecoptera, with very many new taxa to be found in the tropical regions of the world (Fochetti and Tierno de Figueroa, 2008).

The higher taxonomy of Plecoptera, like that of most insect groups, is not resolved to everyone's satisfaction. The taxonomy used here is the most widely accepted and is based on Zwick (2000), as reflected in Stewart and Stark (1988). Two suborders are recognized, the Northern Hemisphere Arctoperlaria Zwick, and the Southern Hemisphere Antarctoperlaria Zwick. Only the former is found in North America. The Arctoperlaria is subdivided into two groups, the Euholognatha Zwick and the Systellognatha Enderlein.

About 650 species of stoneflies are found in North America, in 9 families and around 100 genera. In this study we found 136 species in 34 genera and all 9 families. North American stonefly larvae can be identified to genus, and in some genera, many species are identifiable, as well. Indispensable resources for stonefly larval taxonomy include Stewart and Stark (1988, 1993, 2008). A new series of publications on adult taxonomy, which includes keys to species, is the "Stoneflies (Plecoptera) of Eastern North America," volumes 1 and 2 (Stark and Armitage, 2000, 2002).

Most North American Plecoptera species have univoltine (1-year) or semivoltine (2-year) life cycles (Stewart and Stark, 1988). A small number of species from northern latitudes may have 3-year life cycles. Species that have univoltine life cycles are characterized as being either fast or slow. A fast, univoltine population is one in which a significant amount of time is spent resting in the egg and (or) larval stage without hatching or with no appreciable growth occurring. In these populations, growth occurs very quickly over just a few months. A slow, univoltine life cycle is one in which there is no stasis during growth, which occurs steadily, if not uniformly, over most of the year. Larvae pass through numerous instars, 10 to 20+, although it is virtually impossible to be precise and the number of instars may vary depending on environmental factors (Stewart and Stark 1988). Stonefly larvae have a wide range of feeding and habitat requirements (Stewart and Stark 1988), and the broad generalizations provided in Merritt and others (2008) are viewed with caution. Many larvae are shredders/herbivores, others are carnivores, some are omnivores, and many begin feeding in one manner as early instars before switching to a different manner of feeding as they mature. Habitat requirements are more stable over the life of larvae, and most species can be characterized as preferring a particular type of stream based on size, temperature, gradient, permanency, or other criteria. Many species have specific microhabitat requirements within a water body. One species is only known from depths of 40–60 m in Lake Tahoe; another, from the study area is found only in root mats in undercut banks of Appalachian streams. Some of the leaf shredder species can be reliably found in accumulations of leaves and other coarse organic matter.

Stonefly adults rarely feed, and in fact, have only poorly developed mouthparts. The function of the adults is to reproduce, and consequently adults are short lived. Among the Arctoperlaria families, an intriguing mating behavior exists that is not found among the Antarctoperlaria. Many species across many families use vibrational communication (drumming) that allows males and females to locate each other (Stewart and Sandberg, 2006). In this behavior, among aggregations of individuals following emergence from the larval habitat, males will signal to potential mates in one of four ways: (1) by tapping the substrate

with his abdomen, which may have a specialized structure called a hammer; (2) scratching or scraping the substrate; (3) by rubbing the substrate with the abdomen; (4) by tremulation or shaking of the substrate. Species specific patterns of vibration using one of these methods allow females within range to distinguish potential mates, and the females will then respond to the males with their own drumming pattern, almost always produced by tapping or by tremulation. Laboratory studies have demonstrated that individuals can detect each other as far as 8 m apart. When a potential mate has been detected, they establish a duet pattern of drumming. When the pair has decided the potential for mating with an individual of the same species exists, the male begins moving toward the female by orienting in response to her vibrational communications until he locates her and mating ensues. Stoneflies are believed to have the most complex form of vibrational communication among insects.

Stark and others (1998, 2012) established common names for about 620 species of Nearctic stoneflies. Each family is given a name, and every species in the family has a name that incorporates the family name. For example, the family Capniidae is called the Snowflies, and the species *Allocapnia formosa* Ricker, 1952, is called the Smokies Snowfly. Family and species names based on this system are used below.

## Suborder Arctoperlaria Zwick

### Group Euholognatha Zwick

#### Family Capniidae Klapálek

#### snowflies

This is one of the families of winter stoneflies, so called because the adults emerge in the winter months, principally from Nov through Mar. The family contains more than 310 described species in 17 genera worldwide, and of those, the majority is found in the Nearctic. More than 150 species in 10 genera are found in North America. We collected 9 species in 2 genera in the parks, but only 1 species in the two genera in BLRI. Male snowflies are commonly brachypterous (short-winged) while the females have wings longer than the abdomen (macropterous). Adults are dark brown to black, and may be seen crawling about on snow after emergence, accounting for the common name.

**Genus *Allocapnia* Claassen** - [Habitat — Lotic erosional (coarse sediments, wood, leaf packs) and depositional: Habit — Clingers: Trophic — Shredders detritivores] Approximately 40 species of *Allocapnia* are known from North America, and we found eight species in the parks. Males of most species have the wings shorter than the body, at least in some specimens, and sometimes males may be wingless. Females have fully developed wings that extend beyond the end of the abdomen. Snowflies often are found in springs including those that frequently are dry a short distance from the source (Grubbs, 2008). Bouchard and others (2009) have shown that two species of *Allocapnia* (*A. granulata* and *A. pygmaea*), despite being winter stoneflies often found on snow, are not freeze-tolerant. This finding may explain why adults are more commonly found in late winter and early spring. Larvae of *Allocapnia* cannot be identified to species at present, so the genus has been assigned a tolerance value of 2.5.

| Species                                                   | Parks      | States                                                                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates            |
|-----------------------------------------------------------|------------|--------------------------------------------------------------------------------------------|-----------------|----------|-----------------|-------------------------|
| <i>Allocapnia nivicola</i> (Fitch, 1847)<br>Brook Snowfly | CUGA, LIRI | AL, CT, DC, DE, IL, IN, KY, MA, MD, NB, NC, NJ, NS, NY, OH, PA, QC, RI, TN, VA, VT, WI, WV | 288-423 m       | G5       | 2.5             | 2-30 Mar<br>(Dec – Apr) |

Comments — “*nivicola* occurs almost entirely in small stony brooks” (Ross and Ricker, 1971). *Allocapnia nivicola* emerged from Jan to Apr in Pennsylvania (Masteller 1983). DeWalt and others (2005) rated this species critically imperiled in Ohio. Larva up to 7.5 mm in length, adult up to 7 mm. We have 4 collections and 21 specimens of this species, including 10 specimens from Lewis Hollow in CUGA.

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**Genus *Paracapnia* Hansen** - [Habitat — Lotic erosional (coarse sediments, wood, leaf packs) and depositional: Habit — Clingers: Trophic — Shredders detritivores] A Holarctic genus of eight species, five of which occur in North America (Stark and Baumann, 2004). Two species are found in eastern North America, one of which is common in the study area and was found in four parks. It is highly intolerant of pollution.

| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Parks                                            | States                                                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|----------------|
| <i>Paracapnia angulata</i> Hanson, 1961<br>Angulate Snowfly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | BISO, BLRI, <b>CUGA</b> ,<br>GRSM <sup>(L)</sup> | AR, CO, CT, DE, IL, KY, LB, MA, MB, MD, ME, MI, MN, MO, NC, NF, NH, NY, OH, OK, PA, QC, SD, SK, TN, VA, WI, WV, WY | 295-1757 m      | G5       | 0.1             | 1 Feb - 30 May |
| Comments — In Canada, populations of <i>P. angulata</i> are univoltine and synchronous, with emergence lasting relatively few days, and oviposition occurring about a week later (Dosdall and Lehmkuhl, 1979). Dobrin and Giberson (2003) studied the life history and production of this species in Prince Edward Island. They found it to be univoltine with early instar nymphs first appearing in the stream in late Jun and Jul, becoming abundant in Jul and Aug. Adults emerged in late Apr through May. At GRSM, adults can be found almost continuously throughout the winter months. Grubbs and others (2013) consider this species extirpated from OH, not having been seen there since 1940. Adults may be wingless, have short wings, or may have fully developed wings. Larva up to 8 mm in length, females up to 8.5 mm, apterous males up to 4 mm. It is common in the mountainous parks. We have 55 collections and 165 specimens of this species. We collected 4 specimens from Sugar Run picnic area in CUGA. |                                                  |                                                                                                                    |                 |          |                 |                |

## Family Leuctridae Klapálek needleflies

This family has just over 320 species worldwide, with about 60 known from North America. The common name is in reference to the very slender appearance of the adults, in which the wings are “rolled” around the sides of the body when at rest. Larvae are primarily detritivores. In the study region, these are very common and often very abundant species in small, cold streams.

### Subfamily Leuctrinae Klapálek

**Genus *Leuctra* Stephens** - [Habitat — Lotic erosional and depositional: Habit — Sprawlers clingers: Trophic — Shredders detritivores] This genus includes about 200 species worldwide, with nearly 30 species in North America. We found 17 species in the parks. Larvae are inseparable at this time; species have been assigned a genus-level tolerance value of 2.5.

| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Parks                                                   | States                                                                                         | Elevation Range | Rankings | Tolerance Value | Flight Dates                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|-----------------------------------|
| <i>Leuctra ferruginea</i> (Walker, 1851)<br>Eastern Needlefly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | BLRI, COWP, <b>CUGA</b> ,<br>GRSM <sup>(L)</sup> , LIRI | AL, CT, DE, FL, KY, MA, MD, ME, MI, MN, MS, NB, NC, NF, NS, NY, OH, PA, QC, SC, SK, VA, WI, WV | 274-1944 m      | G5       | 2.5             | 1 Feb - 31 Nov<br>(January - Dec) |
| Comments — Perhaps the most common stonefly in the study area. This species prefers small, cold streams, but can be found in a wide variety of habitats. Emergence occurs over an extended period, and adults can be found almost every month of the year in the study region. Development seems strongly influenced by stream temperatures, with each stage of development taking longer at lower temperatures. In Prince Edward Island, Dobrin and Giberson (2003) reported a two-year life cycle, similar to the life cycle reported for Ontario populations. Harrison and Stark (2010) described two new species from Mississippi that previously would have been called <i>L. ferruginea</i> . It is possible that either or both of these newly recognized species will be found in the parks. Larva up to 7 mm in length, adults up to 8.5 mm. We have 100 collections and 829 specimens of this species. In CUGA we collected 203 specimens from 5 locations in CUGA. |                                                         |                                                                                                |                 |          |                 |                                   |

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| Species                                                                                                                                                                                                                                                                                                                                       | Parks                                                                        | States                                                                                                   | Elevation Range | Rankings | Tolerance Value | Flight Dates                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|-------------------------------|
| <i>Leuctra tenuis</i> (Pictet, 1841)<br>Narrow-lobed Needlefly                                                                                                                                                                                                                                                                                | ABLI, BLRI, <b>CUGA</b> ,<br>GRSM <sup>(L)</sup> , KIMO, SHIL <sup>(L)</sup> | AL, AR, CT, DE, IA, IL, IN, KY, MA, MD,<br>ME, MN, MO, MS, NB, NJ, NS, NY, OH,<br>OK, PA, QC, VA, WI, WV | 124-973 m       | G5       | 2.5             | 7 Jul - 31 Oct<br>(Jun - Sep) |
| Comments — Giberson and Garnett (1996) found this species emerged from Jul through Sep in New Brunswick, and Masteller (1983) reported that it emerged Jun to Aug in Pennsylvania. Larva up to 7 mm in length, adult up to 8 mm. We have 13 collections and 161 specimens of this species, including a single male from Davis Branch in CUGA. |                                                                              |                                                                                                          |                 |          |                 |                               |
| <b>Genus <i>Paraleuctra</i> Hanson</b> — [Habitat — Lotic erosional (coarse sediments, wood, leaf packs) and depositional: Habit — Sprawlers clingers: Trophic — Shredders detritivores] Nine species are known from North America. One widespread species was collected in six of the parks.                                                 |                                                                              |                                                                                                          |                 |          |                 |                               |
| Species                                                                                                                                                                                                                                                                                                                                       | Parks                                                                        | States                                                                                                   | Elevation Range | Rankings | Tolerance Value | Flight Dates                  |
| <i>Paraleuctra sara</i> (Claassen, 1937)<br>Appalachian Needlefly                                                                                                                                                                                                                                                                             | BISO, BLRI, COWP,<br><b>CUGA</b> , GRSM <sup>(L)</sup> , KIMO                | AL, CT, DE, KY, MA, MD, ME, NB, NC,<br>NS, NY, OH, ON, PA, QC, SC, TN, VA,<br>WV                         | 212-1623 m      | G5       | 2.8             | 1 Feb - 30 May                |
| Comments — Larva up to 7.5 mm in length, adult up to 10.5 mm. We have 72 collections and 741 specimens of this species, including 7 specimens from 2 locations in CUGA.                                                                                                                                                                       |                                                                              |                                                                                                          |                 |          |                 |                               |

## Family Peltoperlidae Claassen roachflies

The peltoperlids consist of about 55 species and 11 genera. Approximately 22 species in 6 genera are found in North America, and 24 species in about 5 genera in east Asia.

**Genus *Peltoperla* Needham** - [Habitat — Lotic erosional and depositional (leaf litter): Habit — Sprawlers clingers: Trophic — Shredders (leaf litter)] Only 5 species are known in this genus, 2 of which are Nearctic. Both species were found in this study.

| Species                                                                                                                                                                                                                                                                                                                                                                        | Parks                                         | States                         | Elevation Range | Rankings | Tolerance Value | Flight Dates    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------|-----------------|----------|-----------------|-----------------|
| <i>Peltoperla arcuata</i> JG Needham, 1905<br>Appalachian Roachfly                                                                                                                                                                                                                                                                                                             | BISO, BLRI, <b>CUGA</b> , OBRI <sup>(L)</sup> | KY, NY, OH, PA, QC, TN, VA, WV | 232-807 m       | G4       | 1.0             | 16 May - 26 Jul |
| Comments — Yokum and others (1995) studied the life history of <i>P. arcuata</i> in West Virginia. The populations were semivoltine with a 6-month egg diapause and an 18-month larval stage. Larvae passed through about 15 instars. Adult up to 18 mm in length. We have 7 collections and 29 specimens of this species. We collected 19 specimens from 3 locations in CUGA. |                                               |                                |                 |          |                 |                 |

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### Family Perlidae Latreille stones

This is the largest family of stoneflies, having approximately 50 genera and more than 1,000 species worldwide (Fochetti and Tierno de Figueroa, 2008). This is the only family of Plecoptera that occurs in the Nearctic, Neotropical, Palearctic, Oriental, and Ethiopian Realms. In eastern North America, 15 genera and nearly 80 species are known. Most species appear to be univoltine, but some are known to have bivoltine populations, and trivoltine life cycles have been suggested for others (Peckarsky, 1979). Larvae live in heterogeneous rocky substrates. Certain species are known to prefer a particular range of substrate particle sizes to others (Peckarsky, 1979). Larvae of Perlidae are carnivorous and feed on a wide range of prey species, but seem to prefer baetid mayflies to other prey.

