

Appendix 1. Locations and Events.

Each location at which samples were collected is listed below by the SiteCode given in the database. Each location is unique, with its own set of coordinates that are different from every other location. 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 the events are listed subsequently by date, followed by 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.

Mammoth Cave National Park			
Location	UTMs	Lat/Lon	Elevation
KY:Barren Co., MACA Wondering Woods, pond at Wondering Woods	4109571N 583652E	37.12876°N 86.05826°W	238 m
Event 01: 27-28 Jul 2005, black light trap, CRParker			
Event 02: 28-29 Jul 2005, black light trap, CRParker			
KY:Edmonson Co., MACA 3 Springs, Three Springs area off Flint Ridge Rd	4116773N 581344E	37.19387°N 86.08345°W	221 m
Event 01: 16 Apr 2005, by hand, CRParker (Sample ID: 1)			
Event 02: 16-17 Apr 2005, black light trap, CRParker (Sample ID: 3)			
Event 03: 27-28 Jul 2005, black light trap, CRParker			
Event 04: 2 Apr 2006, by hand, JLRobinson & MGeraghty			
Event 05: 11 Apr 2006, by hand, JLRobinson, MGeraghty & JRobinson			
Event 06: 15-16 Aug 2006, black light trap, CRParker & JLRobinson			
Event 07: 15-16 Aug 2006, black light trap, JLRobinson & CRParker			
KY:Edmonson Co., MACA Blue Spring, Blue Spring, Wet Prong drainage, bridge at trail crossing	4122076N 572748E	37.24238°N 86.17978°W	196 m
Event 01: 7 Jun 2007, by hand, CRParker & JLRobinson			
KY:Edmonson Co., MACA Cinnamon Fern Bog, bog with cinnamon ferns off Collie Ridge Trail	4122174N 575397E	37.24305°N 86.14991°W	237 m
Event 01: 29 Aug 2006, by hand, JLRobinson & CRParker			
Event 02: 29-30 Aug 2006, black light trap, JLRobinson & CRParker			
Event 03: 6 Jun 2007, by hand, CRParker & JLRobinson			
Event 04: 6-7 Jun 2007, black light trap, CRParker & JLRobinson			
KY:Edmonson Co., MACA CRF Hamilton Valley, Cave Research Foundation facility, Hamilton Valley	4115442N 585048E	37.18155°N 86.04188°W	242 m
Event 01: 14 Apr 2005, black light (sheet), CRParker			
KY:Edmonson Co., MACA Doyley Holler Overlook, Doyley Holler Overlook	4113472N 581924E	37.16408°N 86.07728°W	256 m
Event 01: 10 Apr 2006, by hand, JLRobinson & MGeraghty			
KY:Edmonson Co., MACA Dry Branch, Dry Branch (upstrm from Houchin's Ferry)	4117071N 568580E	37.19759°N 86.22723°W	138 m
Event 01: 12 Apr 2006, by hand, JLRobinson & MGeraghty			
KY:Edmonson Co., MACA Echo River Source, spring source of Echo River	4114915N 579153E	37.17732°N 86.10834°W	137 m
Event 01: 15-16 Aug 2006, black light trap, CRParker & JLRobinson			