### Subfamily Acroneuriinae Klapálek

**Genus *Perlesta* Banks** - [Habitat — Lotic erosional and depositional (in detritus); Habit — Clingers; Trophic — Predators (engulfers; Chironomidae, Simuliidae, Ephemeroptera, Trichoptera), facultative collectors gatherers (especially in early instars)] This genus might be an eastern Nearctic endemic, but two species from China are currently placed in this genus. Seventeen species are presently known from North America, but several undescribed species are known from the study area and from several of the parks. Many species of *Perlesta* are assigned a tolerance value of 4.7.

| Species                                                                                                                                                                                                                                                           | Parks                                          | States                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------|-----------------|----------|-----------------|----------------|
| <i>Perlesta decipiens</i> (Walsh, 1862)<br>Widespread Stone                                                                                                                                                                                                       | BISO, <b>CUGA</b> , GRSM <sup>(L)</sup> , GUCO | AR, CO, IA, IL, IN, KY, MO, NC, ND, NE, NM, OH, OK, PA, SD, TN, TX, VA, WI, WV, WY | 245-389 m       | G5       | 0.0             | 8 Jun - 28 Jul |
| Comments — DeWalt and others (2001) found this species in all but the smallest streams in Illinois. Female forewing up to 13 mm in length, male forewing up to 10 mm. We collected 46 specimens of this species, including 12 specimens from 2 locations in CUGA. |                                                |                                                                                    |                 |          |                 |                |
| <i>Perlesta puttmanni</i> BC Kondratieff & RF Kirchner, 2003                                                                                                                                                                                                      | <b>CUGA</b>                                    | KY, NC, VA, WV                                                                     | 349 m           | G3       | 0.0             | 20 Jul         |
| Comments — We collected 14 specimens from Sugar Run picnic area in CUGA.                                                                                                                                                                                          |                                                |                                                                                    |                 |          |                 |                |
| <i>Perlesta teaysia</i> RF Kirchner & BC Kondratieff 1997<br>Teays Stone                                                                                                                                                                                          | BLRI, <b>CUGA</b>                              | IL, IN, KY, MD, OH, PA, TN, VA, WV                                                 | 387-777 m       | G3, VAS2 | 0.0             | 11-26 Jul      |
| Comments — This species is considered vulnerable globally, and imperiled in Virginia. Female forewing up to 11 mm in length, male forewing up to 8.5 mm. We have 2 collections and 4 specimens of this species, including 3 specimens from Station Creek in CUGA. |                                                |                                                                                    |                 |          |                 |                |

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### Family Perlodidae Klapálek stripetails, springflies

This is a cosmopolitan family of nearly 300 species in 51 genera. The North American fauna consists of about 125 species 30 genera. In the study area, we found 26 species in 10 genera.

#### Subfamily Perlodinae Klapálek

springflies

**Genus *Diploperla* Needham & Claassen** - [Habitat — Lotic and lentic erosional: Habit — Clingers: Trophic — Predators (engulfers)] This is an eastern Nearctic genus of four species. We found two in the parks.

| Species                                                            | Parks                                | States                         | Elevation Range | Rankings | Tolerance Value | Flight Dates                      |
|--------------------------------------------------------------------|--------------------------------------|--------------------------------|-----------------|----------|-----------------|-----------------------------------|
| <i>Diploperla robusta</i> Stark & Gaufin, 1974<br>Robust Springfly | ABLI, <b>CUGA</b> , GRSM, LIRI, MACA | CT, IN, KY, OH, PA, TN, VA, WV | 161-993 m       | G5       | 2.7             | 4 April - 18 June<br>(May – June) |

Comments — This species was determined to have a single generation per year in West Virginia (Ashley and others, 1976). No nymphs were found from May through July when the stream was dry. Larvae were found from August to April, with adult emergence in the latter half of May. This species is uncommon, and occurs in lower elevation streams (Kondratieff, written communication, 2010), which conforms well with our data, Larva up to 19 mm in length, male forewing up to 13 mm, female forewing up to 15 mm. We collected 24 specimens of *D. robusta* from 5 parks, including 5 specimens from 2 locations in CUGA.

**Genus *Remenus* Ricker** - [Habitat — Lotic and lentic erosional: Habit — Clingers: Trophic — Predators (engulfers)] An eastern Nearctic genus of three species, two of which were found in this study.

| Species                                                                     | Parks                                   | States                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates            |
|-----------------------------------------------------------------------------|-----------------------------------------|----------------------------------------------------|-----------------|----------|-----------------|-------------------------|
| <i>Remenus bilobatus</i> (JG Needham & PW Claassen, 1925)<br>Lash Springfly | BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> | AL, CT, DE, GA, KY, MD, NC, NY, PA, SC, TN, VA, WV | 355-1480 m      | G4       | 0.3             | 1 May - 29 Jul<br>(Jun) |

Comments — We have 100 collections and 419 specimens of this species, but just a single specimen from Davis Branch in CUGA.

## ORDER TRICHOPTERA KIRBY

### CADDISFLIES

Trichoptera is the largest of the predominately aquatic insect orders, with approximately 15,000 described species in 600 genera and 47 families (Holzenthal and others, 2007). The majority of Trichoptera have aquatic larvae, with only a small number having semi-terrestrial or terrestrial larvae. Caddisflies are found in virtually all freshwater habitats throughout the world, except Antarctica. A small number of species is found in brackish and marine habitats. A majority of larval caddisflies makes cases or fixed retreats, which play roles in larval feeding, respiration, and camouflage. Those species which do not make cases or fixed retreats are free-living. Trichoptera are most closely related to the order Lepidoptera, the moths, skippers, and butterflies. Adult caddisflies, in fact, closely resemble moths. Adult caddisflies range in size from about 1.5 to 43 millimeters. Like Lepidoptera, Trichoptera undergo complete metamorphosis, progressing from egg to larva to pupa to adult. Most caddisflies have a 1-year or univoltine life cycle, although bi- and multivoltine life cycles are known. The majority of species are nocturnal as adults; only a relatively few species are day-active.

The use of silk for case making, net spinning, and other functions is one of the defining characteristics of Trichoptera, and is one of the significant factors responsible for the ecological success of the order. Wiggins and Mackay (1978) list five general categories of uses that allow caddisfly larvae to exploit their aquatic habitats: (1) constructing fixed retreats with feeding nets, (2) making fixed tubular retreats from which the larvae extend to feed on surrounding substrates or passing prey items, (3) building portable cases for protection while moving about and grazing on the substrate in exposed situations, (4) fashioning tubular cases or retreats to maintain or enhance current flow over the body, (5) providing a safety line that provides security for free-living larvae searching for prey in strong currents. In addition, the use of silk has also been considered to increase the stability of gravel substrates in streams, and thus has the potential to reduce the effects of flooding in areas with high densities of filter-feeding caddisflies (Cardinale and others, 2006; Statzner and others, 1999).

### Suborder “Spicipalpia” Weaver

The phylogenetic placement of the first four families is not resolved and represents one of the most debated issues in Trichoptera phylogeny. Some authors treat them as a separate suborder, Spicipalpia (Wiggins and Wichard, 1989; Frania and Wiggins, 1997). Others consider that arrangement to be paraphyletic (that is, artificial) and consider their phylogenetic placement, based on molecular as well as morphological data, to be unresolved (Morse, 1997; Kjer and others, 2001, 2002; Holzenthal and others, 2007; Malm and others, 2013). “Spicipalpia” is used here merely for convenience in grouping and not as a statement of support for any particular phylogenetic arrangement.

## Family Glossosomatidae Wallengren

### saddle-case making caddisflies

The Glossosomatidae are a cosmopolitan family with approximately 660 species worldwide (Holzenthal and others, 2007). The larvae are characterized by their distinctive stone cases that resemble turtle shells. The larva is hidden within its case by a dome of sand and gravel and with a ventral strap or “plastron” of small sand grains, leaving an opening at either end. The larva can extend its head out of either opening while its posterior end extends out the opposite opening. They feed by scrapping diatoms, algae, and other organic material from the surface of rocks in clean flowing water. Some species of *Glossosoma* feed on detritus, as well. When the larval glossosomatid is ready to pupate, it cuts away the ventral strap and fastens the dome portion of the case to the substrate, and forms a cocoon within which it pupates. Adult glossosomatids are generally brown to black with few markings, however, *Padunia* and *Protoptila* have a light transverse bar in the forewing. The species in the Southeast range in size from 2.4 to 8.5 mm in length as adults. Glossosomatids are usually univoltine, taking one year to complete their life cycle; however, some populations produce two or three generations per year (Jin and Ward, 2007). Some species of *Agapetus* in Great Britain have been inferred to have two generations per year (Crichton and Fisher, 1978).

### Subfamily Agapetinae Martynov

**Genus *Agapetus* Curtis** - [Habitat - Lotic erosional: Habit - Clingers (laterally compressed turtle shell case, mineral): Trophic - Scrapers, collectors - gatherers] This genus consists of more than 200 species worldwide, but is absent from the Neotropics. In North America, there are 42 described species with 29 known from the Southeast. Several recently described species were collected during this survey, and some type localities are in the parks of the monitoring networks (Etnier and others, 2010). In that paper, the authors suggest that *Agapetus* species are among the most sensitive caddisflies to human caused disturbance, particularly sedimentation and similar habitat alterations. Human activity that alters streams by eliminating the canopy and increasing the amount of sediment in streams eliminates *Agapetus* species from otherwise suitable habitat. We have observed that healthy populations of *Agapetus* can be found in National Forest and National Park lands while private lands in the vicinity of those protected areas will have few if any populations (Etnier and others, 2010). This is reflected in the tolerance value of 0.0 assigned to all *Agapetus* species. Bonada and others (2004), on the other hand, found larvae of *Agapetus* in Spain living in semiarid regions with relatively low water quality, and assigned the genus a high tolerance value.

At least one European species is known to have 6–7 larval instars in certain populations; however, of those North American species whose life histories have been investigated, larvae have 5 instars. Larvae are not identifiable at present.

| Species                                                                                                                                                                                                                                       | Parks                                   | States                                 | Elevation Range | Rankings       | Tolerance Value | Flight Dates                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------|-----------------|----------------|-----------------|------------------------------|
| <i>Agapetus kirchneri</i> CR Parker, DA Etnier, & JT Baxter, 2010                                                                                                                                                                             | <b>CUGA</b>                             | KY, TN, VA                             | 387 m           | n/a            | 0.0             | 25 Apr – 26 July (Apr - Jul) |
| Comments — This species was described from CUGA. We collected 5 specimens from Station Creek near the horse barn.                                                                                                                             |                                         |                                        |                 |                |                 |                              |
| <i>Agapetus tomus</i> HH Ross, 1941                                                                                                                                                                                                           | BISO, <b>CUGA</b> , GRSM <sup>(L)</sup> | AL, GA, KY, MI, MN, NC, OH, PA, TN, VA | 232-574 m       | G5, ALS1, NCS2 | 0.0             | 17 May - 6 Jul (Mar - Aug)   |
| Comments — <i>Agapetus tomus</i> is an eastern Appalachian species. It is ranked critically imperiled by Alabama, and imperiled by North Carolina. We have 24 collections and 942 specimens of this species, including 2 specimens from CUGA. |                                         |                                        |                 |                |                 |                              |

## Subfamily Glossosomatinae Wallengren

**Genus *Glossosoma* Curtis** - [Habitat - Lotic erosional (including large alpine rivers): Habit - Clingers (turtle shell case, mineral): Trophic - Scrapers] This genus consists of more than 120 species from the Holarctic and Oriental biogeographic regions. In the Southeast, three species are known, one of which is common and widespread in the region. Wymer and Morse (2000) provided a recent redescription of all stages of *G. nigror*, and keys to the Eastern species.

| Species                                | Parks                                                                                                      | States                                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates                  |
|----------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|-------------------------------|
| <i>Glossosoma nigror</i> N Banks, 1911 | BISO, BLRI, CARL, CHCH, COWP, <b>CUGA</b> , FODO, GRSM <sup>(L)</sup> , KIMO, LIRI, MACA, OBRI, RUCA, SHIL | AL, CT, DE, GA, IN, KY, LB, MA, MD, ME, MI, MN, NC, NF, NH, OH, ON, PA, QC, SC, TN, VA, VT, WI, WV | 112-1480 m      | G5       | 1.5             | 3 Mar - 15 Dec<br>(Mar - Sep) |

Comments — Adults have been collected in every month except January and Feb, but greatest adult emergence is through the summer months. Georgian and Wallace (1983) found *G. nigror* to be bivoltine in North Carolina. Trapp and Hendricks (1984) found two populations to be bivoltine and one population to be univoltine in Giles County, Virginia. The difference was attributed to cooler stream temperatures at the site with the univoltine population compared with the other two sites. Jin and Ward (2007) report that two populations they studied in Alabama were trivoltine, which they attributed to warmer stream temperatures than those found in more northern streams. Larvae grazed mostly on algae (50% of gut contents) and detritus (40%). We found *G. nigror* in 436 collections totaling 2,608 specimens from 13 parks during this study, which indicates that it is not at risk regionally. We found 72 specimens in CUGA.

## Family Hydroptilidae Stephens microcaddisflies

The family Hydroptilidae is commonly known as the micro-caddisflies due to their small size. Mature larvae range in size from 1.5 to 7.0 mm (Marshall, 1979). However, Hydroptilidae is the largest family of Trichoptera in terms of the number of described species, with about 2,000 species known worldwide (Holzenthal and others, 2007). In North America, approximately 19 genera are recognized which contain more than 200 species (Wiggins, 1996). In the Southeast, approximately 19 genera containing 173 species are known, many of them having been described within the past 30 years. Little is known of hydroptilid biology because of their small size. Hydroptilids are unique among caddisflies in that the first four instars are free living and only the final fifth instar builds a case. The final instar also is morphologically very different from the earlier instars, as they go through a process called hypermetamorphosis at the final molt. Nielsen (1948) published a widely cited study of hydroptilid biology that is a classic in Trichoptera literature. More recently, Resh and Houpp (1986) and Keiper and others (Keiper, 1999; Keiper, 2002; Keiper and Bartolotta, 2003; Keiper and Foote, 2000; Keiper and Harris, 2002; Keiper and Walton, 1999, 2000) have published studies of hydroptilid biology. As a generalization, hydroptilid larvae feed on diatoms and algae. Some species feed by piercing individual cells of algae and eating the contents. Others eat strands of algal filaments, or scrape diatoms from various substrates. Some species have feeding strategies that vary with instar. Most species are univoltine, although two generations per year have been reported in a few species (Nielsen, 1948; Unzicker and others, 1982). Larval cases are diverse within the family, but many species make a case type referred to as a “purse” case. These cases consist of two valves of silk attached along the upper and lower margins, and having the anterior and posterior ends open. The valves may be made entirely of silk, or may be covered with sand grains or incorporate algae, diatoms, or other materials. The larva can turn around inside the case and have its head extended from either end as it chooses. When not actively crawling about, the larva may attach the case to the substrate with silk. At pupation, the larva firmly affixes the case to the substrate and pupates within. Some genera have very different case types, which will be mentioned below. Larvae are indistinguishable at present.

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**Genus *Hydroptila* Dalman** - [Habitat - Lotic erosional and depositional (including seeps): Habit - Clingers (purse-type case of silk and fine mineral): Trophic - Piercers herbivores, scrapers] This is the largest genus in the family, having approximately 440 described species (Holzenthal and others, 2007). In North America, more than 100 species are currently known, with a number of undescribed species also known, including several found during this study. Final instar larvae make the typical purse case, usually made of silk with a coating sand grains, but sometimes with diatoms or algal filaments incorporated (Wiggins, 1996). Of the 28 species encountered during this study, only nine have a global or state rarity ranking. In addition, because it is not yet possible to identify *Hydroptila* larvae to species, the listed tolerance value (TV = 6.2) is based on evidence that at least some species are relatively tolerant of pollution. The status of *Hydroptila* species in terms of conservation needs is not well advanced. In CUGA, we found 12 species of *Hydroptila*. Only the two below are considered species of interest for this report.

| Species                                                                                                                                                                                                                                                                                                                                                                           | Parks                                                | States                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|-----------------|----------|-----------------|----------------------------|
| <i>Hydroptila amoena</i> HH Ross, 1938                                                                                                                                                                                                                                                                                                                                            | BISO, BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> , OBRI | AL, AR, IL, IN, KY, MN, MO, NH, OH, OK, ON, PA, QC, SC, TN, VA, WI | 260-859 m       | G5, ALS2 | 6.2             | 24 May - 6 Oct (Jun - Sep) |
| Comments — The state records for this species need to be re-evaluated because of the very similar, recently described <i>H. paramoena</i> . Alabama considers <i>H. amoena</i> imperiled. We have 15 collections and 159 specimens of this species, including a single male from CUGA.                                                                                            |                                                      |                                                                    |                 |          |                 |                            |
| <i>Hydroptila paramoena</i> SC Harris, 1985                                                                                                                                                                                                                                                                                                                                       | BISO, BLRI, CHCH, <b>CUGA</b> , LIRI, OBRI           | AL, GA, TN                                                         | 220-859 m       | G2, TNS2 | 6.2             | 9 May - 29 Sep (Mar - Oct) |
| Comments — <i>Hydroptila paramoena</i> is ranked imperiled globally and in Tennessee. However, some state records for <i>H. amoena</i> may actually refer to this species, and <i>H. paramoena</i> may be more widely distributed currently known. Adult up to 2.5 mm in length. We have 13 collections and 91 specimens of this species. In CUGA, we found 1 female and 8 males. |                                                      |                                                                    |                 |          |                 |                            |

**Genus *Neotrichia* Morton** — [Habitat — Lotic erosional: Habit — Clingers (case a tube of fine mineral): Trophic — Scrapers] The species of *Neotrichia* include the smallest of micro-caddisflies, often less than 2 mm in length. *Neotrichia* is endemic to the Neotropical and Nearctic geographic regions, with more than 110 known species. Approximately 30 species occur in North America, and 12 are reported from the Southeast. Known cases of *Neotrichia* are tubular and made of sand grains. Larvae are preferentially found on rocks in rapid currents of streams and rivers. Although several species occur in the region of the monitoring networks (Harris and Rasmussen, 2010), only one was collected during this study, although several are known from literature records from the parks. Continued sampling will be required to clarify the status of this genus in the parks. The only information available for members of this genus is where and when they have been collected. Their small size and our present inability to identify the larvae make it unlikely that biology of different species will be elucidated soon. Kentucky Division of Water (2009) assigns all *Neotrichia* larvae a tolerance value of 2.0.

| Species                                                                                                                                                                                                                 | Parks                             | States                         | Elevation Range | Rankings | Tolerance Value | Flight Dates               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------------------------|-----------------|----------|-----------------|----------------------------|
| <i>Neotrichia collata</i> HH Ross, 1938                                                                                                                                                                                 | <b>CUGA</b> , LIRI <sup>(L)</sup> | AL, IL, KY, ME, NC, SC, UT, VT | 347-419 m       | G5       | 2.0             | 18 Jul - 5 Aug (Jun - Sep) |
| Comments — This species was designated as threatened by the Invertebrate Taxa Review Committee of the South Carolina Heritage Trust Program (Floyd and Morse, 1993). In CUGA we collected 6 specimens from 2 locations. |                                   |                                |                 |          |                 |                            |

## Family Rhyacophilidae Stephens

### free-living caddisflies

The Rhyacophilidae consists of more than 700 species in five genera, one of which, *Rhyacophila* Pictet, contains nearly 600 species (Schmid, 1970). Two genera occur in North America, but only the genus *Rhyacophila* occurs in the study area. Rhyacophilid larvae are free-living, without a case or a retreat. The larvae are predators that search their cold stream habitats for prey items, typically other caddisfly larvae, stonefly and mayfly nymphs, as well as many other organisms of the appropriate size. When larvae are ready to pupate, they construct a domelike rock shelter in a protected area on stable substrate in the water.

**Genus *Rhyacophila* Pictet** - [Habitat - Lotic erosional: Habit - Clingers (free ranging): Trophic - Predators (engulfers), a few scrapers, collectors gatherers, shredders herbivores (chewers)] More than 120 species are known from North America and we recorded 26 species in the parks. *Rhyacophila* larvae are restricted to well-oxygenated, cold-water streams. Most species apparently are univoltine. When a larva is ready to pupate, it finds a protected spot under or between rocks, or even within rotten wood, and builds a loose shelter of sand and gravel held together with silk. Pupation normally lasts several weeks (Manuel and Folsom, 1982), but we have found one species during this study that survives in an intermittent stream by remaining in its pupal cocoon for up to four months. Most *Rhyacophila* larvae in the parks can be identified with available literature (Flint, 1962a; Weaver and Sykora, 1979; Unzicker and others, 1982; Prather and Morse, 2001 as corrected by Stocks and Morse, 2005), but considerable uncertainty remains concerning some species, as noted below. Much of the information in the Comments below is from Flint (1962a).

| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Parks                                                                                                                                                     | States                                                                                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|--------------------------------|
| <i>Rhyacophila carolina</i> N Banks, 1911                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | BISO, BLRI, CARL, CHCH, COWP, <b>CUGA</b> <sup>(L)</sup> , FODO, GRSM <sup>(L)</sup> , KIMO, LIRI, MACA, OBRI <sup>(L)</sup> , SHIL <sup>(L)</sup> , STRI | AL, CT, DE, FL, GA, KY, MA, ME, MO, NB, NC, NF, NH, NJ, NY, OH, ON, PA, QC, SC, TN, VA, VT, WV         | 114-1715 m      | G5       | 1.0             | 21 Mar - 5 Nov<br>(Apr - Sep)  |
| Comments — Often found in small streams less than 5 m in width. In South Carolina, Manuel and Folsom (1982) found this species to be univoltine with an extended adult flight period, with reproduction extending into Oct. Larva up to 16 mm in length. We have 325 collections and 1,543 specimens of this species, including 61 specimens from 10 locations in CUGA.                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                           |                                                                                                        |                 |          |                 |                                |
| <i>Rhyacophila carpenteri</i> LJ Milne, 1936                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> , OBRI                                                                                                            | KY, MA, NC, NF, NH, NY, OH, PA, QC, SC, TN, VA, VT, WV                                                 | 369-1623 m      | G5       | 1.0             | 25 May - 21 Jul<br>(May - Jul) |
| Comments — This species prefers small, cold brooks up to 3 m in width. Larva up to 16 mm in length. We have 18 collections and 66 specimens of this species, including 38 specimens from 2 locations in CUGA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                           |                                                                                                        |                 |          |                 |                                |
| <i>Rhyacophila fuscula</i> F Walker, 1852                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | BLRI, <b>CUGA</b> <sup>(L)</sup> , GRSM <sup>(L)</sup> , KIMO                                                                                             | AL, CT, DE, GA, IL, LB, MA, ME, MI, MN, NB, NC, NF, NH, NJ, NS, NY, ON, PA, QC, SC, TN, VA, VT, WI, WV | 211-1665 m      | G5       | 1.0             | 1 Dec - 27 Oct<br>(Apr - Oct)  |
| Comments — <i>Rhyacophila fuscula</i> is found in clean, cold streams of various sizes, but is not often in streams less than 1 m in width. Martin and Mackay (1983) found <i>R. fuscula</i> preferred headwaters and that it grew fastest on a diet of black fly and mayfly larvae compared with other prey items. Martin (1985) found it to be univoltine in Ontario streams. Manuel and Folsom (1982) found populations in South Carolina to be univoltine with extended emergence. Overwintering larvae were generally early instars. Adults emerged from Apr through Sep. Larva up to 25 mm in length. We have 467 collections and 2,458 specimens of this species, including 6 specimens from 4 locations in CUGA. |                                                                                                                                                           |                                                                                                        |                 |          |                 |                                |

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| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Parks                                                                                                                        | States                                                                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-----------------|----------|-----------------|--------------------------------|
| <i>Rhyacophila glaberrima</i> G Ulmer, 1907                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | BISO, BLRI, CARL, CHCH, <b>CUGA</b> <sup>(L)</sup> , FODO, GRSM <sup>(L)</sup> , LIRI, MACA, OBRI, RUCA, SHIL <sup>(L)</sup> | AL, AR, CT, GA, IL, IN, KY, MA, ME, MO, MS, NC, NH, NS, NY, OH, PA, QC, SC, TN, VA, VT, WV | 125-1694 m      | G5, ALS2 | 0.8             | 20 Mar - 6 Nov<br>(Jul - Oct)  |
| Comments — Despite being very widespread and being found in 10 parks, <i>R. glaberrima</i> is ranked S2 in Alabama. At LIRI, we discovered <i>R. glaberrima</i> pupae in mosses along the edge of an intermittent stream, Laurel Creek, after it had dried up at the start of the summer. We brought some of these pupae back to the lab for rearing, and adults emerged up to four months later. This extended pupal diapause has not been reported previously in <i>R. glaberrima</i> . The larvae of <i>R. glaberrima</i> cannot be distinguished from those of <i>R. montana</i> . We have never collected adults of these two species from the same location, although both occur in high elevation springs and seeps of BLRI. <i>Rhyacophila montana</i> is restricted to higher elevations (610-1850 m), while <i>R. glaberrima</i> is found at lower elevations (125-1694 m). Larva up to 12 mm in length. We have 198 collections and 746 specimens of this species, of which 24 specimens were found at 4 different locations in CUGA. |                                                                                                                              |                                                                                            |                 |          |                 |                                |
| <i>Rhyacophila ledra</i> HH Ross, 1939                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CHCH, <b>CUGA</b> , LIRI, MACA, OBRI, RUCA                                                                                   | AL, DE, GA, IL, IN, KY, MI, NC, OH, PA, SC, TN, VA, WV                                     | 172-549 m       | G5       | 3.4             | 21 Mar - 18 Jun<br>(May - Jul) |
| Comments — In addition to <i>R. ledra</i> , we also collected adults from LIRI that greatly resemble this species, except that the males lack parameres (structures of the male genitalia). It is possible that this is a population characteristic, or that these specimens represent an undescribed species. The ranges of the two forms do not overlap. Additional study is required. Adult up to 11 mm in length. We have 45 collections and 414 specimens of this species, with one male known from CUGA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                              |                                                                                            |                 |          |                 |                                |
| <i>Rhyacophila parantra</i> HH Ross, 1948                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | BISO, BLRI, <b>CUGA</b> , MACA, OBRI                                                                                         | IN, KY, MO, OH, QC, TN, VA, WV                                                             | 161-869 m       | G4       | 1.0             | 5 Apr - 28 Jul<br>(May - Jun)  |
| Comments — This species, like <i>R. banksi</i> , shows considerable variation that requires further study to clarify what the variation represents. Larvae live near the sources of cold, clear springs and streams, including those issuing from caves (Ross, 1948). Adult up to 9 mm in length. We have 27 collections and 199 specimens of this species. In CUGA we collected 12 specimens from 4 locations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                              |                                                                                            |                 |          |                 |                                |
| <i>Rhyacophila torva</i> HA Hagen, 1861                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | BISO, BLRI, CARL, COWP, <b>CUGA</b> <sup>(L)</sup> , GRSM <sup>(L)</sup> , KIMO, LIRI, MACA, OBRI                            | AL, CT, DC, DE, KY, MA, ME, NC, NF, NH, NJ, NS, NY, OH, PA, QC, SC, TN, VA, VT, WI, WV, WY | 177-1757 m      | G5, ALS2 | 1.5             | 23 Feb - 21 Sep<br>(Feb - Sep) |
| Comments — The preferred habitat seems to be small streams up to 6 m in width. Considered imperiled in Alabama. Larva up to 24 mm in length, adult up to 10 mm. We have 135 collections and 357 specimens of this species. Seventy-five specimens were collected from 3 locations in CUGA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                              |                                                                                            |                 |          |                 |                                |

## Suborder Annulipalpia Martynov

There is little argument about the monophyly of the Annulipalpia, although there is some disagreement about exactly which families to recognize. However, there is no dispute that the five families from the study area are annulipalpian. Annulipalpia are characterized by making fixed nets, which they use to capture particles from the water column. The form of nets and retreats made are characteristic not only of the families, but also of the genera and sometimes the species. The requirements of net construction and maintenance dictate that larvae live in flowing, or at least moving water—some are found in lakes that have enough wave action to support a net.

### Family Hydropsychidae Curtis retreat-making caddisflies

Hydropsychidae is the third largest family of caddisflies, with over 1,500 described species (Holzenthal and others, 2007) in five subfamilies, four of which occur in the study area. The taxonomy of the family is in a state of flux. Some authors have treated one of the subfamilies as a separate family Arctopsychidae: (Nimmo, 1987; Schmid, 1998). Other authors split the large genus *Hydropsyche* into two or more genera. Recent studies using molecular and (or) morphological analyses find little support for splitting the Arctopsychinae from the larger family. Recent evidence also finds little support for splitting out the genera *Ceratopsyche* and *Symphitopsyche* from *Hydropsyche*. We have adopted the more conservative approach here: among the hydropsychids found in this survey, we recognize the subfamilies Diplectroninae, Hydropsychinae, and Macronematinae; and we recognize the genus *Hydropsyche* without subgenera.

The nets and retreats made by the larvae have attracted a good deal of ecological and evolutionary study (Alstad, 1982; Edler and Georgian, 2004; Georgian and Wallace, 1981; Loudon and Alstad, 1990; Miller, 1984; Thorp, 1983, 1984; Thorp and others, 1986; Wallace and Merritt, 1980; Wallace and Sherberger, 1975). Each subfamily, genus, and species tends to have characteristic retreat and net structure, and a consistent net mesh size, which have led to considerable investigation into the mechanisms by which the larvae partition the stream resources of space, current speed, and drifting particulate matter. All larvae of Hydropsychidae have a scraper and file feature that permits them to make sounds. This has been demonstrated in *Cheumatopsyche* and *Macrostemum*, but has been best studied in *Hydropsyche* and is discussed under that genus.

### Subfamily Diplectroninae Ulmer

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**Genus *Diplectrona* Westwood** - [Habitat - Lotic erosional (headwater streams): Habit - Clingers (net spinners, fixed retreats): Trophic - Collectors filterers (coarse particles, especially detritus)] This genus has about 100 species worldwide, but is absent from Africa and most of South America (Flint and others, 2004). Atypically among hydropsychids in North America, adult genitalia are of little use in distinguishing species, so characters of the head of adults are given more weight. Larvae seem to hold more promise for species discrimination, so an approach that relies on larval characters and molecular analyses is being used to clarify what is likely a complex of several species instead of the two listed here (Harvey and others, 2012). Because the adults are so unreliably identified, we list below records based on larval collections. Consequently, we do not present flight dates from our data, but instead only provide flight dates based on published information.

| Species                                  | Parks                                                                                                      | States                                                                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates |
|------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|--------------|
| <i>Diplectrona modesta</i> N Banks, 1908 | BISO, BLRI, CARL, CHCH, COWP, <b>CUGA</b> , FODO, GRSM <sup>(1)</sup> , GUCO, KIMO, LIRI, MACA, OBRI, SHIL | AL, AR, CT, DE, FL, GA, IL, IN, KS, KY, LA, MA, ME, MI, MO, MS, NC, NF, NH, NS, NY, OH, OK, ON, PA, QC, SC, SD, TN, VA, VT, WI, WV | 112-1533 m      | G5       | 2.2             | (Mar - Sep)  |

Comments — This "species" is a complex of at least five forms (Harvey and others, 2012). These forms are distinct based on molecular analyses, and can be recognized as larvae, but not yet as adults. Several of these forms have been collected during this survey. Ongoing studies combining molecular and morphological methods are attempting to clarify this situation and determine which, if any, of the recognizable forms should be treated as separate species or other taxonomic categories. We labeled the adults as "*Diplectrona* species." We suggest that this species be considered of special interest because of the current taxonomic uncertainty. Studies of the biology of *D. modesta* in the literature indicate a univoltine life history (for example, (Benke and Wallace, 1980), but all such information will need to be reevaluated when the current systematic studies are completed). We have 382 collections and 4,930 specimens of this species complex, including 6 specimens from 2 locations in CUGA.