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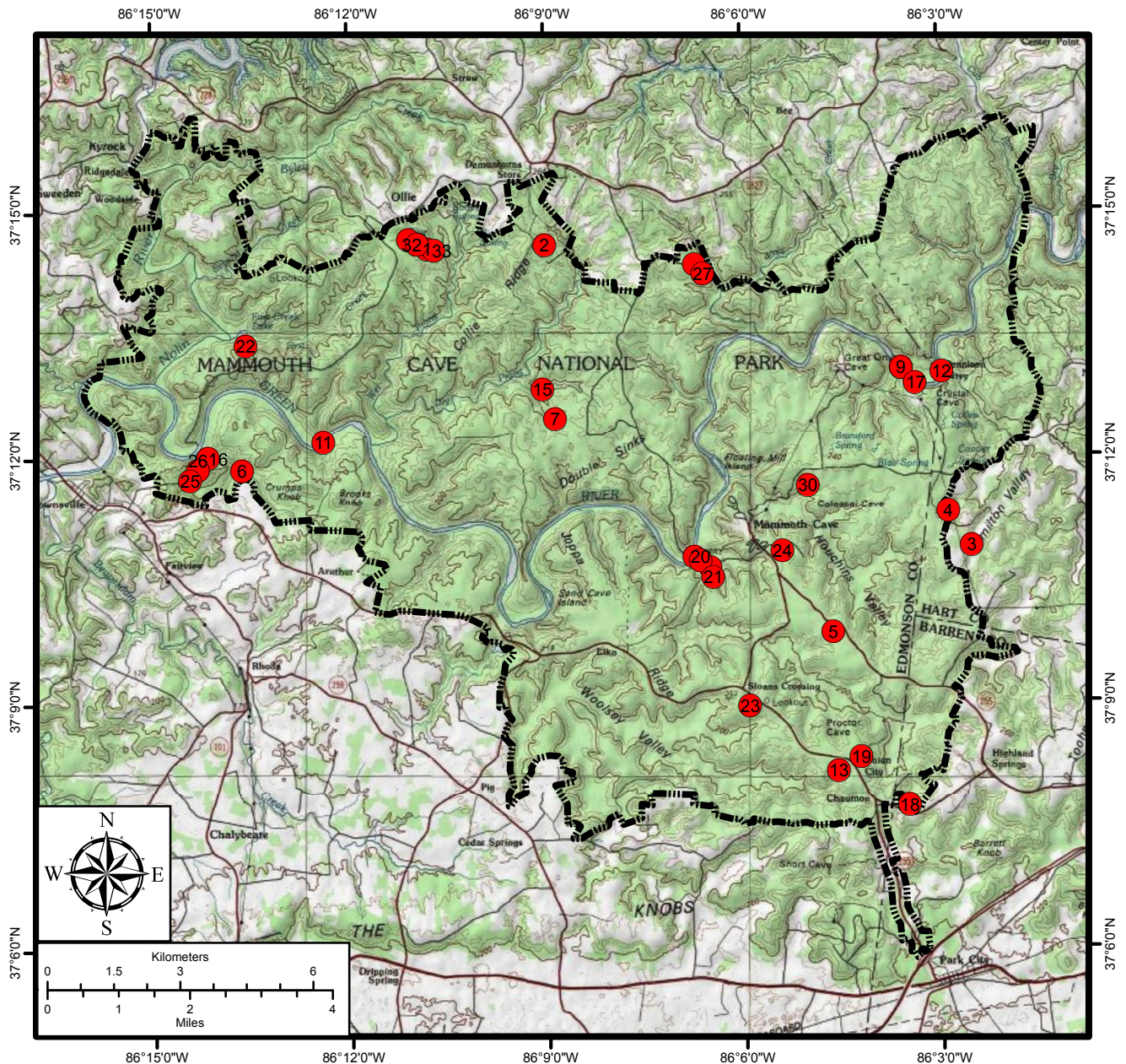
Mammoth Cave National Park			
Location	UTMs	Lat/Lon	Elevation
KY:Edmonson Co., MACA First Creek Lake, shore of First Creek Lake nr campsite B Event 01: 28-29 Jul 2005, black light trap, CRParker	4119892N 568658E	37.22300°N 86.22609°W	153 m
KY:Edmonson Co., MACA Good Spring, Good Spring nr Good Spring Church Event 01: 11 Apr 2006, by hand, JLRobinson, MGeraghty & JRobinson Event 02: 15-16 Aug 2006, black light trap, CRParker & JLRobinson Event 03: 28-29 Jun 2006, black light trap, CRParker & JLRobinson Event 04: 5 Jun 2007, by hand, CRParker & JLRobinson Event 05: 5-6 Jun 2007, black light trap, CRParker & JLRobinson	4118260N 575643E	37.20775°N 86.14753°W	218 m
KY:Edmonson Co., MACA Green River below Mile 189, Green River below Mile 189 Event 01: 29-30 Aug 2006, black light trap, JLRobinson & CRParker	4117720N 570415E	37.20330°N 86.20650°W	134 m
KY:Edmonson Co., MACA Green River Ferry, Green River at ferry Event 01: 5-6 Jun 2007, black light trap, CRParker & JLRobinson	4115149N 578784E	37.17946°N 86.11247°W	138 m
KY:Edmonson Co., MACA Green River mile 203.9, Green River at 1st shoal dwnstrm Dennison Ferry, river mile 203.9 Event 01: 7 Jun 2007, by hand, CRParker & JLRobinson	4119440N 583444E	37.21772°N 86.05950°W	142 m
KY:Edmonson Co., MACA Green River mile 204.1, Green River at 1st shoal dwnstrm Dennison Ferry, river mile 204.1, Three Sisters Island Event 01: 7 Jun 2007, by hand, CRParker & JLRobinson	4119440N 583444E	37.21772°N 86.05950°W	142 m
KY:Edmonson Co., MACA Hawkins Pond, Hawkins Pond Event 01: 27-28 Jul 2005, black light trap, CRParker	4110341N 582052E	37.13584°N 86.07618°W	260 m
KY:Edmonson Co., MACA Houchins Ferry, mouth Dry Creek, Houchins Ferry Event 01: 28-29 Jul 2005, black light trap, CRParker Event 02: 12 Apr 2006, sweeping, JLRobinson	4117354N 567812E	37.20019°N 86.23586°W	156 m
KY:Edmonson Co., MACA middle Houchins Ferry Road, small unnamed stream along Houchins Ferry Rd 0.7 mi from gate Event 01: 16 Apr 2005, by hand, CRParker	4117091N 567586E	37.19784°N 86.23843°W	173 m
KY:Edmonson Co., MACA Mill Branch, Mill Br 10 m upstrm Good Spring Trail footbridge Event 01: 5-6 Jun 2007, black light trap, CRParker & JLRobinson	4118923N 575355E	37.21375°N 86.15071°W	174 m
KY:Edmonson Co., MACA Pike Spring, Pike Spring Event 01: 7 Jun 2007, sweeping, CRParker & JLRobinson	4119097N 583758E	37.21461°N 86.05599°W	150 m
KY:Edmonson Co., MACA pond in woods near Union City, pond in woods off trail from Union City, South Entrance Road Event 01: 14-15 Aug 2006, black light trap, CRParker & JLRobinson	4110653N 582557E	37.13861°N 86.07046°W	266 m
KY:Edmonson Co., MACA roadside spring Green River Ferry Road, roadside spring Green River Ferry Road Event 01: 10 Apr 2006, by hand, JLRobinson & MGeraghty Event 02: 14-15 Aug 2006, black light trap, CRParker & JLRobinson	4114699N 579210E	37.17536°N 86.10772°W	172 m
KY:Edmonson Co., MACA Roadside Spring, Roadside Spring Event 01: 10 Apr 2006, by hand, JLRobinson & MGeraghty	4115068N 578925E	37.17871°N 86.11088°W	149 m
KY:Edmonson Co., MACA Sloans Crossing Pond, Sloans Crossing Pond Event 01: 27 Jul 2005, black light trap, CRParker Event 02: 27-28 Jul 2005, black light trap, CRParker Event 03: 14 Aug 2006, sweeping, CRParker & JLRobinson (Sample ID: sweeping) Event 04: 14-15 Aug 2006, black light trap, CRParker & JLRobinson	4111794N 580045E	37.14911°N 86.09862°W	256 m
KY:Edmonson Co., MACA spring below Wilson Cemetery, spring, Little Jordan Rd 0.9 mi e North Entrance Rd, below Wilson Cem. Event 01: 7 Jun 2007, by hand, CRParker & JLRobinson (Sample ID: by hand) Event 02: 7 Jun 2007, sweeping, CRParker & JLRobinson Event 03: 7-8 Jun 2007, black light trap, CRParker & JLRobinson Event 04: 7-8 Jun 2007, black light trap, CRParker & JLRobinson (Sample ID: blt)	4121745N 578773E	37.23891°N 86.11190°W	177 m
KY:Edmonson Co., MACA spring on Little Jordan Road 1.2, spring on Little Jordan Rd 1.2 mi E North Entrance Rd Event 01: 8 Jun 2007, black light trap, CRParker & JLRobinson	4121543N 578967E	37.23707°N 86.10973°W	161 m

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Mammoth Cave National Park			
Location	UTMs	Lat/Lon	Elevation
Event 02: 8 Jun 2007, sweeping, JLRobinson			
KY:Edmonson Co., MACA stream under road to Park offices, small ephemeral stream under road to Park offices	4115300N 580769E	37.18065°N 86.09009°W	227 m
Event 01: 14 Aug 2006, by hand, CRParker & JLRobinson			
KY:Edmonson Co., MACA upper Houchins Ferry Road, small unnamed stream along Houchins Ferry Rd 0.5 mi from gate	4116849N 567410E	37.19567°N 86.24044°W	183 m
Event 01: 16 Apr 2005, by hand, CRParker			
	4122188N 572526E	37.24341°N 86.18228°W	178 m
KY:Edmonson Co., MACA Wet Prong 1, Wet Prong ca 790 m E Houchin Ferry Rd			
Event 01: 6-7 Jun 2007, black light trap, CRParker & JLRobinson			
	4122294N 572323E	37.24438°N 86.18455°W	213 m
KY:Edmonson Co., MACA Wet Prong Headwaters, headwaters Wet Prong			
Event 01: 28 Aug 2006, by hand, JLRobinson & CRParker			
Event 02: 28-29 Aug 2006, black light trap, JLRobinson & CRParker			
Event 03: 6-7 Jun 2007, black light trap, JLRobinson & CRParker			
KY:Edmonson Co., MACA Wet Prong site 2, Wet Prong upstream from Pinnocks Pocket, below headwaters site	4122051N 572902E	37.24215°N 86.17804°W	187 m
Event 01: 6-7 Jun 2007, black light trap, CRParker & JLRobinson			
	4122189N 572526E	37.24342°N 86.18228°W	178 m
KY:Edmonson Co., MACA Wet Prong site 3, Wet Prong upstrm Pinnocks Pocket			
Event 01: 6-7 Jun 2007, black light trap, CRParker & JLRobinson			
	4116213N 584516E	37.18854°N 86.04778°W	262 m
KY:Hart Co., MACA Cooper Spring, Cooper Spring 20 m dwnstrm source			
Event 01: 5 Jun 2007, by hand, CRParker & JLRobinson			
Event 02: 5-6 Jun 2007, black light trap, CRParker & JLRobinson			
KY:Hart Co., MACA Green River Dennison Ferry, Green River, 50 m upstrm Dennison Ferry	4119346N 584359E	37.21680°N 86.04920°W	135 m
Event 01: 5 Jun 2007, sweeping, CRParker & JLRobinson			
Event 02: 5-6 Jun 2007, black light trap, CRParker & JLRobinson			
MACA location, date, collector unknown			
Event 01: unknown			

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Legend



Sample Location



Boundary

Site Code

- 1 - MACA Blue Spring
- 2 - MACA Cinnamon Fern Bog
- 3 - MACA CRF Hamilton Valley
- 4 - MACA Cooper Spring
- 5 - MACA Doyley Holler Overlook
- 6 - MACA Dry Branch
- 7 - MACA Good Spring
- 8 - MACA Green River mile 203.9
- 9 - MACA Green River mile 204.1
- 10 - MACA Green River Ferry
- 11 - MACA Green River below Mile 189