**Genus *Homoplectra* Ross** - [Habitat - Lotic erosional (rock face springs and seeps): Habit - Clingers (net spinners, fixed retreats): Trophic - Collectors filterers] This is a North American genus with about a dozen species. Three are found in the study area, the rest are restricted to the West. Larvae make retreats in small, high gradient streams having gravel and cobble substrates.

| Species                                     | Parks                                                            | States                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates                   |
|---------------------------------------------|------------------------------------------------------------------|--------------------------------------------|-----------------|----------|-----------------|--------------------------------|
| <i>Homoplectra doringa</i> (LJ Milne, 1936) | BISO, BLRI, CHCH, <b>CUGA</b> , GRSM <sup>(1)</sup> , LIRI, OBRI | AL, AR, IN, KY, MA, NC, NH, SC, TN, VA, WV | 232-1944 m      | G5, ALS1 | 6.6             | 20 Mar - 20 Jul<br>(Apr - May) |

Comments — The only relatively common and widespread species in the genus in the East. It is rated critically imperiled in Alabama. We have 22 collections and 82 specimens of this species, including 32 specimens from 2 locations in CUGA.

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### Subfamily Hydropsychinae Curtis

**Genus *Cheumatopsyche* Wallengren** - [Habitat - Lotic erosional (especially warmer streams and rivers): Habit - Clingers (net spinners, fixed retreats): Trophic - Collectors filterers (particles include algae, detritus, some animals)] A cosmopolitan genus of more than 250 species, including more than 50 in North America (Gordon, 1974). It is absent from the Neotropics. Fifteen species were detected during this survey. Larvae prefer warmer streams, and build their retreats in more sheltered, slower current microhabitats than do *Hydropsyche*. At this time, *Cheumatopsyche* larvae can only be separated into broad groups. Mature larvae may be as much as 13 mm in length; adults range from 5 - 9 mm in length. The genus is considered more tolerant of pollution than many other caddisflies, with a genus tolerance value of 6.6. Betten (1934) reported that the larvae of one species, *C. analis* (which is extremely common in the study area), became pests when the larvae entered a fish hatchery in New York and began to make retreats that incorporated fish eggs. All of our records are based on adult males.

| Species                                                                                                                                                                                                                                                                                                                    | Parks                                                            | States                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------|----------|-----------------|-----------------------------|
| <i>Cheumatopsyche aphantia</i> HH Ross, 1938                                                                                                                                                                                                                                                                               | <b>CUGA</b>                                                      | AR, IL, IN, KS, KY, ME, MI, MN, MOM NB, ND, NH, NY, OH, OK, PA, QC, TN, TX, VT, WI | 389 m           | G5       | 6.6             | 15 May - 21 Jul (May - Sep) |
| Comments — Larvae prefer small spring-fed brooks and creeks. Adults 7-9 mm in length. We collected two males from the upper beaver pond on Davis Branch.                                                                                                                                                                   |                                                                  |                                                                                    |                 |          |                 |                             |
| <i>Cheumatopsyche ela</i> DG Denning, 1942                                                                                                                                                                                                                                                                                 | BLRI, CARL, <b>CUGA</b> , GRSM <sup>(L)</sup> , STRI             | AL, DC, DE, GA, ME, NC, NY, ON, PA, QC, SC, TN, VA, WV                             | 170-987 m       | G5, ALS2 | 6.6             | 19 May - 16 Jul (Apr - Oct) |
| Comments — This species is relatively common and widespread in the East, found from Ontario, Quebec, and south to Alabama and Georgia. However, in Alabama it is considered imperiled. We have 6 collections and 70 specimens of this species. In CUGA, we found two specimens from the upper beaver pond on Davis Branch. |                                                                  |                                                                                    |                 |          |                 |                             |
| <i>Cheumatopsyche gyra</i> HH Ross, 1938                                                                                                                                                                                                                                                                                   | <b>CUGA</b> , GRSM                                               | GA, KY, ME, NC, PA, SC, VA, WV                                                     | 381 m           | G4       | 6.6             | 19 May - 16 Jul (May - Aug) |
| Comments — Female up to 7 mm in length. We collected a single male from the beaver pond bridge on Davis Branch.                                                                                                                                                                                                            |                                                                  |                                                                                    |                 |          |                 |                             |
| <i>Cheumatopsyche harwoodi</i> DG Denning, 1949                                                                                                                                                                                                                                                                            | BLRI, COWP, <b>CUGA</b> , GRSM <sup>(L)</sup> , KIMO, MACA, OBRI | AL, CT, GA, IN, KY, ME, NC, NS, NY, OH, ON, PA, PE, RI, SC, TN, VA, WV             | 177-1176 m      | G5, ALS2 | 6.6             | 23 May - 26 Sep (May - Sep) |
| Comments — Although widespread and found in seven parks, <i>C. harwoodi</i> is considered imperiled in Alabama. We have 57 collections and 2,816 specimens of this species. We collected 5 specimens from 2 locations in CUGA.                                                                                             |                                                                  |                                                                                    |                 |          |                 |                             |

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**Genus *Hydropsyche* Pictet** - [Habitat - Lotic erosional: Habit - Clingers (net spinners, fixed retreats): Trophic - Collectors filterers (particles include diatoms, algae, detritus, animals)] Another very large genus having nearly 400 species in all biogeographic regions, but absent from the Neotropics. *Hydropsyche* larvae, as all larvae of Hydropsychidae, are able to make sounds by stridulating, a process in which a projection on the fore femur, the scraper, is stroked across a series of fine ridges, the file, on the underside of the head. Studies by Jansson and Vuoristo (1979) demonstrated that stridulation is primarily used as a defensive action by larvae in a retreat in response to another larva attempting to enter its retreat, and is normally successful more than 90% of the time in repelling the advancing larva. In order to stridulate successfully, larvae hold their forelegs steady by clinging to the net and moving their head. Matczak and Mackay (1990) report that *Hydropsyche* larvae respond to resource limitations (amount of food and amount of suitable substrate) by adjusting the size of their territories around their retreats, and by becoming more aggressive as resources become scarcer. This genus has been variously reshuffled, split, and recombined in different fashions for many years. Some North American workers still prefer to split the genus into *Hydropsyche sensu strictu*, also known as the *scalaris* species group, and *Ceratopsyche*. Others treat *Ceratopsyche* as a subgenus of *Hydropsyche*, or as the *morosa* species group of *Hydropsyche*. Because of the current lack of clarity, we prefer to treat all species as *Hydropsyche*, although in the Comments we indicate the species group for each species. Larvae of many species can be identified, with caution, using one of several resources: Schuster and Etnier (1978), Scheffer and Wiggins (1986), Unzicker and others (1982).

| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Parks                                                                            | States                                                                                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|----------------------------|
| <i>Hydropsyche alhedra</i> HH Ross, 1939                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> , LIRI, OBRI                             | AB, AK, BC, CO, CT, IA, MA, MB, ME, MN, NC, ND, ON, PA, QC, SC, SD, SK, TN, VA, VT, WI, WV, WY, YT                                                 | 266–968 m       | G5       | 0.0             | 5 Apr - 29 Sep (May - Sep) |
| Comments — [ <i>morosa</i> species group] Northern transcontinental, from Alaska and the Yukon to Quebec, and south to North Carolina and Tennessee. The populations in GRSM are considered to be atypically large for the species and to have an unusually synchronous spring emergence (Scheffer and Wiggins, 1986). Those larvae normally have a uniformly dark brown head capsule, as well, compared with most other populations in which the head capsule is normally brown with light spots on the frontoclypeus. Larvae are found on rocks in fast currents. <i>Hydropsyche alhedra</i> is considered highly intolerant of disturbance, even though in Wisconsin they often occur in silty streams with eroded banks (Schmude and Hilsenhoff, 1986). We have 50 collections and 450 specimens of this species, including 30 specimens from 6 locations in CUGA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                  |                                                                                                                                                    |                 |          |                 |                            |
| <i>Hydropsyche bronta</i> HH Ross, 1938                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | BLRI, <b>CUGA</b> <sup>(L)</sup> , GRSM <sup>(L)</sup>                           | AB, AR, CO, CT, DE, IA, IL, IN, KY, MA, MB, MD, ME, MI, MN, MO, MT, NB, NC, ND, NE, NH, NS, NY, OH, OK, ON, PA, QC, SC, SK, TN, VA, VT, WI, WV, WY | 329–1492 m      | G5       | 2.7             | 19 May - 5 Sep (May - Oct) |
| Comments — [ <i>morosa</i> species group] <i>H. bronta</i> larvae come in two forms, the typical “checkerboard” pattern consisting of several regularly spaced light spots on a dark frontoclypeus; and the “Appalachian” form that has alternating dark and light transverse bands across the head capsule. Intermediates between the two forms are also reported (Scheffer and Wiggins, 1986). In the study area, most larvae have the distinctive Appalachian pattern. Larvae seem to prefer cold mountain streams, but have also been collected in small, warm creeks in North Carolina (Schuster and Etnier, 1978). In Wisconsin Schmude and Hilsenhoff (1986) found larvae in silty streams that often contain algae and slimes, and are uncommon in cleaner, wooded streams. Mackay (1984) found populations to be bi- and trivoltine. Michael and Culver (1987) found that <i>H. bronta</i> larvae chose smaller-sized substrate over larger-size substrate in the presence of either of two different predators. However, the presence of one of the two predators caused increased drifting, while the presence of the other predator did not affect drifting behavior. Larvae up to 14 mm in length, adults up to 10 mm. We have 45 collections and 150 specimens of this species. Of these 19 were collected from 4 locations in CUGA. |                                                                                  |                                                                                                                                                    |                 |          |                 |                            |
| <i>Hydropsyche cheilonis</i> HH Ross, 1938                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | BISO <sup>(L)</sup> , BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> , LIRI, MACA, OBRI | AL, IL, IN, KY, MI, NC, OH, PA, TN, VA, WI, WV                                                                                                     | 177–1086 m      | G5       | 1.4             | 8 Jun – 28 Sep (Apr - Aug) |
| Comments — [ <i>morosa</i> species group] We found 52 specimens of <i>H. cheilonis</i> at 8 locations in CUGA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                  |                                                                                                                                                    |                 |          |                 |                            |

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| Species                                                                                                                                                                                                                                                                                 | Parks                                                                                            | States                                                                                                                                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|-----------------------------------|
| <i>Hydropsyche etnieri</i> GA Schuster & A Talak, 1977                                                                                                                                                                                                                                  | CHCH, <b>CUGA</b>                                                                                | GA, KY, TN, VA                                                                                                                                             | 220-433 m       | G2       | 4.3             | 16 Jun - 20 Jul<br>(May - August) |
| Comments — [morosa species group] We collected 272 specimens from 2 locations in CUGA.                                                                                                                                                                                                  |                                                                                                  |                                                                                                                                                            |                 |          |                 |                                   |
| <i>Hydropsyche slossonae</i> N Banks, 1905                                                                                                                                                                                                                                              | BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> , KIMO                                                   | AB, AR, BC, CO, CT, DE, IL, IN, KY, LB, MA, MB, ME, MI, MN, MO, MT, NB, NC, ND, NF, NH, NJ, NS, NT, NY, OH, ON, PA, QC, SC, SD, SK, TN, VA, VT, WI, WV, WY | 211-1492 m      | G5       | 0.0             | 1 May - 30 Oct                    |
| Comments — [morosa species group] We found 14 specimens from Martins Fork in CUGA.                                                                                                                                                                                                      |                                                                                                  |                                                                                                                                                            |                 |          |                 |                                   |
| <i>Hydropsyche sparna</i> HH Ross, 1938                                                                                                                                                                                                                                                 | BISO, BLRI, CARL, CHCH, COWP, <b>CUGA</b> , GRSM, GUCO, KIMO, LIRI, MACA, NISI, OBRI, RUCA, SHIL | AL, CT, DE, GA, IL, IN, KS, KY, LB, MA, MB, MD, ME, MI, MN, MS, NB, NC, NE, NJ, NS, NY, OH, ON, PA, PE, QC, SC, TN, VA, VT, WI, WV                         | 116-1929 m      | G5       | 2.5             | 12 Apr – 27 Oct                   |
| Comments — [morosa species group] This is a common and widespread species. We collected 9,450 specimens from 15 parks. In CUGA we found 66 specimens from 11 locations.                                                                                                                 |                                                                                                  |                                                                                                                                                            |                 |          |                 |                                   |
| <i>Hydropsyche ventura</i> HH Ross, 1941                                                                                                                                                                                                                                                | BISO, BLRI, <b>CUGA</b> , OBRI <sup>(L)</sup>                                                    | CT, KY, MA, ME, MN, NC, NF, NY, ON, PA, QC, TN, VA, VT, WV                                                                                                 | 260-807 m       | G5, NCS3 | 0.0             | 17 May - 15 Sep<br>(May - Sep)    |
| Comments — [morosa species group] This species "occurs in cold, rapid unpolluted streams" (Scheffer and Wiggins, 1986). It is extremely sensitive to disturbance. We have 9 collections and 53 specimens of this species. Of these 8 specimens were collected from 3 locations in CUGA. |                                                                                                  |                                                                                                                                                            |                 |          |                 |                                   |

## Family Polycentropodidae Ulmer

### polycentropodid caddisflies

This cosmopolitan family has more than 650 described species in 15 (Chamorro and Holzenthal, 2011; Holzenthal and others, 2011) or 23 (de Moor and Ivanov, 2008) genera. The Oriental region has approximately 230 described species, the Neotropical realm has more than 170, the Palearctic has more than 100, while the Nearctic, Afrotropical, and Australian regions have less than 100 species each. In North America, fewer than 80 species are known among 8 genera. We collected 30 species in 6 genera during this study. Larvae do not make cases; rather they make silken nets of several characteristic configurations. These are described for each genus. Many are filter feeders, however others are predators.

**Genus *Nyctiophylax* Brauer** - [Habitat - Lotic erosional and depositional, lentic littoral: Habit - Clingers (silk tube retreats): Trophic - Predators (engulfers), collectors filterers, shredders herbivores] More than 100 species have been described in this genus, from most regions of the world. The majority of species are found in the Oriental, with about 12 species known from North America. We collected 9 species during this survey, of which 6 were found in BLRI. Larvae are predators that make retreats in substrate depressions that are very similar to those made by *Cernotina*. Life history is generally unknown for *Nyctiophylax* species, but probably is univoltine for most (Unzicker and others, 1982). A genus level tolerance value of 0.9 has been assigned.

| Species                                     | Parks                                                | States                                                                                                                                                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates               |
|---------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|----------------------------|
| <i>Nyctiophylax affinis</i> (N Banks, 1897) | BISO, BLRI, CARL, CUGA, GRSM, LIRI, NISI, SHIL, STRI | AL, AR, BC, CT, DE, FL, GA, IL, IN, KS, KY, LA, MA, MB, ME, MI, MN, MO, MS, MT, NC, ND, NF, NH, NJ, NS, NY, OH, OK, ON, PA, PQ, SC, SD, SK, TN, TX, VA, VT, WI, WV, WY | 129-1080 m      | G5       | 0.9             | 28 May - 1 Aug (Jun - Sep) |

Comments — We have 30 collections and 147 specimens of this species, including 14 specimens from 3 locations at CUGA.

**Genus *Plectrocnemia* Stephens** - [Habitat - Lotic erosional, lentic littoral: Habit - Clingers (silk tube retreats): Trophic - Predators (engulfers), collectors filterers, shredders herbivores] This genus contains 91 species (Chamorro and Holzenthal, 2011), with about a dozen known from North America. For many years, North American workers have included this genus as a part of the genus *Polycentropus*, along with the genus *Holocentropus* McLachlan. Chamorro and Holzenthal (2011) restored both groups to genus level following their phylogenetic analysis of the family Polycentropodidae. We use their treatment here. Larvae build sac-like nets with a small tubular dwelling chamber (Lepneva, 1964).

| Species                                       | Parks            | States                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates    |
|-----------------------------------------------|------------------|------------------------------------------------------------------------------------|-----------------|----------|-----------------|-----------------|
| <i>Plectrocnemia nascotia</i> (HH Ross, 1941) | BISO, BLRI, CUGA | AL, DE, GA, IN, KS, MA, ME, MN, NB, NC, NH, NS, OH, OK, ON, PA, QC, SC, TX, VA, WI | 218-1080 m      | G5, ALS1 | 3.5             | 18 May - 18 Jul |

Comments — This species is considered critically imperiled in South Carolina. We have 4 collections and 29 specimens of this species. All specimens were collected at ponds, including 1 specimen from Davis Branch beaver pond in CUGA.

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### Family Psychomyiidae Walker psychomyiid caddisflies

The Psychomyiidae is a small, nearly cosmopolitan family of more than 400 species in nine genera. Psychomyiids are found in every biotic realm with the exception of the Neotropics. In North America, four genera with nearly 20 species are known, but only three species in two genera are known from the study area. One of those is *Lype diversa* Banks, 1914, a widespread predominantly eastern species that we collected in 14 parks.

**Genus *Psychomyia* Latreille** - [Habitat - Lotic erosional: Trophic - Scrapers] Flint (1964) described and keyed the larvae of the species that occur in the parks.

| Species                                                                                                             | Parks                                                | States                                                                                                                                                                                                        | Elevation Range | Rankings | Tolerance Value | Flight Dates  |
|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|---------------|
| <i>Psychomyia flavida</i> HA Hagen, 1861                                                                            | BISO, CHCH, CUGA, GRSM, KIMO, LIRI, MACA, OBRI, SHIL | AB, AL, AR, AZ, BC, CA, CO, CT, DC, DE, FL, ID, IL, IN, IS, KS, KY, MA, MB, MAD, ME, MI, MN, MO, MT, NB, NC, MAD, NH, NJ, NS, NY, OH, OK, ON, OR, PA, QC, SC, SD, SK, TN, UT, VA, VT, WA, WI, WV, WY, Siberia | 152-1074 m      | G5       | 3.0             | 9 May – 6 Oct |
| Comments — We collected more than 3,000 specimens of this species, including 89 specimens from 4 locations in CUGA. |                                                      |                                                                                                                                                                                                               |                 |          |                 |               |

## Family Philopotamidae Stephens

### fingernet-making caddisflies

Another large cosmopolitan family, Philopotamidae has about 800 described species and 20 genera. In North America five genera are recognized, two of those only recently erected. Philopotamid larvae are characterized by the unique membranous, T-shaped labrum, or “upper lip.” Larvae construct a fine-meshed tube attached to rocks or other solid substrates in flowing water. The nets are kept expanded by the flow of water through them, and collapse into an amorphous mass when removed from the water. The labrum is specially modified to aid with the construction of these nets, being able to lay down about 70 fine strands of silk simultaneously. Wallace and Malas (1976) calculated that a single net of a mature *Dolophilodes distincta* larva could contain up to 100 million tiny mesh openings and more than a kilometer of silk. Philopotamid nets have the finest mesh found among filter-feeding caddisflies. Because of this, philopotamid larvae primarily consume fine detritus (>85% of their diet).

**Genus *Chimarra* Stevens** - [Habitat - Lotic erosional (warmer rivers): Habit - Clingers (saclike silk nets): Trophic - Collectors filterers] This is a very large genus having nearly 600 described species in all biogeographic regions of the world. In North America, about 20 species are known, with 10 known from the Southeast. We encountered five species in the parks. Most species in this genus are sensitive to pollution and disturbance.

| Species                                 | Parks                                                                                                                                                 | States                                                                                                                                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates                   |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|--------------------------------|
| <i>Chimarra aterrima</i> HA Hagen, 1861 | ABLI, BISO <sup>(L)</sup> , BLRI, CARL, CHCH, COWP, <b>CUGA</b> , FODO, GRSM <sup>(L)</sup> , KIMO, LIRI, MACA, NISI, OBRI, RUCA, SHIL <sup>(L)</sup> | AL, AR, CT, DC, DE, FL, GA, IL, IN, KY, LA, MA, MB, MD, ME, MI, MN, MO, MS, NB, NC, NF, NH, NJ, NS, NY, OH, OK, ON, PA, QC, SC, TN, TX, VA, VT, WI, WV | 114-739 m       | G5       | 2.6             | 21 Mar - 16 Oct<br>(Apr - Sep) |

Comments — Widespread and common in North America, and throughout the study area. We have 103 collections and 734 specimens of this species, including 51 specimens from 2 locations in CUGA.

**Genus *Wormaldia* McLachlan** - [Habitat - Lotic erosional: Habit - Clingers (sac like silk nets): Trophic - Collectors filterers] This genus is cosmopolitan, with nearly 150 species. Most species are Oriental or Western Palearctic, but approximately 20 species are found in North America. Muñoz-Quesada and Holzenthal (2008) revised the North American species and provide keys for adult males. We found four species in the parks. We also found specimens that we are hesitant to put a name on, as they have characters that do not fit exactly with any known species.

| Species                               | Parks                                                                                                               | States                                                                                                                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|--------------|
| <i>Wormaldia moesta</i> N Banks, 1914 | ABLI, BISO, BLRI, CARL, COWP, <b>CUGA</b> , GRSM <sup>(L)</sup> , KIMO, LIRI, MACA, OBRI, RUCA, SHIL <sup>(L)</sup> | AL, AR, CT, DE, FL, GA, IL, IN, KY, MA, MB, ME, MN, MO, MS, NB, NC, NF, NH, NJ, NS, NT, NY, OH, OK, ON, PA, QC, SC, TN, VA, VT, WI, WV | 51-1786 m       | G5       | 2.0             | 21 -16 Dec   |

Comments — A common and widespread species. We have 248 collections and 788 specimens of this species. Six specimens were found at two locations in CUGA.

## Suborder Integripalpia Martynov

This is the suborder of the case-building caddisflies, which represents just over one third of all Trichoptera. The development of cases was a major milestone in the evolution of caddisflies (Mackay and Wiggins, 1979), and, of course, cases have attracted a great deal of attention from scientists, and people in general. The roles of cases continue to be debated, with many ideas being propounded about their function in caddisfly biology. An obvious idea is that cases provide protection for the larvae, either directly by providing a shelter when a larva encounters a predator, or indirectly by serving as camouflage or by protecting the larva from environmental hazards. Some workers suggest that cases are essential in respiration, enhancing the flow of fresh water over the gills of the larva as its abdomen undulates within the case. This has allowed many species to colonize and inhabit warmer, lower oxygen habitats than might otherwise have been possible. In addition, it is possible that cases serve as a means of reducing cannibalism among larvae under certain conditions (Wissinger and others, 1996). Good expositions of many of these ideas are found in Wiggins (1996, 2004). Most of these ideas have supporters and critics, and no doubt, many new ideas remain to be postulated. Under any circumstances, cases are a key element in the lives of the Integripalpia.

## Family Apataniidae Wallengren

### apataniid caddisflies

This is a small Holarctic family with fewer than 200 species. Two genera and three species are currently recognized from the study area. The two genera are placed into separate subfamilies.

**Genus *Manophylax* Wiggins** – [Habitat – Lotic erosional (torrential): Habit – Clingers (case tapered, curved, mineral and plant materials): Trophic – Scrapers] Chuluunbat and others, (2010) described a new species of *Manophylax* from Alaska, raising the known number of species in this genus to seven. Three species occur in Japan, and four species occur in North America. Larvae are notable for living on vertical or near-vertical rock faces that are moist much of the time, but may be dry for extended periods of time. Schuster (1993) considers both of the regional species to be terrestrial insects. Adults emerge in late March, followed quickly by mating and egg-laying. Eggs are laid on the rock wall of their habitat. Larvae hatch from the eggs in about three weeks. Development requires two or more years, so all instars are present almost continuously. Final instar larvae pupate in late October, becoming pharate adults by November. Since the habitats of *Manophylax* are not the sort regularly monitored in macroinvertebrate monitoring programs, these species have not been assigned a tolerance. However, Schuster (1993) considered both species to be potentially at risk from typical maintenance activities, such as road-side bush-hogging, snow removal, and any other activities which would alter the habitats of populations along roads.

| Species                                     | Parks      | States     | Elevation Range | Rankings       | Tolerance Value | Flight Dates       |
|---------------------------------------------|------------|------------|-----------------|----------------|-----------------|--------------------|
| <i>Manophylax butleri</i> GA Schuster, 1997 | BISO, CUGA | KY, TN, WV | 331-448 m       | G2, KYS2, TNS2 | n/a             | 18 Apr (Mar - Apr) |

Comments — This species is found on vertical rock faces that are moist only part of the year. In some locations, they are found on exposed rock walls with no vegetation on or near the walls. In other locations they may be found on walls with moss or other vegetation on or obscuring the rock surface. We have found them in both situations in BISO. When the rocks dry out, larvae become inactive. When the rock walls become moist again and remain moist for a period of time, larvae become active again. But, when dry conditions return, the larvae again become inactive. When active, larvae feed on diatoms and blue-green algae. It is not surprising, therefore, that larvae grow slowly, taking two to three years to mature (Schuster 1997). This species was not collected in CUGA during this survey, but M. Floyd (Fish and Wildlife Service, KY) collected specimens just outside the CUGA boundary on a rock wall adjacent to a trail leading into the park. Future collecting will undoubtedly reveal populations inside the park. Considered imperiled in Kentucky and Tennessee. Case up to 10 mm in length, adult up to 9 mm. We have 3 collections and 29 specimens of this species. However, the specimens from CUGA actually are known from a rock wall just a few meters outside of the boundary, and thus technically are not actually known from the park.

## Family Calamoceratidae Ulmer

### thick-horned caddisflies

There are approximately 175 species in eight genera worldwide in this family (Holzenthal and Andersen, 2007). Only three genera occur in North America, and only two of those, having one species each, occur in the study area. Only the genus *Heteroplectron* was found in CUGA. The larvae of the two genera make very different cases; those of *Heteroplectron* are described below. Both species are shredders that feed on leaves and other detritus that accumulate in slower reaches of small streams and rivers.

**Genus *Heteroplectron* McLachlan** - [Habitat - Lotic erosional (detritus) and depositional (detritus): Habit - Sprawlers (case a hollowed out stick or piece of bark): Trophic - shredders detritivores (chewers, of leaf litter and gougers of wood), scrapers?] This is another genus having species disjunct between North America and Asia (Holzenthal and Andersen, 2007). The two North American species are disjunct continentally, *H. americanum* restricted to the east coast and *H. californicum* restricted to the west coast. Larvae normally make a case by hollowing out a twig. The main cavity is lined with silk, and an opening is left at both ends for water circulation; in long twigs, the posterior opening is made in the side of the twig.

| Species                                         | Parks                                                                                                          | States                                                         | Elevation Range | Rankings | Tolerance Value | Flight Dates                |
|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------|----------|-----------------|-----------------------------|
| <i>Heteroplectron americanum</i> F Walker, 1852 | BISO <sup>(L)</sup> , BLRI, <b>CUGA<sup>(L)</sup></b> , GRSM <sup>(L)</sup> , KIMO, OBRI <sup>(L)</sup> , SHIL | AL, CT, DE, GA, KY, MA, ME, NC, NH, NJ, NY, QC, SC, TN, VA, VT | 124-1025 m      | G5, ALS2 | 6.6             | 15 May - 26 Jul (Mar - Jun) |

Comments — Patterson and Vannote (1979) studied the life history of *H. americanum* in Delaware. The life cycle is univoltine, with pupation occurring in April and adult emergence about three weeks later. Eggs were deposited in masses on submerged branches or tree roots, or among mosses at the perimeter of the stream. Egg development time was strongly correlated with temperature, ranging from 12 days at 20°C to 65 days at 8°C. First instar larvae made a case of detritus fragments within 10 minutes of leaving the egg mass. Larvae began hollowing twigs for cases during the second and third instars. Final instar cases ranged from 11-37 mm. A few larvae made cases of small pieces of decaying wood, or of plant parts, or appropriated empty *Psilotreta* cases. Most larvae reach the final instar by December. Alabama has ranked *H. americanum* imperiled. We have 48 collections and 153 specimens of this species. A single specimen is known from CUGA.

## Family Leptoceridae Leach

### long-horned caddisflies

The Leptoceridae is the second largest family of Trichoptera, with approximately 1,800 described species and 47 described genera (Holzenthal and Andersen, 2007). The common name derives from the very long antennae of the adults, which are much longer than the front wings. Adults typically have narrow front wings, which are often strikingly marked and colorful, unlike in so many other caddisfly adults. The wing patterns are important in identification, and some adults are more easily identified from dry pinned material than from alcohol material. Larvae make a wide variety of cases and live in many different habitats. Fittingly, the larvae also tend to have unusually long antennae for caddisfly larvae.

**Genus *Ceraclea* Stephens** - [Habitat - Lotic and lentic (some in sponges): Habit - Sprawlers, climbers (case a fine mineral or silk tube): Trophic - Collectors gatherers, shredders herbivores (chewers), predators (engulfers of sponge)] The genus *Ceraclea* is composed of approximately 160 species from every biotic region except the Neotropics. Approximately 40 species are found in North America, and 16 were found in this study. *Ceraclea* larvae engage in a variety of behaviors and have diverse feeding habits. Some species are detritus feeders and some are herbivores. Some species are predators of freshwater sponges. Morse (1975) revised *Ceraclea* adults and Resh (1976a, b) reviewed the biology, described the larvae, and presented a key to 22 species. Much of the information below is taken from these works. The biology of *Ceraclea* species that feed on sponges has received a great deal of study (Corallini and Gaino, 2003; Resh, 1976a, b; Resh and others, 1976). Larvae that live in and feed on sponges differ from other larvae morphologically, as well as in habits. The antennae of most leptocerid larvae are quite long relative to other caddisflies, being up to eight times the length versus the diameter of the antenna. Sponge feeding larvae of *Ceraclea* have much shorter antennae that are only twice as long as wide. In addition, larvae of sponge feeders lack the parafrontal areas characteristic of larvae that do not feed on sponges. In addition, the cases of sponge-feeding larvae are cylindrical and are made entirely of silk or of silk with bits of sponge. The cases of non-sponge-feeding larvae typically incorporate sand grains, pieces of detritus, or other materials, and may be cylindrical, tapered, or flattened and hooded with lateral expansions. Many species of *Ceraclea* are highly intolerant of disturbance. A single species of *Ceraclea* was found in CUGA.

| Species                                          | Parks                                                                                    | States                                                                                                                                                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates                 |
|--------------------------------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|------------------------------|
| <i>Ceraclea tarsipunctata</i> (CT Vorhies, 1909) | BISO, BLRI, CHCH, <b>CUGA</b> , FODO, GRSM <sup>(L)</sup> , LIRI, MACA, NISI, OBRI, STRI | AL, AR, CA, CT, DE, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MB, ME, MI, MN, MO, MS, MT, NB, NC, ND, NH, NY, OH, OK, ON, OR, PA, QC, SC, SD, SK, TN, TX, VA, VT, WI, WV, WY | 114-1396 m      | G5, NCS3 | 2.6             | 8 May - 7 Aug<br>(Apr - Aug) |

Comments — This species is considered vulnerable in North Carolina. Cases are cylindrical and made of plant material and sand grains. Populations seem to be univoltine. Larva up to 8 mm in length, case up to 9 mm, adult up to 11 mm. We have 53 collections and 789 specimens of this species, including a single male from Davis Branch in CUGA.

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**Genus *Oecetis* McLachlan** - [Habitat - Lotic erosional and depositional, lentic littoral: Habit - Clingers sprawlers, climbers (case a curved tube, often tapered, of coarse mineral or plant material): Trophic - Predators (engulfers), shredders herbivores (chewers)?] *Oecetis* consists of nearly 500 described species in all biotic regions. Approximately 25 species are known from North America, but see the discussion below under *O. inconspicua*. *Oecetis* larvae are considered carnivorous, feeding exclusively on small aquatic invertebrates, although some species, particularly the early instars, may feed on plant matter. Floyd (1995) described, illustrated, and keyed the larvae of 22 species. His paper is the source for much of the biology information in the Comments below. We found 11 species in the parks. *Oecetis* larvae have a genus-level tolerance value of 5.7.

| Species                                   | Parks                                                                                                                  | States                                                                                                                                                                                                                             | Elevation Range | Rankings | Tolerance Value | Flight Dates                    |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|---------------------------------|
| <i>Oecetis inconspicua</i> F Walker, 1852 | ABLI, BISO, BLRI, CHCH, COWP, <b>CUGA</b> , FODO, GRSM <sup>(L)</sup> , GUCO, KIMO, LIRI, MACA, NISI, OBRI, SHIL, STRI | AB, AK, AL, AR, AZ, BC, CA, CO, CT, DC, DE, FL, GA, IA, IL, IN, KS, KY, LA, MA, MB, MD, ME, MI, MN, MO, MS, MT, NB, NC, ND, NE, NF, NH, NJ, NS, NT, NY, OH, OK, ON, OR, PA, QC, SC, SD, SK, TN, TX, UT, VA, VT, WA, WI, WV, WY, YT | 105-1146 m      | G5       | 5.7             | 12 January - 21 Sep (Apr - Oct) |

Comments — Floyd (1995) associated seven larval types that belong to the *O. inconspicua* complex, but did not distinguish any particular form as this species. Current rankings treat each of the separate types of Floyd, referred to as sp. A through sp. G, as globally critically imperiled, imperiled, or vulnerable. Much work remains to be done before this widespread complex of species is resolved. Because of the taxonomic uncertainty in this taxon, it is included in this table. We have 250 collections and 5,809 specimens of this “species.” We found 141 specimens from 11 locations in CUGA.

**Genus *Trienodes* McLachlan** - [Habitat - Lentic littoral, lotic depositional (vascular hydrophytes): Habit - Swimmers, climbers (case long, tapered of spirally arranged leaf and stem fragments): Trophic - Shredders herbivores (chewers)] Another large genus with more than 200 species rather evenly distributed throughout the biotic regions, including about 25 species in North America. All species make similar cases from plant material arranged in a long, tapered spiral. Glover (1996) described, illustrated, and keyed the larvae of 16 species. His paper is the source of much of the information in the Comments below. Manuel (2010) revised the North American species and is the best source for information on adults and distributions.

| Species                                     | Parks                                                                              | States                                                                                                                                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates                |
|---------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|-----------------------------|
| <i>Trienodes marginatus</i> CK Sibley, 1926 | BISO, BLRI, CARL, CHCH, <b>CUGA</b> , GRSM <sup>(L)</sup> , KIMO, LIRI, SHIL, STRI | AB, AL, AR, CT, DC, DE, GA, IL, IN, KS, MA, MB, MD, ME, MI, MN, MO, MS, NC, ND, NF, NH, NJ, NS, NY, OH, OK, ON, PA, QC, SC, SD, SK, TN, TX, VA, WI, WV | 154-1078 m      | G5, NCS3 | 0.0             | 19 May - 28 Sep (Apr - Nov) |

Comments — Larvae are often found in association with aquatic macrophytes in lakes, ponds, and in root mats in streams. Larva up to 10 mm in length, case up to 23 mm, adult 12-13 mm. We have 33 collections and 172 specimens of this species. We found 41 specimens from 7 locations in CUGA.

## Family Molannidae Curtis

### molannid caddisflies

The Molannidae is a small family of the Oriental and Holarctic faunas, having only two genera and about three dozen species. Both genera occur in North America, but only one of those occurs in the study area. Larvae are instantly recognized by their distinctive shield-shaped tube cases, made of a central tube of fine sand grains with lateral flanges and a prolonged hood or cowl anteriorly made of larger sand grains or gravel. Larvae are completely hidden by the flanges and hood when moving and feeding. In this sense, they resemble certain larvae of *Ceraclea* (Leptoceridae), but differ in details of the case construction and in their habitats.

**Genus *Molanna* Curtis** - [Habitat - Lentic erosional, lotic depositional (headwater streams and springs): Habit - Sprawlers clingers (case flat with dorsal projection and flanges): Trophic - Scrapers, collectors gatherers, predators (engulfers)] This is a mostly Holarctic genus with approximately two-dozen known species. Six species are known from North America, and four are recorded from the parks. Larvae are believed to be omnivorous, feeding on diatoms, algae, plant material, and small invertebrates. Larvae of three species were described, illustrated, and keyed by Sherberger and Wallace (1971) (see also (Unzicker and others, 1982). These papers and Roy and Harper (1980) are the sources for much of the information cited in the Comments below.

| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Parks                                                                                                   | States                                                                                                         | Elevation Range | Rankings | Tolerance Value | Flight Dates               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|----------------------------|
| <i>Molanna blenda</i> CK Sibley, 1926                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | BISO, BLRI, CHCH, COWP, <b>CUGA</b> , GRSM <sup>(L)</sup> , KIMO, LIRI, MACA, OBRI, SHIL <sup>(L)</sup> | AL, AR, CT, DE, GA, IL, IN, KY, LA, MA, MI, MN, MO, MS, NC, NF, NH, NY, OH, ON, PA, QC, SC, TN, VA, VT, WI, WV | 124-1757 m      | G5, ALS2 | 2.0             | 10 May - 5 Oct (Mar - Oct) |
| Comments — <i>Molanna blenda</i> occurs in cold springs and seeps, and in similar areas with accumulations of debris, sand, and silt along the edges of small streams. It is common and widespread in the mountainous areas of the study zone, but also occurs in the coastal zone of at least some of the target states. <i>Molanna blenda</i> cases tend to have numerous mica flakes incorporated in them, along with a fair amount of vegetable debris. Alabama has rated this species as imperiled. Larva up to 12 mm in length, adult up to 11 mm. We have 190 collections and 627 specimens of this species, including a single male from Yellow Creek in CUGA. |                                                                                                         |                                                                                                                |                 |          |                 |                            |

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### Family Goeridae Ulmer armored caddisflies

This family often has been treated as a subfamily within the Limnephilidae. The consensus now is to treat it as a separate family. It consists of approximately 180 species and 11 or 12 genera found in most regions of the world, although they are absent from the Neotropical region and Australia (de Moor and Ivanov, 2008, Holzenthal and others, 2011). There are 30 species in 5 genera in North America, of which 6 species in 2 genera were found in the parks. Among these species, larvae are characterized by having, among other features, the anterolateral corners of the pronotum and the mesepisternum sharply produced forward. In addition, the cases are strongly made sand particles with larger “ballast” stones attached along the sides. When a larva is tightly tucked in its stone case with its legs withdrawn and these stout projections at the entrance, the larva seems well protected from intrusion by potential predators. For these reasons, we refer to goerids as armored caddisflies. Larvae feed on periphyton and fine detritus.

**Genus *Goera* Stevens** - [Habitat - Lotic erosional: Habit - Clingers (case mineral, with two lateral ballast stones on each side): Trophic - Scrapers] This genus is represented in Asia, Europe, and North America by about 130 species. Six species are found in the Southeast, and three have been found in the parks. Flint (1960) described and keyed the larvae of three species. All species have very similar cases consisting of a central cylinder of rock pieces, with larger “ballast” stones attached in a series along each side. The number of ballast stones on each side of a case is typically 2-4, but in some populations, there is a single, very large stone on each side. A rather common and well-known undescribed species occurs throughout GRSM.

| Species                                                                                                               | Parks                                                                                    | States                                                                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates   |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------|----------|-----------------|----------------|
| <i>Goera calcarata</i> N Banks, 1895                                                                                  | BISO <sup>(L)</sup> , BLRI, CHCH, COWP, <b>CUGA</b> <sup>(L)</sup> , GRSM <sup>(L)</sup> | AL, CT, DE, GA, KY, MA, ME, MN, NB, NC, NH, NJ, NS, NY, OH, PA, PQ, SC, TN, VA, VT, WV | 206 - 1575 m    | G5       | 0.3             | 5 May - 21 Oct |
| Comments — We have 122 collections and 707 specimens of this species, including 1 specimen from Yellow Creek in CUGA. |                                                                                          |                                                                                        |                 |          |                 |                |

## Family Lepidostomatidae Ulmer

### scale-mouthed caddisflies

This worldwide family of more than 400 species contains only two genera, *Lepidostoma* Rambur and *Theliopsyche* Banks, each in its own subfamily. Both genera are represented in the study region. Males of *Lepidostoma* often have bizarre secondary sexual characteristics, such as highly modified palps, antennae, and wings. This led one of the pioneers of Trichoptera studies to call *Lepidostoma* the “curiosity shop” of the Trichoptera (McLachlan, 1874-1880). Many early Trichoptera workers erected genera for oddly modified species, such that about 20 different genera were at one time recognized within the family. Comprehensive work by Weaver (1988, 2002) led to most of those genera being synonymized with *Lepidostoma*, resulting in the classification used here.

### Subfamily Lepidostomatinae Ulmer

**Genus *Lepidostoma* Rambur** - [Habitat - Lotic erosional and depositional (detritus) (headwater streams and springs): Habit - Climbers sprawlers clingers (case square or “rough log cabin” type of leaf and bark fragments, or cylindrical, of sand or silk): Trophic - Shredders detritivores (chewers) (also scavengers)] This large genus contains nearly 400 species distributed around the world. Approximately 80 species are known from North America, and 23 were collected in the parks. Eggs are carried by the females in green masses at the end of the abdomen, and are deposited directly into or nearby water. Larval cases are varied, although the cases of species within certain groups are characteristic of those groups. Cases of early instars of many species may be entirely of sand grains. Some species retain the sand grain construction throughout development, while others transition to cases of stems, leaves, and other detrital material. These cases are then either a panel case or a turret case. In the panel-type case, larvae cut leaves or other appropriate detrital material into quadrate pieces and attach the pieces together in a 4-sided arrangement, linking several such units together. Depending on the softness of the material used, the resulting cases are somewhat rounded to almost perfectly square in cross-section. Turret cases are formed of small stems or other slender plant fragments arranged transversely in a whorl. The larvae are not generally identifiable. *Lepidostoma* larvae a tolerance value of 1.0.

| Species                                                                                                                       | Parks               | States | Elevation Range | Rankings | Tolerance Value | Flight Dates |
|-------------------------------------------------------------------------------------------------------------------------------|---------------------|--------|-----------------|----------|-----------------|--------------|
| <i>Lepidostoma etnieri</i> Weaver, 1988                                                                                       | CUGA <sup>(L)</sup> | KY, TN | 807 m           | G1       | 0.0             | 29 Sep (Apr) |
| Comments — This is a spring-inhabiting species of limited range. We collected a single specimen from Shillalah Creek in CUGA. |                     |        |                 |          |                 |              |

## Family Limnephilidae Kolenati

### northern caddisflies

This family has nearly 900 described species in about 100 genera. As the common name implies, these caddisflies are dominant in the Holarctic region, with many species found in both the Nearctic and the Palearctic. More than 200 species in 39 genera occur in the Nearctic, while 45 species in 10 genera occur in the Neotropical region. This group has attracted the attention of scientists for many years (for example, Schmid, 1955), yet much uncertainty remains about what the family limits and internal organization should be. Most recently, Vshivkova and others (2007) have suggested a number of changes to the classification of the family. The arrangement used below likely will change again in the near future. Wiggins (1996) and Morse and Holzenthal (2008) provide keys to genera of larvae. For adults, Ruiter (1995) published a key to the genera of the Western Hemisphere.

### Subfamily Dicosmoecinae Schmid

**Genus *Ironoquia* Banks** - [Habitat - Lotic depositional, lentic littoral (temporary streams and ponds): Habit - Sprawlers (case a curved tube of leaf or bark pieces, or mineral): Trophic - Shredders] [Habitat - Lotic depositional, lentic littoral (temporary streams and ponds): Habit - Sprawlers (case a curved tube of leaf or bark pieces, or mineral): Trophic - Shredders] This is a genus of six species, five from North America and one from Europe. Four have been found in the study area, and three in the parks. Larvae of *Ironoquia* are unusual among North American Dicosmoecinae in that they live in temporary pools and streams, which often have extremes of temperature and extended dry periods (Wiggins, 1996). The larvae of one species, *I. plattensis*, are known to burrow and aestivate underground for up to four months (Geluso and others, 2011; Whiles and others, 1999). The larvae of *I. punctatissima* and *I. parvula* have been described by Flint (1960), and the larvae of *I. lyrata* are known (Wiggins, 1996). Kentucky Division of Water (2009) assigns *Ironoquia* larvae a tolerance value of 7.7.

| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Parks                                                                  | States                                                                                                                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|-----------------------------|
| <i>Ironoquia lyrata</i> (HH Ross, 1938)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>CUGA</b>                                                            | CT, IL, IN, KY, ME, MN, NY, OH, PA, QC, VA, WI                                                                                             | 379 m           | G5       | 6.7             | 6-29 Sep                    |
| Comments — A seldom-collected species (Flint et al., 2008). We collected a single male from Tunnel Creek in CUGA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                        |                                                                                                                                            |                 |          |                 |                             |
| <i>Ironoquia punctatissima</i> (F Walker, 1852)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | BLRI, CHCH, <b>CUGA</b> , GRSM <sup>(L)</sup> , LIRI, MACA, NISI, SHIL | AK, AL, AR, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, NH, NJ, NS, NY, OH, OK, ON, PA, QC, SC, TN, TX, VA, VT, WI, WV | 124-960 m       | G5, ALS2 | 7.8             | 15 Jun - 26 Oct (Jun - Nov) |
| Comments — This species is included here because Alabama has ranked it as imperiled. Larvae prefer marshes and slow moving streams with an abundance of plants and organic matter (Flint, 1960). Williams and Williams (1975) reported that larvae of <i>I. punctatissima</i> first appeared in Oct in the temporary stream in Ontario that they studied, just as pools began forming following a five-month summer dry spell. Extremely rapid growth occurred with the larvae reaching the 4th instar by early Nov, and 5 <sup>th</sup> instars appearing by the end of Dec. Following ice melt in early Apr, larvae migrated from the water to the stream banks, where they remained mostly without moving and without feeding until Jul. Then they sealed their cases and pupated. Adults first appeared at the end of Jul, and continued to emerge into Aug. Case made of pieces of bark and leaves, slightly tapered and curved. Larva up to 20 mm in length, adult up to 18 mm. We have 29 collections and 113 specimens of this species, including 32 specimens from 2 locations in CUGA. |                                                                        |                                                                                                                                            |                 |          |                 |                             |

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**Genus *Pycnopsyche* Banks** - [Habitat - Lotic erosional and depositional, lentic littoral (detritus): Habit - Sprawlers climbers or clingers (case smooth mineral, or like *Hydatophylax*): Trophic - Shredders detritivores (chewers), scrapers (last instar in some species)] This is a North American genus of approximately 17 species, mostly distributed east of the Rocky Mountains. Fourteen species were collected during this survey. Betten (1950) and Wojtowicz (1982b) reviewed the genus most recently. Flint (1960) described the larvae of six species and one species group, and presented a key. (Wojtowicz, 1982a) described the larva of *P. flavata*. Wojtowicz and Flint (2007) described *P. pani* and reported that the larvae were indistinguishable from *P. luculenta* and *P. sonso*. Certain species are identifiable as larvae (for example, *P. gentilis* and *P. flavata*), but many specimens can only be assigned to a group, and the larvae of some species remain undescribed. The genus has a tolerance value of 2.3. *Pycnopsyche* are shredders, feeding on leaves and other organic detritus.

| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Parks                                                                                                                                | States                                                                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------|----------|-----------------|--------------------------------|
| <i>Pycnopsyche antica</i> (F Walker, 1852)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | BISO <sup>(L)</sup> , BLRI, <b>CUGA</b> <sup>(L)</sup> , GRSM <sup>(L)</sup> , KIMO, MACA, OBRI <sup>(L)</sup> , SHIL <sup>(L)</sup> | AL, FL, GA, IN, LA, MA, MI, MS, NC, NH, NJ, NY, ON, PA, SC, TN, TX, VA, WI, WV         | 124-1694 m      | G5       | 2.3             | 14 Jun - 27 Oct<br>(Jun - Nov) |
| Comments — This species is often synonymized with <i>P. scabripennis</i> (for example, Flint and others, 2008). We have chosen to accept Wojtowicz's interpretation (Wojtowicz, 1982b) and treat <i>P. antica</i> as a valid species. All specimens we collected were identified as <i>P. antica</i> ; none matched the description of <i>P. scabripennis</i> . Larva up to 25 mm, adult up to mm. We have 86 collections and 403 specimens of this species, including 6 specimens from 3 locations from CUGA.                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                      |                                                                                        |                 |          |                 |                                |
| <i>Pycnopsyche flavata</i> (N Banks, 1914)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> , OBRI                                                                                       | GA, NC, SC, TN, VA                                                                     | 549-1710 m      | G4       | 2.3             | 30 May - 8 Nov<br>(Jun - Sep)  |
| Comments — Larvae were described by Wojtowicz (1982a). They are similar, but distinguishable from those of <i>P. gentilis</i> , and have very similar cases. See the case description under <i>P. gentilis</i> . <i>Pycnopsyche flavata</i> larvae overwinter as fifth instars. Emergence of adults peaks in the fall, although some records exist for as early as May. Mature larvae appear to have very reduced activity during the lengthy interval from reaching maturity and beginning pupation. Larva up to 25 mm in length, adult up to 23 mm. We have 82 collections and 252 specimens of this species. We found 2 specimens from Shillalah Creek in CUGA.                                                                                                                                                                                     |                                                                                                                                      |                                                                                        |                 |          |                 |                                |
| <i>Pycnopsyche gentilis</i> (R McLachlan, 1871)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | BISO <sup>(L)</sup> , BLRI, <b>CUGA</b> <sup>(L)</sup> , GRSM <sup>(L)</sup> , MACA, OBRI                                            | AL, CT, DE, GA, KY, MA, MD, ME, NC, NF, NH, NJ, NS, NY, OH, PA, QC, SC, TN, VA, VT, WV | 173-1694 m      | G5, ALS1 | 2.3             | 25 -27 Nov<br>(Jul - Oct)      |
| Comments — Alabama ranks <i>P. gentilis</i> as critically imperiled. This species lives in tiny spring seeps only a few centimeters wide up to about 1 meter wide. They can also be found in larger streams with strong currents. Many early instar larvae make cases of circular leaf pieces attached to a silk cylinder in a triangular arrangement. Wojtowicz (1982a) reported that some early instar individuals make sand cases throughout their development. Later instars convert leaf cases to sand and gravel cases. It is not uncommon to find cases in the intermediate state that are partly sand and partly leaf. Mature larvae are always in cylindrical sand cases. Larva up to 25 mm in length, adult up to 19 mm. We have 165 collections and 826 specimens of this species. Three specimens were collected from 2 locations in CUGA. |                                                                                                                                      |                                                                                        |                 |          |                 |                                |

## Cumberland Gap National Historical Park

### Survey of Aquatic Insects of the Cumberland Piedmont and Appalachian Highlands Monitoring Networks

| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Parks                                                                                           | States                                                                                                                                                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|--------------------------------|
| <i>Pycnopsyche guttifer</i> (F Walker, 1852)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | BISO <sup>(L)</sup> , BLRI, <b>CUGA</b> <sup>(L)</sup> , GRSM <sup>(L)</sup> , MACA, OBRI, SHIL | AB, AL, AR, CO, CT, DE, FL, GA, IL, IN, KS, KY, LA, LB, MA, MB, ME, MI, MN, MO, MT, NC, ND, NE, NF, NH, NJ, NS, NY, OH, ON, PA, QC, SC, SD, SK, TN, VA, VT, WA, WI, WV, WY | 139-973 m       | G5       | 2.3             | 16 -1 Nov<br>(Aug - Oct)       |
| Comments — Larvae inhabit larger, warmer streams, usually at least several meters wide, and are sometimes taken at the margins of lakes in northern states. Case made of slender plant fragments, but usually with sand incorporated, and having long sticks extending posteriorly, with the anterior sticks shorter and obliquely oriented. Williams and Williams (1982) report that larvae may be shredders or scrapers depending on the current of their micro-habitat, with those in faster currents tending toward scrapping and those in slower currents tending toward shredding. Cummins (1964) found larvae lived in marginal substrates of the stream on silt, periphyton, debris, and aquatic plants throughout the larval and pupal periods, and only moved to deeper areas of the stream when water flows were reduced. Early instar larvae made cases of leaf material, and upon reaching the terminal instar converted their cases to primarily stick construction. Larva up to 22 mm in length. We have 29 collections and 699 specimens of this species. We collected a male and a female from Tunnel Creek in CUGA. |                                                                                                 |                                                                                                                                                                            |                 |          |                 |                                |
| <i>Pycnopsyche luculenta</i> (C Betten, 1934)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | BLRI, <b>CUGA</b> <sup>(L)</sup> , FODO, GRSM <sup>(L)</sup> , MACA, OBRI, SHIL <sup>(L)</sup>  | AL, CT, DE, GA, IN, KY, MA, ME, MS, NC, NH, NJ, NY, OH, ON, PA, QC, SC, TN, VA, VT, WI, WV                                                                                 | 116-880 m       | G5, ALS2 | 2.3             | 8 Aug - 20 Dec<br>(Aug - Nov)  |
| Comments — In Alabama, this species is ranked imperiled. The preferred habitat seems to be small streams about a meter wide, but the larvae also are found in larger streams, but not those as large as preferred by <i>P. guttifer</i> . Larvae prefer areas with detritus to those areas consisting mostly of leaves (Mackay and Kalff, 1973). Case is a slightly flattened cylinder of organic matter, with long sticks laterally and small pieces dorsally and ventrally (Flint, 1960). Larva up to 22 mm. We have 52 collections and 1,070 specimens of this species. From CUGA we recorded 36 specimens from Shillalah Creek in CUGA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                 |                                                                                                                                                                            |                 |          |                 |                                |
| <b>Subfamily Pseudostenophylacinae Schmid</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                 |                                                                                                                                                                            |                 |          |                 |                                |
| <b>Genus <i>Pseudostenophylax</i> Martynov</b> - [Habitat - Lotic erosional (detritus) and depositional (including seeps and temporary streams): Habit - Sprawlers (case tapered, curved, smooth, mineral): Trophic - Shredders detritivores (chewers), collectors gatherers] This is the only genus of the subfamily Pseudostenophylacinae found in North America. The genus is primarily Oriental, with a few Asian Palearctic species, and three species in North America. One species is found in the West, and either one or two species are found in the East. We treat the eastern forms as separate species—some prefer to treat them as variants of a single species. Larvae are found in cold headwater streams, and in intermittent streams. Cases are made of small rock pieces, and are tapered and slightly curved. Larva up to 16 mm in length, case up to 19 mm. Kentucky Division of Water (2009) assigns larvae of <i>Pseudostenophylax</i> a tolerance value of 2.0.                                                                                                                                               |                                                                                                 |                                                                                                                                                                            |                 |          |                 |                                |
| Species                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Parks                                                                                           | States                                                                                                                                                                     | Elevation Range | Rankings | Tolerance Value | Flight Dates                   |
| <i>Pseudostenophylax uniformis</i> C Betten, 1934                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | BLRI, <b>CUGA</b> , GRSM <sup>(L)</sup> , MACA, RUCA                                            | CT, IL, IN, KY, MA, ME, MN, MO, NC, NH, NY, OH, ON, PA, QC, SC, TN, VA, VT, WI, WV                                                                                         | 149-1944 m      | G5, NCS3 | 2.0             | 10 May - 12 Sep<br>(May - Jul) |
| Comments — Larvae are restricted to small spring fed streams and pools (Flint, 1957). Larva up to 15 mm in length, pupa up to 17 mm, case up to 17 mm. We collected 249 specimens from 59 locations in the 5 parks listed. We found 5 larvae from the Hensley settlement spring in CUGA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                 |                                                                                                                                                                            |                 |          |                 |                                |

## Family Phryganeidae Burmeister

### phryganeid caddisflies

The Phryganeidae is a small family of less than 75 species in 15 genera. The family generally is Holarctic in distribution. Ten genera have representatives in North America and species of five of those genera occur in the study area. The largest known caddisflies are phryganeids, having a forewing length of up to 43 mm. Most larvae make cylindrical cases from plant pieces cut into rectangles and arranged either as stacked rings (*Oligostomis*, *Ptilostomis*) or as a spiral (*Agrypnia*, *Banksiola*, *Phryganea*). Phryganeid larvae occur in a wide range of habitats, from cool streams to lakes and ponds, and temporary pools, and even acidic bogs and brackish coastal waters. Selgeby (1974) reported larvae of three genera from depths as much as 100 m in Lake Superior. Larvae are primarily predaceous as final instars, but early instars of some species feed on filamentous algae and detritus. The principal source for information about Phryganeidae is the book by Wiggins (1998). Phryganeid larvae are easily separated to genus using Wiggins (1996, 1998), but cannot be identified to species at this time. Phryganeids do not have assigned tolerance values.

**Genus *Banksiola* Martynov** - [Habitat - Lentic vascular hydrophytes, lotic depositional: Habit - Climbers (case similar to *Agrypnia* but with some irregular strands of vegetation): Trophic - Shredders herbivores (chewers; early instars, filamentous green algae); last two instars predators (engulfers)] This genus is found only in North America. It consists of five species, all of which occur in the east, with one having an extended range westward to Yukon and Alaska (Wiggins, 1998). Only one species was collected during the survey. Forewing of adults up to 15 mm in length, larva up to 22 mm, case up to 45 mm.

| Species                                | Parks             | States                                                                         | Elevation Range | Rankings | Tolerance Value | Flight Dates                   |
|----------------------------------------|-------------------|--------------------------------------------------------------------------------|-----------------|----------|-----------------|--------------------------------|
| <i>Banksiola dossuaria</i> T Say, 1828 | BLRI, <b>CUGA</b> | CT, KY, MA, ME, MN, NC, NF, NH, NJ, NS, NY, OH, ON, PA, QC, SC, VA, VT, WI, WV | 735-1024 m      | G5       | n/a             | 10 Jun - 19 Jul<br>(May - Jul) |

Comments — Common in eastern Canada and the New England states, with populations extending south along the Appalachians. *Banksiola dossuaria* wings are light with strong spots. Stout and others (1992) reported *B. dossuaria* larvae feeding on egg masses of the spotted salamander, *Ambystoma maculatum* (Shaw). A population in a bog in West Virginia was found to have *Banksiola* larvae on 18% of salamander egg masses, and to have as many as five *Banksiola* larvae on a single *Ambystoma* egg mass. All individuals on egg masses were fifth instars. Field and laboratory observations demonstrated that the *Banksiola* larvae would burrow into the mass surrounding the eggs and eat them, often eliminating all eggs in a mass. Final instar larvae found on egg masses were significantly larger than larvae not found on egg masses. They concluded that *Banksiola* larvae could inflict significant mortality on spotted salamander egg masses. We have 5 collections and 5 specimens of this species, including a single male from Martins Fork in CUGA.

## Family Helicopsychidae Ulmer

### snail-case maker caddisflies

Helicopsychid larvae are instantly recognizable by their unique cases that look like snail shells covered with sand grains. The family is cosmopolitan, with the genus *Helicopsyche* having more than 200 described species. The family contains one other genus, having a single species that is endemic to New Zealand.

**Genus *Helicopsyche* von Siebold** - [Habitat - Lotic and lentic erosional (including thermal springs): Habit - Climbers (case snail shell shaped, mineral): Trophic - Scrapers] In the Americas, this genus has over 100 species, most of them found in the Neotropics; eight species occur in the United States and one extends into Canada. Two species occur in the Southeast, but only one was found during this study. *Helicopsyche* larvae scrape periphyton from rocks, but the gut contents sometimes are reported to contain animal matter as well. Larvae up to 8 mm in length, case up to 7 mm diameter, adult up to 7 mm.

| Species                                     | Parks                                                                                                     | States                                                                                                                                                                                                         | Elevation Range | Rankings | Tolerance Value | Flight Dates                 |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|------------------------------|
| <i>Helicopsyche borealis</i> HA Hagen, 1861 | ABLI, BISO <sup>(L)</sup> , BLRI, CHCH, CUGA, GRSM <sup>(L)</sup> , KIMO, MACA, NISI, OBRI <sup>(L)</sup> | AB, AL, AR, AZ, CA, CO, CT, DE, FL, GA, ID, IL, IN, KS, KY, MA, MB, MD, ME, MI, MN, MO, MS, MT, NB, NC, ND, NF, NH, NJ, NM, NS, NT, NY, OH, OK, ON, OR, PA, QC, SC, SD, SK, TN, TX, UT, VA, VT, WA, WI, WV, WY | 153-1025 m      | G5       | 0.0             | 9 May - 6 Oct<br>(May - Oct) |

Comments — The life history of *H. borealis* is highly variable. Vaughn (1985) studied populations in thermally constant and thermally fluctuating streams in Oklahoma, and found the population in the constant temperature stream was multivoltine while the population in the thermally varying stream was univoltine. She found that larvae pupated within 9-12 weeks after hatching from eggs in the laboratory, and found no egg diapause. Williams and others (1983) found that a population in southern Ontario was univoltine. They also found that larvae lived in the hyporheic zone as well as on rocks at the surface. Interestingly, they hypothesized that the unique snail shape of the cases could be an evolutionary adaptation to living and moving about in the interstices because the shape of the case makes it resistant to crushing. Wiggins (1996) reports that larvae have a thermal tolerance, with specimens occurring in thermal streams of Yellowstone National Park where water temperatures reach 34°C and no other caddisflies occur. Ross (1944) reported continual emergence of adults from spring through early fall, whereas other studies found no evidence of egg-diapause or extended adult emergence (Resh and others, 1984). These authors also determined that *H. borealis* displayed a high degree of tolerance to chemical pollutants in Big Sulphur Creek, California. Because of the wide variance between the biology and thermal tolerance of many western populations compared with eastern populations, Jackson and Resh (1992) examined the genetic variation in several California locations and in three eastern populations. They found 4 genetically distinct types of *Helicopsyche* in California, including one type that was similar to the eastern type. Future study may reveal 2 or more distinct species that currently are called *H. borealis*. However, it is most likely that the eastern form found in the parks will retain the name *H. borealis* since Hagen described the species based on specimens from Washington, DC, and the St. Lawrence River, Canada. As with other scrapers, *H. borealis* is considered highly vulnerable to disturbance, especially siltation, which accounts for its tolerance value of 0.0. We have 57 collections and 1,107 specimens of this species. In CUGA we found 2 specimens from 2 locations.

## Family Thremmatidae Martynov

### horsehead caddisflies

This family has a disjunct North America - eastern Asia distribution. Some subfamilies and genera have closest relatives in the two regions to the exclusion of other regions. Worldwide there are fewer than 90 species in seven genera. Only one genus occurs in the study area, *Neophylax*, which has about 40 species worldwide. There are 21 species in North America, with 17 in the East.

**Genus *Neophylax* McLachlan** - [Habitat - Lotic erosional: Habit - Clingers (case tapered, slightly curved, mineral with ballast stones one each side): Trophic - Scrapers] Currently about 32 species of *Neophylax* are known from North America, Western Palearctic, and Oriental regions. In the seven states of the study area 16 species are known, along with at least two undescribed species. Eleven species were found during this inventory, although only larvae were found for *N. fuscus*. Larvae make a very distinctive case that is instantly recognizable in the field. Cases are robust and tubular, slightly curved and tapered, made of rock pieces, and often have larger “ballast” stones laterally. Pupal cases are firmly attached to the underside of stable rocks. Larvae are found in springs, creeks, and large rivers. Within a stream, species tend to be longitudinally distributed, with overlapping populations resulting in more than one species being found at a single site. Larvae are scrapers, feeding on diatoms, periphyton, and organic debris from the surfaces of rocks. *Neophylax* are univoltine, the adults normally emerging in the fall following a summer diapause of two to six months in the prepupal stage. Eggs are laid under rocks or overhanging banks above the water surface (Beam and Wiggins, 1987), although at least one western Nearctic species lays eggs in water. Larval growth rates vary considerably. In North Carolina, Georgian and Wallace (1983) demonstrated that *N. consimilis* larvae take 135 days or fewer to progress from 1st instar to prepupa, while in Ontario, Beam and Wiggins (1987) demonstrated that *N. aniqua* larvae take up to 240 days. When larvae prepare for diapause, they tend to aggregate and often are found in clumps of 5 to 20 cases on the same rock. Often the current generation of larvae uses the same locations for aestivation as previous generations. Empty pupal cases from prior generations may persist and be found together with those of the current cohort. This has been demonstrated to lead to enhanced aquatic invertebrate diversity compared with rocks that do not have aggregations of *Neophylax* larvae (McCabe and Gotelli, 2003). *Neophylax* was revised recently by Vineyard and others (2005), which is the best source for information and keys to the species. Although *Neophylax* larvae are usually easily identifiable, in biomonitoring programs they are given a genus level tolerance value of 1.6.

| Species                                                                                                                                                                                                                                                                                                                                                                              | Parks                                                          | States                                                                                                                 | Elevation Range | Rankings | Tolerance Value | Flight Dates                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------|----------|-----------------|-----------------------------|
| <i>Neophylax aniqua</i> HH Ross, 1947                                                                                                                                                                                                                                                                                                                                                | BISO, BLRI, CHCH, CUGA, GRSM <sup>(1)</sup> , LIRI, OBRI, SHIL | ME, NB, NC, NF, NH, NS, NY, ON, PA, QC, TN, VA, VT, WV                                                                 | 140-1311 m      | G5       | 1.6             | 29 Sep - 18 Oct (Sep - Oct) |
| Comments — This species is restricted to springs and headwater streams. It is normally the first species encountered longitudinally in a stream system (Beam and Wiggins, 1987). Adult up to 12 mm in length. We have 51 collections and 284 specimens of this species. We collected 98 specimens from 4 locations in CUGA.                                                          |                                                                |                                                                                                                        |                 |          |                 |                             |
| <i>Neophylax concinnus</i> R McLachlan, 1871                                                                                                                                                                                                                                                                                                                                         | ABLI, BISO, BLRI, CHCH, CUGA, FODO, LIRI, MACA, OBRI           | AL, AR, CT, DE, FL, GA, IL, IN, KY, MA, MD, ME, MI, MN, MO, NC, NH, NJ, NY, OH, ON, PA, QC, RI, SC, TN, VA, VT, WI, WV | 128-1025 m      | G5, ALS1 | 1.6             | 6–9 Oct (Sep - Oct)         |
| Comments — A variable species morphologically and ecologically, limited barcoding data indicate that it is genetically well defined. In Alabama, <i>N. concinnus</i> is considered critically imperiled. Larva up to 10 mm in length, case up to 11 mm, adult up to 11 mm. We have 30 collections and 115 specimens of this species. We found 29 specimens from 2 locations in CUGA. |                                                                |                                                                                                                        |                 |          |                 |                             |

## Cumberland Gap National Historical Park

### Survey of Aquatic Insects of the Cumberland Piedmont and Appalachian Highlands Monitoring Networks

| Species                                                                                                                                                                                                                                                           | Parks                                | States                 | Elevation Range | Rankings | Tolerance Value | Flight Dates                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------|-----------------|----------|-----------------|-----------------------------|
| <i>Neophylax etnieri</i> Vineyard & GB Wiggins, 1987                                                                                                                                                                                                              | <b>CUGA</b>                          | KY, TN, VA             | 359-387 m       | G3       | 1.6             | 29 Sep – 3 Oct              |
| Comments — We collected 152 specimens from 3 locations in CUGA.                                                                                                                                                                                                   |                                      |                        |                 |          |                 |                             |
| <i>Neophylax wigginsi</i> JL Sykora & JS Weaver III, 1978                                                                                                                                                                                                         | ABLI, BISO, <b>CUGA</b> , MACA, OBRI | KY, OH, PA, TN, VA, WV | 161-807 m       | G3       | 1.6             | 25 Sep - 16 Oct (Sep - Oct) |
| Comments — Most populations are found in small springs and cold streams (Vineyard et al. 2005). This species is classified vulnerable globally. We have 21 collections and 426 specimens of this species. We collected 53 specimens from Shillalah Creek in CUGA. |                                      |                        |                 |          |                 |                             |

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## Appendix 6. Unverified Records

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During the course of this study, we evaluated a number of records that represent specimens that we have not been able to examine. Many of the records, especially those from Copeland, represent potentially valuable data. Because we have not had the opportunity to examine the specimens ourselves, we are unable to vouch for the reliability of the identifications. We present these data to preserve the records, and to permit CUGA managers to evaluate their potential usefulness.

The data came from two sources. The first source is a list of specimens collected, identified, and recorded by Jonathan Copeland, Lincoln Memorial University, Harrogate, TN. This list consists of 440 aquatic invertebrate samples collected from June 1990 to November 2000. We believe that the data are significant, and perhaps related to the work that was being done on the Cumberland Gap tunnel during that time frame. However, because we do not have any specimens from Copeland's study, we cannot verify any macroinvertebrate identifications from that work. We prepared a spreadsheet of the data, and updated the taxonomy of some of the specimens. However, without specimens to examine, we do not think it is appropriate for us to treat the taxa from that list as confirmed to occur in CUGA. Associated with the spreadsheet are 4 pdf files named "WQsitesUTMs.pdf", "May1993letterCopelandAQinsects.pdf", "July1993letterCopeland-AQinsects.pdf", "Feb2000letterCopelandAQinsects.pdf" that we include as additional information of interest.

The second source is based on information from the CUGA web site, <https://www.nps.gov/cuga/learn/nature/insects.htm> and is listed below. The taxonomy in this list is fairly current, although some corrections are indicated. Those taxa with a ☐ have been confirmed by sampling done as part of the multi-park survey. However, as with the Copeland data, we do not verify any identifications that we have not personally examined. Taxa with a strikethrough indicate that a change in spelling or taxonomy is required.

### **Insects, Spiders, Centipedes, and Millipedes Known to Occur in Cumberland Gap National Historical Park**

#### **INSECTS**

##### **Order Diptera – Flies**

Family Athericidae

*Atherix* sp.

Family Blephariceridae - Net-winged midges

*Blepharicera* sp.

Family Dixidae - Dixie midges

*Dixella* sp.

Family Dolichopodidae – Long-legged flies

*Rhaphium* sp.

Family Empididae - Dance flies

*Chelifera* sp.

*Hemerodromia* sp.

Family Limoniidae

*Antocha* sp.

*Pilaria* sp.

Family Muscidae – House flies

*Limnophora* sp.

Family Pediciidae

*Dicranota* sp.

Family ~~Simuliidae~~ Simuliidae - Black flies

*Prosimulium mixtum*

*Simulium* sp.

Family Stratiomyidae - Soldier flies

*Stratiomys* sp.

Family Tabanidae – Horse flies and deer flies

*Tabanus* sp.

Family Tipulidae - Crane flies

*Prionocera* sp.

*Tipula* sp.

## **Order Coleoptera – Beetles**

Family Dryopidae - Long-toed water beetles

*Helichus basalis*

~~*Helichus*~~ *lithophilus*

Family Elmidae - Riffle beetles

*Anchytarus bicolor*

*Dubiraphia ~~bittata~~ vittata vittata*

*Macronychus glabratus*

*Optioservus ovalis*

*Stenelmis crenata*

Family ~~Gyrinidae~~ Gyrinidae - Whirligig beetles

*Dineutus assimilis*

*Gyrinus lugens*

Family Hydrophilidae - Water scavenger beetles

~~*Hydrobius*~~ *melaenus*

*Paracymus* sp.

*Tropisternus blatchleyi blatchleyi*

*Tropisternus glaber*

*Tropisternus lateralis nimbatus*

Family Psephenidae - Water penny beetles

*Ectopria* sp.

{*Optioservus trivittatus* – Family Elmidae}

*Psephenus herricki*

{*Stenelmis* sp. Family Elmidae}

## **Order ~~Ephemera~~ Ephemeroptera – Mayflies**

Family Baetidae – Mayflies

*Baetis brunneicolor*

*Baetis intercalaris*

*Pseudocloeon* sp.

Family Baetiscidae - Armored mayflies

*Baetisca gibbera*

Family Ephemerellidae - Spiny crawler mayflies

*Attenella attenuata*

*Drunella cornutella*

*Ephemerella dorothea*

*Ephemerella invaria*

*Ephemerella rotunda*

*Eurylophella doris*

~~*Serratella*~~ *Teloganopsis deficiens*

Family Ephemeridae – Common burrowing mayflies

~~*Ephemer*~~ *blanda*

*Ephemer* *guttulata*

*Ephemer* *varia*

Family Heptageniidae

*Epeorus dispar*

*Epeorus rubidus*

*Stenacron pallidum*

~~*Stenonema*~~ *Maccaffertium exiguum*

~~*Stenonema*~~ *femoratum*

~~*Stenonema*~~ *Maccaffertium interpunctatum*

~~*Stenonema*~~ *Maccaffertium vicarium*

Family Isonychiidae

*Isonychia* sp.

Family Leptophlebiidae - Prong-gilled mayflies

*Habrophlebia* ~~*bibrans*~~ *vibrans*

*Habrophlebiodes* sp.

~~*Paraleptophlebia*~~ *guttata*

## **Order Hemiptera – True bugs**

Family Gerridae – Water striders

*Gerris remigis*

*Rheumatobates rileyi*

*Trepobates* sp.

Family Veliidae – Broad-shouldered water striders

*Microvelia paludicola*

*Rhagovelia obesa*

## **Order Megaloptera– Dobsonflies**

Family Corydalidae - Dobsonflies, Fishflies

~~*Corydalus*~~ *cornutus*

~~*Nigronia*~~ *fasciatus*

*Nigronia serricornis*

~~Order Neuroptera – Lacewings~~ – in Order Megaloptera

Family Sialidae – Alderflies

*Sialis* sp.

## Order Odonata – Dragonflies and damselflies

Family Aeshnidae – Darners

*Aeshna umbrosa*

*Boyeria grafiana*

~~B~~*oyeria vinosa*

Family Calopterygidae - Broad-winged Damselflies

*Calopteryx dimidiata*

~~C~~*alopteryx maculata*

Family Coenagrionidae - Narrow-winged Damselflies

*Argia fumipennis fumipennis fumipennis*

*Argia sedula*

~~E~~*hallagma divagans*

Family Corduligastridae – Spiketails

~~Cordulegaster~~ *Cordulegaster erronea*

~~Cordulegaster~~ *Cordulegaster fasciata*

~~Cordulegaster maculate~~ *Cordulegaster maculata*

Family Corduliidae – Emeralds

~~H~~*elocordulia uhleri*

{*Macromia taeniolata* – now placed in Family Macromiidae}

*Somatochlora linearis*

Family Gomphidae – Clubtails

*Dromogomphus spinosus*

*Gomphus abbreviatus*

*Lanthus parvulus*

~~S~~*tylogomphus albistylus*

Family Libellulidae – Skimmers

*Dythemis velox*

~~E~~*rythemis simplicicollis*

## Order Plecoptera – Stoneflies

Family Capniidae Capniidae - Smallwinter stoneflies

~~A~~*llocapnia* sp.

Family Chloroperlidae - Green stoneflies

*Rasvena terna*

~~Uta~~*perla gaspesiana* - not known from the Southeast

Family Leuctridae - Rolled-winged stoneflies

~~L~~*euctra* sp.

Family Nemouridae - Spring stoneflies

*Amphinemura delosa*

~~A~~*mphinemura wui*

{~~Hastaperla~~ (*Haploperla*) *brevis* – Family Chloroperlidae}

*Nemoura* sp.

Family Peltoperlidae - Roachlike stoneflies

~~P~~*eltoperla* sp.

*Tallaperla* sp.

Family Perlidae – Common stoneflies

*Acroneuria abnormis*

*Acroneuria carolinensis*

*Acroneuria lycorias*

*Eccoptura xanthenes*

{*Isoperla* sp. – Family Perlodidae}

*Perlesta* sp.

Family Perlodidae - Perlodid stoneflies

*Yugus arinus*

Family Taeniopterygidae - Winter stoneflies

*Taeniopteryx metequi*

## Order Trichoptera – Caddisflies

Family Apataniidae

*Apatania* sp.

Family Glossosomatidae

*Agapetus* sp.

*Glossosoma* sp.

Family Goeridae

*Goera calcarata*

Family Hydropsychidae - Net Spinning caddisflies

*Cheumatopsyche* sp.

*Diplectrona modesta*

*Potamyia flava*

~~*Symphitopsyche*~~ *Hydropsyche bifida*

~~*Symphitopsyche*~~ *Hydropsyche bronta*

~~*Symphitopsyche*~~ *Hydropsyche sparna*

Family Lepidostomatidae

*Lepidostoma* sp.

Family Limnephilidae - Northern caddisflies

*Limnephila* sp.

*Pseudostenophylax uniformis*

*Pycnopsyche divergens*

*Pycnopsyche lepida*

*Pycnopsyche luculenta*

*Pycnopsyche scabripennis* *antica*

~~*Pycnopsyche uniformis*~~ - not a valid species

Family Philopotamidae - Finger net caddisflies

*Chimarra* sp.

*Dolophilodes* sp.

*Wormaldia* sp.

Family Polycentropodidae

*Neureclipsis* sp.

*Myctiophylax* sp.

*Polycentropus* sp.

Family Rhyacophilidae - Primitive caddisflies

*Rhyacophila carolina*

*Rhyacophila fuscula*

~~R~~*hyacophila glaberrima*

*Rhyacophila nigrita*

~~R~~*hyacophila torva*

Family Uenoidae Thremmatidae

*Neophylax oligius*

*Neophylax mitchelli*