- 12 - MACA Green River Dennison Ferry
- 13 - MACA Hawkins Pond
- 14 - MACA Wet Prong Headwaters
- 15 - MACA Mill Branch
- 16 - MACA Houchins Ferry
- 17 - MACA Pike Spring
- 18 - MACA Wondering Woods
- 19 - MACA pond in woods near Union City
- 20 - MACA Roadside Spring
- 21 - MACA roadside spring Green River Ferry Road
- 22 - MACA First Creek Lake
- 23 - MACA Sloans Crossing Pond

- 24 - MACA stream under road to Park offices
- 25 - MACA upper Houchins Ferry Road
- 26 - MACA middle Houchins Ferry Road
- 27 - MACA spring on Little Jordan Road 1.2
- 28 - MACA Echo River Source
- 29 - MACA spring below Wilson Cemetery
- 30 - MACA 3 Springs
- 31 - MACA Wet Prong 1
- 32 - MACA Wet Prong site 3
- 33 - MACA Wet Prong site 2

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 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, *Hydropsyche* species. Adult specimens are identified in the table by the ♂ (male) and ♀ (female) symbols, larvae by the words “larva” and “larvae”, and pupae by the words “pupa” and “pupae”. The entries “mmt” and “mmts”, which are found for 8 Trichoptera records, mean that the specimens are metamorphotypes. 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 caddisfly students. Subimago mayflies are indicated by “sub.” or “subs”, and cast larval skins are referred to as “sub exuv.”

Mammoth Cave National Park			
Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera			
Order	Family	Species	Specimens
KY:Barren Co., MACA Wondering Woods, 27-28 Jul 2005, black light trap			
Trichoptera	Hydropsychidae	<i>Hydropsyche simulans</i> HH Ross, 1938	1 ♂
		<i>Hydropsyche</i> species	1 ♀
	Leptoceridae	<i>Ceraclea enodis</i> Whitlock & JC Morse, 1994	2 ♂
	Polycentropodidae	<i>Polycentropus</i> species	1 ♀
KY:Barren Co., MACA Wondering Woods, 28-29 Jul 2005, black light trap			
Ephemeroptera	Caenidae	<i>Caenis</i> species	1 ♀
	Ephemeridae	<i>Hexagenia limbata</i> (Serville, 1829)	4 ♀
	Heptageniidae	Heptageniidae species	4 ♀
		<i>Maccaffertium</i> species	2 ♂, 1 sub exuv.
		<i>Stenacron</i> species	15 ♀, 1 ♂
Isonychiidae	<i>Isonychia</i> species	1 ♀, 3 sub exuv.	
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i> species	3 ♀
		<i>Hydroptila gunda</i> Milne, 1936	1 ♂
	Hydroptilidae	<i>Hydroptila spatulata</i> Morton, 1905	2 ♂
		<i>Orthotrichia aegerfasciella</i> (Chambers, 1873)	2 ♂
		<i>Ceraclea cancellata</i> (Betten, 1934)	3 ♀, 10 ♂
	Leptoceridae	<i>Ceraclea enodis</i> Whitlock & JC Morse, 1994	3 ♀, 7 ♂
		<i>Ceraclea</i> species	38 ♀
		<i>Nectopsyche candida</i> (HA Hagen, 1861)	1 ♀
	<i>Nectopsyche exquisita</i> (Walker, 1852)	6 ♀	
	<i>Nectopsyche pavida</i> (HA Hagen, 1861)	6 ♀	
	<i>Oecetis cinerascens</i> (HA Hagen, 1861)	1 ♂	
	<i>Oecetis inconspicua</i> (Walker, 1852)	31 ♀, 36 ♂	
	<i>Triaenodes tardus</i> Milne, 1934	1 ♂	
	Thremmatidae	<i>Neophylax</i> species	15 ♀
	KY:Edmonson Co., MACA 3 Springs, 11 Apr 2006, by hand		
Trichoptera	Hydropsychidae	<i>Diplectrona modesta</i> N Banks, 1908	7 larvae
		<i>Diplectrona</i> species	5 larvae
	Hydroptilidae	<i>Agraylea multipunctata</i> Curtis, 1834	1 ♀
		<i>Ochrotrichia eliaga</i> (HH Ross, 1941)	5 ♀, 12 ♂
		<i>Ochrotrichia</i> species	3 ♀

Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera			
Order	Family	Species	Specimens
	Limnephilidae	<i>Pycnopsyche</i> species	5 larvae
	Philopotamidae	<i>Dolophilodes distincta</i> (Walker, 1852)	1 ♂
		<i>Wormaldia moesta</i> (N Banks, 1914)	1 ♂
KY:Edmonson Co., MACA 3 Springs, 15-16 Aug 2006, black light trap			
Trichoptera	Hydropsychidae	<i>Diplectrona</i> species	16 ♀, 1 ♂
		<i>Hydropsyche simulans</i> HH Ross, 1938	1 ♂
	Hydroptilidae	<i>Hydroptila delineata</i> Morton, 1905	1 ♂
		<i>Ochrotrichia tarsalis</i> (HA Hagen, 1861)	1 ♂
	Leptoceridae	<i>Nectopsyche</i> species	1 ♀
	Molannidae	<i>Molanna blenda</i> Sibley, 1926	1 ♀, 1 ♂
	Philopotamidae	<i>Dolophilodes distincta</i> (Walker, 1852)	2 ♂
		<i>Wormaldia moesta</i> (N Banks, 1914)	4 ♂
	Polycentropodidae	<i>Polycentropus carolinensis</i> N Banks, 1905	3 ♀, 1 ♂
KY:Edmonson Co., MACA 3 Springs, 16 Apr 2005, by hand			
Ephemeroptera	Ephemerellidae	<i>Eurylophella funeralis</i> (J McDunnough, 1925)	10 larvae
	Leptophlebiidae	<i>Paraleptophlebia</i> species	4 larvae
Megaloptera	Corydalidae	<i>Nigronia fasciatus</i> (Walker, 1853)	1 larva
Odonata	Calopterygidae	<i>Calopteryx</i> species	1 larva
Plecoptera	Leuctridae	<i>Leuctra grandis</i> N Banks, 1906	2 ♀, 1 ♂
	Nemouridae	<i>Amphinemura nigritta</i> (Provancher, 1876)	8 ♀, 10 ♂, 3 larvae
Trichoptera	Hydropsychidae	<i>Diplectrona modesta</i> N Banks, 1908	6 larvae
		<i>Diplectrona</i> species	1 ♂
	Hydroptilidae	<i>Hydroptila</i> species	1 pupa
		Hydroptilidae species	1 larva
		<i>Ochrotrichia</i> species	4 larvae
	Lepidostomatidae	<i>Lepidostoma</i> species	12 larvae
	Limnephilidae	<i>Pycnopsyche guttifer</i> (Walker, 1852)	1 larva
	Odontoceridae	<i>Psilotreta rufa</i> (HA Hagen, 1861)	1 ♂
	Philopotamidae	<i>Wormaldia moesta</i> (N Banks, 1914)	5 ♂
	Rhyacophilidae	<i>Rhyacophila</i> species	2 larvae
	Thremmatidae	<i>Neophylax concinnus</i> MacLachlan, 1871	1 larva
		<i>Neophylax fuscus</i> N Banks, 1903	1 larva
KY:Edmonson Co., MACA 3 Springs, 16-17 Apr 2005, black light trap			
Plecoptera	Leuctridae	<i>Leuctra grandis</i> N Banks, 1906	2 ♂
	Nemouridae	<i>Amphinemura nigritta</i> (Provancher, 1876)	3 ♂
KY:Edmonson Co., MACA 3 Springs, 2 Apr 2006, by hand			
Trichoptera	Rhyacophilidae	<i>Rhyacophila acutiloba</i> JC Morse & HH Ross, 1971	2 larvae
KY:Edmonson Co., MACA 3 Springs, 27-28 Jul 2005, black light trap			
Plecoptera	Nemouridae	<i>Amphinemura nigritta</i> (Provancher, 1876)	1 ♂
Trichoptera	Hydropsychidae	<i>Diplectrona</i> species	3 ♀, 5 ♂
		<i>Hydropsyche simulans</i> HH Ross, 1938	1 ♂
		<i>Hydropsyche</i> species	5 ♀
	Hydroptilidae	<i>Hydroptila coweetensis</i> Huryn, 1985	2 ♂
		<i>Hydroptila</i> species	4 ♀
		<i>Orthotrichia</i> species	1 ♀
	Philopotamidae	<i>Dolophilodes distincta</i> (Walker, 1852)	1 ♀, 2 ♂
	Rhyacophilidae	<i>Rhyacophila parantra</i> HH Ross, 1948	3 ♂
KY:Edmonson Co., MACA Blue Spring, 7 Jun 2007, by hand			
Trichoptera	Calamoceratidae	<i>Anisocentropus pyraloides</i> (Walker, 1852)	1 ♀
	Glossosomatidae	<i>Agapetus minutus</i> Sibley, 1926	4 ♀, 5 ♂, 7 ♂ mmts
		<i>Glossosoma nigrior</i> N Banks, 1911	2 ♂, 2 ♂ mmts
	Thremmatidae	<i>Neophylax concinnus</i> MacLachlan, 1871	1 larva
KY:Edmonson Co., MACA Cinnamon Fern Bog, 29 Aug 2006, by hand			
Trichoptera	Limnephilidae	<i>Pycnopsyche luculenta</i> (Betten, 1934)	1 ♀
	Thremmatidae	<i>Neophylax concinnus</i> MacLachlan, 1871	1 ♂, 1 ♀ mmt, 3 ♂
KY:Edmonson Co., MACA Cinnamon Fern Bog, 29-30 Aug 2006, black light trap			
Trichoptera	Hydropsychidae	<i>Diplectrona</i> species	12 ♀, 18 ♂, 1 pupa
	Limnephilidae	<i>Pycnopsyche antica</i> (Walker, 1852)	1 ♂

Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera			
Order	Family	Species	Specimens
		<i>Pycnopsyche gentilis</i> (McLachlan, 1871)	1 ♂
	Philopotamidae	<i>Chimarra aterrima</i> HA Hagen, 1861	3 ♀, 8 ♂
		<i>Dolophilodes</i> species	1 ♀
	Polycentropodidae	<i>Polycentropus centralis</i> N Banks, 1914	1 ♀, 1 ♂
	Thremmatidae	<i>Neophylax concinnus</i> MacLachlan, 1871	1 ♂
KY:Edmonson Co., MACA Cinnamon Fern Bog, 6 Jun 2007, by hand			
Trichoptera	Dipseudopsidae	<i>Phyloctenopus lucidus</i> (HA Hagen, 1861)	1 ♀, 3 ♂
	Hydropsychidae	<i>Diplectrona modesta</i> N Banks, 1908	1 pupa
	Odontoceridae	<i>Psilotreta rufa</i> (HA Hagen, 1861)	4 ♂
	Philopotamidae	<i>Chimarra</i> species	1 ♀
		<i>Dolophilodes distincta</i> (Walker, 1852)	2 ♂
	Rhyacophilidae	<i>Rhyacophila torva</i> HA Hagen, 1861	1 ♀, 1 ♂
	Thremmatidae	<i>Neophylax wigginsi</i> Sykora & Weaver, 1978	4 larvae
KY:Edmonson Co., MACA Cinnamon Fern Bog, 6-7 Jun 2007, black light trap			
Megaloptera	Corydalidae	<i>Chauliodes pectinicornis</i> Linnaeus, 1783	1 ♀
Plecoptera	Nemouridae	<i>Amphinemura</i> species	1 ♀
Trichoptera	Calamoceratidae	<i>Anisocentropus pyraloides</i> (Walker, 1852)	7 adults, 7 ♀, 3 ♂
	Dipseudopsidae	<i>Phyloctenopus lucidus</i> (HA Hagen, 1861)	2 ♂
	Glossosomatidae	<i>Agapetus minutus</i> Sibley, 1926	1 ♀, 2 ♂
		<i>Glossosoma nigrior</i> N Banks, 1911	2 ♀, 2 ♂
	Hydropsychidae	<i>Cheumatopsyche</i> species	6 ♀
		<i>Diplectrona</i> species	13 adults, 9 ♀, 8 ♂
		<i>Hydropsyche betteni</i> HH Ross, 1938	2 ♀, 1 ♂
		<i>Hydropsyche phalerata</i> HA Hagen, 1861	1 ♂
		<i>Hydropsyche simulans</i> HH Ross, 1938	1 ♂
		<i>Hydropsyche sparna</i> HH Ross, 1938	1 ♂
		<i>Hydropsyche</i> species	4 ♀
	Hydroptilidae	<i>Hydroptilidae</i> species	6 ♀
		<i>Ochrotrichia riesi</i> HH Ross, 1944	1 ♂
		<i>Oxyethira pallida</i> (N Banks, 1904)	1 ♂
	Leptoceridae	<i>Ceraclea maculata</i> (N Banks, 1899)	1 ♂
		<i>Ceraclea</i> species	3 ♀
		<i>Ceraclea tarsipunctata</i> (Vorhies, 1909)	1 ♂
		<i>Leptocerus americanus</i> (N Banks, 1899)	1 ♀
		<i>Nectopsyche</i> species	1 ♀
		<i>Oecetis inconspicua</i> (Walker, 1852)	3 ♀
	Molannidae	<i>Molanna blenda</i> Sibley, 1926	1 ♀, 4 ♂
	Odontoceridae	<i>Psilotreta rufa</i> (HA Hagen, 1861)	2 ♂
	Philopotamidae	<i>Chimarra</i> species	1 ♀
		<i>Dolophilodes distincta</i> (Walker, 1852)	22 adults, 12 ♀, 34 ♂
		<i>Wormaldia moesta</i> (N Banks, 1914)	1 ♂
	Polycentropodidae	<i>Nyctiophylax</i> species	2 ♀
		<i>Polycentropus confusus</i> HA Hagen, 1861	2 ♀, 1 ♂
		<i>Polycentropus elarus</i> HH Ross, 1944	3 ♂
	Psychomyiidae	<i>Lype diversa</i> (N Banks, 1914)	1 ♀
	Rhyacophilidae	<i>Rhyacophila parantra</i> HH Ross, 1948	1 ♂
		<i>Rhyacophila torva</i> HA Hagen, 1861	1 ♂
KY:Edmonson Co., MACA CRF Hamilton Valley, 14 Apr 2005, black light (sheet)			
Plecoptera	Perlidae	<i>Perlinella drymo</i> (Newman, 1839)	1 ♂
Trichoptera	Hydropsychidae	<i>Cheumatopsyche analis</i> (N Banks, 1903)	1 ♂
KY:Edmonson Co., MACA Doyley Holler Overlook, 10 Apr 2006, by hand			
Trichoptera	Limnephilidae	<i>Ironoquia punctatissima</i> (Walker, 1852)	1 larva
	Polycentropodidae	<i>Polycentropus</i> species	1 larva
	Rhyacophilidae	<i>Rhyacophila fenestra</i> HH Ross, 1938	1 larva
		<i>Rhyacophila ledra</i> HH Ross, 1939	1 larva
KY:Edmonson Co., MACA Dry Branch, 12 Apr 2006, by hand			
Ephemeroptera	Leptophlebiidae	<i>Leptophlebia</i> species	1 ♀
Plecoptera	Leuctridae	<i>Leuctra alta</i> James, 1974	3 ♂

Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera			
Order	Family	Species	Specimens
Trichoptera	Nemouridae	<i>Amphinemura</i> species	3 ♀
	Perlidae	<i>Perlinella drymo</i> (Newman, 1839)	1 ♂
	Brachycentridae	<i>Micrasema bennetti</i> HH Ross, 1947	5 ♀, 3 ♂
	Hydropsychidae	<i>Diplectrona modesta</i> N Banks, 1908	8 larvae
		<i>Diplectrona</i> species	1 ♂
	Philopotamidae	<i>Chimarra aterrima</i> HA Hagen, 1861	17 ♀, 10 ♂
		<i>Dolophilodes distincta</i> (Walker, 1852)	1 ♂
Phryganeidae	<i>Oligostomis ocelligera</i> (Walker, 1852)	1 ♀	
KY:Edmonson Co., MACA Echo River Source, 15-16 Aug 2006, black light trap			
Trichoptera	Hydropsychidae	<i>Cheumatopsyche oxa</i> HH Ross, 1938	1 ♂
		<i>Cheumatopsyche pasella</i> HH Ross, 1941	1 ♂
		<i>Cheumatopsyche</i> species	3 ♀
	Hydroptilidae	<i>Hydroptila</i> species	7 ♀
	Leptoceridae	<i>Nectopsyche pavidia</i> (HA Hagen, 1861)	2 ♀
		<i>Oecetis nocturna</i> HH Ross, 1966	1 ♀, 1 ♂
		<i>Triaenodes injustus</i> (HA Hagen, 1861)	2 ♂
	Polycentropodidae	<i>Polycentropus elarus</i> HH Ross, 1944	4 ♀, 8 ♂
KY:Edmonson Co., MACA First Creek Lake, 28-29 Jul 2005, black light trap			
Trichoptera	Hydropsychidae	<i>Cheumatopsyche campyla</i> HH Ross, 1938	3 ♂
		<i>Cheumatopsyche oxa</i> HH Ross, 1938	4 ♂
		<i>Cheumatopsyche pasella</i> HH Ross, 1941	11 ♂
		<i>Cheumatopsyche</i> species	28 ♀
		<i>Diplectrona</i> species	1 ♀
		<i>Hydropsyche simulans</i> HH Ross, 1938	5 ♀, 3 ♂
	Hydroptilidae	<i>Hydropsyche</i> species	9 ♀
		<i>Hydroptila armata</i> HH Ross, 1938	2 ♂
		<i>Hydroptila</i> species	1 ♀
	Leptoceridae	<i>Orthotrichia aegerfasciella</i> (Chambers, 1873)	2 ♂
		<i>Ceraclea cancellata</i> (Betten, 1934)	1 ♂
		<i>Nectopsyche pavidia</i> (HA Hagen, 1861)	2 ♀
		<i>Nectopsyche</i> species	1 ♀
		<i>Oecetis cinerascens</i> (HA Hagen, 1861)	2 ♂
		<i>Oecetis ditissa</i> HH Ross, 1966	9 ♀, 1 ♂
		<i>Oecetis inconspicua</i> (Walker, 1852)	4 ♂
		<i>Oecetis persimilis</i> (N Banks, 1907)	1 ♂
<i>Triaenodes tardus</i> Milne, 1934		1 ♀	
KY:Edmonson Co., MACA Good Spring, 11 Apr 2006, by hand			
Ephemeroptera	Heptageniidae	<i>Maccaffertium</i> species	1 ♂ subimago
	Leptophlebiidae	<i>Leptophlebia</i> species	1 ♀
Plecoptera	Leuctridae	<i>Leuctra sibleyi</i> Claassen, 1923	5 ♀, 3 ♂
		<i>Leuctra</i> species	1 ♀
	Nemouridae	<i>Amphinemura nigritta</i> (Provancher, 1876)	1 ♀, 3 ♂
		<i>Soyedina vallicularia</i> (Wu, 1923)	1 ♂
Trichoptera	Glossosomatidae	<i>Glossosoma nigrior</i> N Banks, 1911	1 ♂
	Hydropsychidae	<i>Diplectrona modesta</i> N Banks, 1908	7 larvae
		<i>Diplectrona</i> species	9 larvae
	Philopotamidae	<i>Dolophilodes distincta</i> (Walker, 1852)	1 ♂
	Rhyacophilidae	<i>Rhyacophila torva</i> HA Hagen, 1861	2 ♂
KY:Edmonson Co., MACA Good Spring, 15-16 Aug 2006, black light trap			
Trichoptera	Hydropsychidae	<i>Diplectrona</i> species	8 ♀, 3 ♂
		<i>Hydropsyche betteni</i> HH Ross, 1938	1 ♂
	Leptoceridae	<i>Triaenodes injustus</i> (HA Hagen, 1861)	1 ♀
	Limnephilidae	<i>Pycnopsyche antica</i> (Walker, 1852)	1 ♂
	Molannidae	<i>Molanna blenda</i> Sibley, 1926	1 ♀, 3 ♂
	Polycentropodidae	<i>Polycentropus elarus</i> HH Ross, 1944	1 ♂
KY:Edmonson Co., MACA Good Spring, 28-29 Jun 2006, black light trap			
Ephemeroptera	Leptophlebiidae	<i>Leptophlebiidae</i> species	1 ♀
Plecoptera	Leuctridae	<i>Leuctra</i> species	1 ♀
Trichoptera	Hydropsychidae	<i>Cheumatopsyche pasella</i> HH Ross, 1941	1 ♂

Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera			
Order	Family	Species	Specimens
		<i>Diplectrona</i> species	1 ♀, 1 ♂
	Molannidae	<i>Molanna blenda</i> Sibley, 1926	1 ♂
	Philopotamidae	<i>Chimarra obscura</i> (Walker, 1852)	1 ♂
	Polycentropodidae	<i>Polycentropus</i> species	1 ♀
	Psychomyiidae	<i>Lype diversa</i> (N Banks, 1914)	4 ♀, 1 ♂
KY:Edmonson Co., MACA Good Spring, 5 Jun 2007, by hand			
Trichoptera	Glossosomatidae	<i>Agapetus minutus</i> Sibley, 1926	5 ♀, 3 ♂, 1 pupa
	Hydroptilidae	Hydroptilidae species	1 ♀
	Rhyacophilidae	<i>Rhyacophila parantra</i> HH Ross, 1948	1 prepupa
KY:Edmonson Co., MACA Good Spring, 5-6 Jun 2007, black light trap			
Ephemeroptera	Leptophlebiidae	<i>Habrophlebiodes americana</i> (N Banks, 1903)	1 ♂
Trichoptera	Calamoceratidae	<i>Anisocentropus pyraloides</i> (Walker, 1852)	14 adults, 1 ♀
	Glossosomatidae	<i>Agapetus minutus</i> Sibley, 1926	1 ♀, 2 ♂, 1 ♂ mmt
		<i>Glossosoma nigrir</i> N Banks, 1911	1 ♂
	Goeridae	<i>Goera fuscata</i> N Banks, 1905	4 ♀
		<i>Goera stylata</i> HH Ross, 1938	2 ♀
	Helicopsychidae	<i>Helicopsyche borealis</i> (HA Hagen, 1861)	1 ♀, 1 ♂
	Hydropsychidae	<i>Cheumatopsyche analis</i> (N Banks, 1903)	2 ♂
		<i>Cheumatopsyche campyla</i> HH Ross, 1938	2 ♀, 1 ♂
		<i>Cheumatopsyche oxa</i> HH Ross, 1938	4 ♂
		<i>Cheumatopsyche</i> species	62 ♀
		<i>Diplectrona</i> species	2 ♀, 9 ♂
		<i>Hydropsyche betteni</i> HH Ross, 1938	1 ♀, 1 ♂
	Hydroptilidae	<i>Hydroptila kuehnei</i> Hou, Hou, & Harris, 1998	5 ♂
		<i>Hydroptila</i> species	3 ♀
		<i>Hydroptila vala</i> HH Ross, 1938	1 ♂
		Hydroptilidae species	85 ♀
		<i>Ochrotrichia eliaga</i> (HH Ross, 1941)	2 ♀, 4 ♂
	Leptoceridae	<i>Ceraclea</i> species	1 ♀
		<i>Oecetis inconspicua</i> (Walker, 1852)	2 ♀
	Molannidae	<i>Molanna blenda</i> Sibley, 1926	2 ♀, 8 ♂
	Odontoceridae	<i>Psilotreta rufa</i> (HA Hagen, 1861)	3 ♂
	Philopotamidae	<i>Dolophilodes distincta</i> (Walker, 1852)	10 adults, 1 ♀, 3 ♂
		<i>Wormaldia moesta</i> (N Banks, 1914)	1 ♀
	Phryganeidae	<i>Agrypnia vestita</i> (Walker, 1852)	1 ♂
		<i>Phryganea cinerea</i> Walker, 1852	1 ♀
	Polycentropodidae	<i>Nyctiophylax moestus</i> N Banks, 1911	17 ♀, 15 ♂
		<i>Plectrocnemia cinerea</i> (HA Hagen, 1861)	2 ♀, 2 ♂
		<i>Polycentropus centralis</i> N Banks, 1914	1 ♂
		<i>Polycentropus elarus</i> HH Ross, 1944	3 ♂
	Psychomyiidae	<i>Lype diversa</i> (N Banks, 1914)	3 ♀, 3 ♂
		<i>Psychomyia flavida</i> HA Hagen, 1861	3 ♀
	Rhyacophilidae	<i>Rhyacophila carolina</i> N Banks, 1911	6 ♀, 12 ♂
		<i>Rhyacophila parantra</i> HH Ross, 1948	10 ♀, 10 ♂, 1 ♂
KY:Edmonson Co., MACA Green River below Mile 189, 29-30 Aug 2006, black light trap			
Ephemeroptera	Ephemeridae	<i>Hexagenia limbata</i> (Serville, 1829)	2 ♂ subs.
	Leptohyphidae	<i>Tricorythodes</i> species	48 adults
Plecoptera	Nemouridae	<i>Amphinemura nigritta</i> (Provancher, 1876)	31 subs.
Trichoptera	Hydropsychidae	<i>Cheumatopsyche pasella</i> HH Ross, 1941	4 ♀, 1 ♂
		<i>Hydropsyche</i> species	1 ♀
	Hydroptilidae	Hydroptilidae species	5 ♀
	Leptoceridae	<i>Ceraclea</i> species	1 ♀
		<i>Nectopsyche pavidata</i> (HA Hagen, 1861)	2 ♀, 1 ♂
	Phryganeidae	<i>Phryganea sayi</i> Milne, 1931	1 ♂
	Polycentropodidae	<i>Cyrnellus fraternus</i> (N Banks, 1905)	1 ♀, 1 ♂
		<i>Plectrocnemia cinerea</i> (HA Hagen, 1861)	2 ♂
KY:Edmonson Co., MACA Green River Ferry, 5-6 Jun 2007, black light trap			
Trichoptera	Glossosomatidae	<i>Protophila palina</i> HH Ross, 1941	1 ♀, 41 ♂
	Hydroptilidae	<i>Ochrotrichia tarsalis</i> (HA Hagen, 1861)	1 ♀, 3 ♂

Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera					
Order	Family	Species	Specimens		
	Leptoceridae	<i>Ceraclea cancellata</i> (Betten, 1934)	1601 ♂		
		<i>Ceraclea flava</i> (N Banks, 1904)	451 ♂		
		<i>Ceraclea tarsipunctata</i> (Vorhies, 1909)	441 ♂		
		<i>Nectopsyche exquisita</i> (Walker, 1852)	2 ♂		
		<i>Nectopsyche pavidia</i> (HA Hagen, 1861)	1 ♂		
	Polycentropodidae	<i>Neureclipsis crepuscularis</i> (Walker, 1852)	1 ♂		
KY:Edmonson Co., MACA Green River mile 203.9, 7 Jun 2007, by hand					
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i> species	1 larva		
	Heptageniidae	<i>Stenacron interpunctatum</i> (T Say,1839)	9 larvae		
		<i>Stenonema femoratum</i> (T Say,1823)	3 larvae		
	Potamanthidae	<i>Anthopotamus</i> species	3 larvae		
Trichoptera	Thremmatidae	<i>Neophylax fuscus</i> N Banks, 1903	1 larva		
KY:Edmonson Co., MACA Green River mile 204.1, 7 Jun 2007, by hand					
Odonata	Coenagrionidae	<i>Argia moesta</i> (HA Hagen, 1861)	1 ♂		
		<i>Argia tibialis</i> (Rambur, 1842)	1 ♂		
		<i>Enallagma exsulans</i> (HA Hagen, 1861)	2 ♀, 4 ♂		
		<i>Ischnura posita</i> HA Hagen, 1861	1 ♀		
	Gomphidae	<i>Hagenius brevistylus</i> Selys, 1854	1 ♀		
KY:Edmonson Co., MACA Hawkins Pond, 27-28 Jul 2005, black light trap					
Megaloptera	Corydalidae	<i>Chauliodes rastricornis</i> Rambur, 1842	2 ♂		
Odonata	Coenagrionidae	<i>Ischnura posita</i> HA Hagen, 1861	1 ♂		
Trichoptera	Hydropsychidae	<i>Cheumatopsyche analis</i> (N Banks, 1903)	1 ♂		
		<i>Cheumatopsyche pasella</i> HH Ross, 1941	1 ♂		
		<i>Hydropsyche</i> species	3 ♀		
		<i>Hydroptila</i> species	6 ♀		
		<i>Oxyethira</i> species	1 ♀		
		Leptoceridae	<i>Ceraclea cancellata</i> (Betten, 1934)	1 ♂	
	<i>Oecetis inconspicua</i> (Walker, 1852)		4 ♀, 13 ♂		
	KY:Edmonson Co., MACA Houchins Ferry, 12 Apr 2006, sweeping				
	Odonata		Coenagrionidae	<i>Ischnura posita</i> HA Hagen, 1861	1 ♀
	KY:Edmonson Co., MACA Houchins Ferry, 28-29 Jul 2005, black light trap				
Trichoptera	Hydropsychidae	<i>Cheumatopsyche analis</i> (N Banks, 1903)	2 ♂		
		<i>Cheumatopsyche oxa</i> HH Ross, 1938	1 ♂		
		<i>Cheumatopsyche pasella</i> HH Ross, 1941	2 ♂		
		<i>Cheumatopsyche</i> species	6 ♀		
		<i>Hydropsyche</i> species	30 ♀		
		<i>Hydroptilidae</i>	1 ♀		
		<i>Orthotrichia aegerfasciella</i> (Chambers, 1873)	1 ♀		
		Leptoceridae	<i>Oecetis ditissa</i> HH Ross, 1966	2 ♀, 1 ♂	
			<i>Oecetis inconspicua</i> (Walker, 1852)	1 ♂	
	Phryganeidae	<i>Phryganea sayi</i> Milne, 1931	1 ♂		
	Polycentropodidae	<i>Cyrnellus fraternus</i> (N Banks, 1905)	2 ♀, 4 ♂		
		<i>Plectrocnemia cinerea</i> (HA Hagen, 1861)	2 ♀		
	KY:Edmonson Co., MACA middle Houchins Ferry Road, 16 Apr 2005, by hand				
Plecoptera	Nemouridae	<i>Soyedina</i> species	1 ♀		
Trichoptera	Goeridae	<i>Goera stylata</i> HH Ross, 1938	1 pupa		
	Hydropsychidae	<i>Diplectrona modesta</i> N Banks, 1908	1 larva		
	Hydroptilidae	<i>Ochrotrichia eliaga</i> (HH Ross, 1941)	5 larvae, 1 pupa		
	Limnephilidae	<i>Pycnopsyche gentilis</i> (McLachlan, 1871)	1 larva		
	Thremmatidae	<i>Neophylax fuscus</i> N Banks, 1903	1 larva		
KY:Edmonson Co., MACA Mill Branch, 5-6 Jun 2007, black light trap					
Trichoptera	Glossosomatidae	<i>Agapetus minutus</i> Sibley, 1926	1 ♂ mmt		
	Leptoceridae	<i>Oecetis inconspicua</i> (Walker, 1852)	1 ♀, 1 ♂		
KY:Edmonson Co., MACA Pike Spring, 7 Jun 2007, sweeping					
Plecoptera	Perlidae	<i>Acroneuria frisoni</i> Stark & Brown, 1991	1 ♀		
KY:Edmonson Co., MACA pond in woods near Union City, 14-15 Aug 2006, black light trap					
Megaloptera	Corydalidae	<i>Chauliodes pectinicornis</i> Linnaeus, 1783	1 ♂		

Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera				
Order	Family	Species	Specimens	
KY:Edmonson Co., MACA roadside spring Green River Ferry Road, 10 Apr 2006, by hand				
Plecoptera	Nemouridae	Nemouridae species	3 larvae	
Trichoptera	Limnephilidae	<i>Pseudostenophylax uniformis</i> (Betten, 1934)	3 imms., 4 pupae	
	Rhyacophilidae	<i>Rhyacophila ledra</i> HH Ross, 1939	1 larva	
KY:Edmonson Co., MACA roadside spring Green River Ferry Road, 14-15 Aug 2006, black light trap				
Trichoptera	Leptoceridae	<i>Ceraclea cancellata</i> (Betten, 1934)	1 ♂	
		<i>Triaenodes injustus</i> (HA Hagen, 1861)	2 ♂	
KY:Edmonson Co., MACA Roadside Spring, 10 Apr 2006, by hand				
Trichoptera	Hydropsychidae	<i>Diplectrona metaqui</i> HH Ross, 1970	5 larvae	
		<i>Diplectrona</i> species	1 larva, 1 pupa	
	Limnephilidae	<i>Pseudostenophylax uniformis</i> (Betten, 1934)	1 pupa	
KY:Edmonson Co., MACA Sloans Crossing Pond, 14 Aug 2006, sweeping				
Odonata	Libellulidae	<i>Erythemis simplicicollis</i> (T Say,1839)	2 ♂	
KY:Edmonson Co., MACA Sloans Crossing Pond, 14-15 Aug 2006, black light trap				
Megaloptera	Corydalidae	<i>Chauliodes pectinicornis</i> Linnaeus, 1783	1 ♀	
Odonata	Coenagrionidae	Coenagrionidae species	1 ♀	
		<i>Ischnura posita</i> HA Hagen, 1861	2 ♀	
Trichoptera	Hydropsychidae	<i>Cheumatopsyche pasella</i> HH Ross, 1941	1 ♂	
		<i>Hydropsyche</i> species	1 ♀	
		Hydroptilidae species	2 ♀	
	Hydroptilidae	Hydroptilidae species	2 ♀	
		Leptoceridae	<i>Ceraclea cancellata</i> (Betten, 1934)	6 ♀, 2 ♂
			<i>Nectopsyche pavidus</i> (HA Hagen, 1861)	1 ♂
	<i>Oecetis cinerascens</i> (HA Hagen, 1861)		1 ♀, 1 ♂	
	<i>Oecetis inconspicua</i> (Walker, 1852)		21 ♀, 39 ♂	
	<i>Oecetis nocturna</i> HH Ross, 1966		30 ♀, 1 ♂	
	Philopotamidae		<i>Chimarra</i> species	1 ♀
	KY:Edmonson Co., MACA Sloans Crossing Pond, 27 Jul 2005, black light trap			
	Plecoptera	Perlidae	<i>Perlesta</i> species	1 ♀
Trichoptera	Hydropsychidae	<i>Hydropsyche scalaris</i> HA Hagen, 1861	2 ♂	
		Hydroptilidae	<i>Hydroptila remita</i> Blickle & WC Morse, 1954	1 ♂
	Leptoceridae	<i>Ceraclea</i> species	1 ♀	
		<i>Oecetis ditissa</i> HH Ross, 1966	1 ♀, 1 ♂	
	<i>Oecetis persimilis</i> (N Banks, 1907)	1 ♂		
	Polycentropodidae	<i>Nyctiophylax</i> species	1 ♀	
	KY:Edmonson Co., MACA Sloans Crossing Pond, 27-28 Jul 2005, black light trap			
Trichoptera	Leptoceridae	<i>Nectopsyche exquisita</i> (Walker, 1852)	1 ♀	
		<i>Oecetis inconspicua</i> (Walker, 1852)	1 ♀	
KY:Edmonson Co., MACA spring below Wilson Cemetery, 7 Jun 2007, by hand				
Odonata	Aeshnidae	<i>Epiaeschna heros</i> (Fabricius, 1798)	1 ♀	
KY:Edmonson Co., MACA spring below Wilson Cemetery, 7 Jun 2007, sweeping				
Trichoptera	Goeridae	<i>Goerita betteni</i> HH Ross, 1962	1 ♂, 1 larva	
	Hydroptilidae	<i>Ochrotrichia eliaga</i> (HH Ross, 1941)	2 ♀, 1 ♂, 1 larva, 1	
	Philopotamidae	<i>Dolophilodes distincta</i> (Walker, 1852)	2 ♂	
	Rhyacophilidae	<i>Rhyacophila parantra</i> HH Ross, 1948	6 ♀, 18 ♂, 1 ♂ mmt	
		<i>Rhyacophila</i> species	1 ♀	
KY:Edmonson Co., MACA spring below Wilson Cemetery, 7-8 Jun 2007, black light trap				
Megaloptera	Corydalidae	<i>Nigronia fasciatus</i> (Walker, 1853)	1 ♀	
Plecoptera	Leuctridae	<i>Leuctra</i> species	2 ♀	
	Nemouridae	<i>Amphinemura nigritta</i> (Provancher, 1876)	11 ♀, 6 ♂	
		<i>Neoperla stewarti</i> Stark & Baumann, 1978	1 ♂	
	Perlidae	<i>Perlesta</i> species	1 ♀	
		<i>Perlinella ephyre</i> (Newman, 1839)	2 ♀	
		<i>Diploperla robusta</i> Stark & Gaufin, 1974	1 ♀, 2 ♂	
	Trichoptera	Glossosomatidae	<i>Glossosoma nigrior</i> N Banks, 1911	2 ♀, 2 ♂
			<i>Protophila</i> species	1 ♀
		Hydropsychidae	<i>Cheumatopsyche analis</i> (N Banks, 1903)	2 ♂
			<i>Cheumatopsyche harwoodi</i> Denning, 1948	10 ♀, 2 ♂
		<i>Cheumatopsyche</i> species	3 ♀	

Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera			
Order	Family	Species	Specimens
Ephemeroptera	Hydropsychidae	<i>Diplectrona</i> species	5 adults, 23 ♀, 47 ♂
		<i>Hydropsyche betteni</i> HH Ross, 1938	2 ♂
		<i>Hydropsyche cheilonis</i> HH Ross, 1938	3 ♂
		<i>Hydropsyche orris</i> HH Ross, 1938	2 ♂
		<i>Hydropsyche simulans</i> HH Ross, 1938	12 ♀, 44 ♂
		<i>Hydropsyche sparna</i> HH Ross, 1938	2 ♂
		<i>Hydropsyche</i> species	2 ♀
	Hydroptilidae	<i>Hydroptila armata</i> HH Ross, 1938	2 ♂
		<i>Hydroptila consimilis</i> Morton, 1905	1 ♂
		<i>Hydroptila coweetensis</i> Huryn, 1985	1 ♂
		<i>Hydroptila</i> species	26 ♀
		<i>Ochrotrichia eliaga</i> (HH Ross, 1941)	12 ♂
		<i>Ochrotrichia riesi</i> HH Ross, 1944	13 ♂
		<i>Ochrotrichia</i> species	15 ♀
		<i>Orthotrichia aegerfasciella</i> (Chambers, 1873)	1 ♂
		<i>Orthotrichia cristata</i> Morton, 1905	1 ♂
		<i>Orthotrichia</i> species	2 ♀
		<i>Oxyethira</i> species	1 ♀
	Lepidostomatidae	<i>Lepidostoma</i> species	1 ♀
	Leptoceridae	<i>Ceraclea</i> species	4 ♀
		<i>Leptocerus americanus</i> (N Banks, 1899)	1 ♀
		<i>Nectopsyche pavidia</i> (HA Hagen, 1861)	1 ♀
		<i>Oecetis cinerascens</i> (HA Hagen, 1861)	1 ♀
		<i>Oecetis inconspicua</i> (Walker, 1852)	8 ♀, 16 ♂
		<i>Oecetis persimilis</i> (N Banks, 1907)	2 ♀, 3 ♂
		<i>Setodes incertus</i> (Walker, 1852)	1 ♂
		<i>Triaenodes injustus</i> (HA Hagen, 1861)	1 adult, 1 ♂
		<i>Molanna blenda</i> Sibley, 1926	1 ♀, 2 ♂
		<i>Dolophilodes distincta</i> (Walker, 1852)	7 ♀, 11 ♂
	Molannidae	<i>Wormaldia moesta</i> (N Banks, 1914)	3 ♂
		<i>Agrypnia vestita</i> (Walker, 1852)	1 ♀, 1 ♂
	Philopotamidae	<i>Polycentropus carolinensis</i> N Banks, 1905	11 ♂
		<i>Polycentropus confusus</i> HA Hagen, 1861	1 ♂
		<i>Polycentropus elarus</i> HH Ross, 1944	1 ♂
		<i>Polycentropus</i> species	19 ♀
	Rhyacophilidae	<i>Rhyacophila banksi</i> HH Ross, 1944	1 ♂
		<i>Rhyacophila carolina</i> N Banks, 1911	5 ♂
		<i>Rhyacophila glaberrima</i> Ulmer, 1907	2 ♀
		<i>Rhyacophila parantra</i> HH Ross, 1948	11 ♀, 50 ♂
		<i>Rhyacophila torva</i> HA Hagen, 1861	3 ♀, 3 ♂
	Trichoptera_family	Trichoptera species	19 adults
KY:Edmonson Co., MACA spring on Little Jordan Road 1.2, 8 Jun 2007, black light trap			
Ephemeroptera	Ephemeridae	<i>Ephemera guttulata</i> Pictet, 1843	3 ♀, 1 ♂
	Heptageniidae	<i>Stenonema femoratum</i> (T Say, 1823)	1 ♂
	Leptophlebiidae	<i>Paraleptophlebia debilis</i> (Walker, 1853)	4 ♀, 7 ♂
Plecoptera	Leuctridae	<i>Leuctra</i> species	2 ♀
	Nemouridae	<i>Amphinemura nigrutta</i> (Provancher, 1876)	11 ♀, 6 ♂
	Perlidae	<i>Neoperla stewarti</i> Stark & Baumann, 1978	1 ♂
		<i>Perlesta</i> species	1 ♀
		<i>Perlinella ephyre</i> (Newman, 1839)	2 ♀
	Perlodidae	<i>Diploperla robusta</i> Stark & Gaufin, 1974	1 ♀, 2 ♂
Trichoptera	Hydropsychidae	<i>Diplectrona</i> species	1 ♂
		<i>Hydropsyche simulans</i> HH Ross, 1938	13 ♂
		<i>Hydropsyche sparna</i> HH Ross, 1938	1 ♂
		<i>Hydropsyche</i> species	1 ♀
	Psychomyiidae	<i>Lype diversa</i> (N Banks, 1914)	1 ♀
	Rhyacophilidae	<i>Rhyacophila parantra</i> HH Ross, 1948	5 ♀, 6 ♂
	Thremmatidae	<i>Neophylax concinnus</i> MacLachlan, 1871	8 larvae
		<i>Neophylax wigginsi</i> Sykora & Weaver, 1978	17 larvae

Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera			
Order	Family	Species	Specimens
KY:Edmonson Co., MACA spring on Little Jordan Road 1.2, 8 Jun 2007, sweeping			
Odonata	Petaluridae	<i>Tachopteryx thoreyi</i> (HA Hagen in Selys, 1857)	1 ♂
KY:Edmonson Co., MACA stream under road to Park offices, 14 Aug 2006, by hand			
Trichoptera	Rhyacophilidae	<i>Rhyacophila glaberrima</i> Ulmer, 1907	3 prepupae
KY:Edmonson Co., MACA upper Houchins Ferry Road, 16 Apr 2005, by hand			
Ephemeroptera	Ameletidae	<i>Ameletus lineatus</i> JR Traver, 1932	3 larvae
	Baetidae	Baetidae species	1 larva
	Ephemerellidae	<i>Eurylophella funeralis</i> (J McDunnough, 1925)	4 larvae
		<i>Eurylophella</i> species	1 larva
	Leptophlebiidae	<i>Paraleptophlebia</i> species	2 larvae
Megaloptera	Corydalidae	<i>Nigronia fasciatus</i> (Walker, 1853)	1 larva
Plecoptera	Chloroperlidae	<i>Sweltsa</i> species	1 larva
	Nemouridae	<i>Amphinemura nigrutta</i> (Provancher, 1876)	2 ♀, 2 ♂, 5 larvae
Trichoptera	Goeridae	<i>Goera stylata</i> HH Ross, 1938	1 ♀ mmt, 1 ♂ mmt
	Hydropsychidae	<i>Diplectrona modesta</i> N Banks, 1908	8 larvae
	Hydroptilidae	<i>Ochrotrichia eliaga</i> (HH Ross, 1941)	9 larvae, 10 ♀
	Lepidostomatidae	<i>Lepidostoma sackeni</i> (N Banks, 1936)	1 larva
		<i>Lepidostoma</i> species	1 larva
	Limnephilidae	<i>Pycnopsyche guttifer</i> (Walker, 1852)	1 larva
	Philopotamidae	<i>Dolophilodes distincta</i> (Walker, 1852)	2 larvae
	Rhyacophilidae	<i>Rhyacophila glaberrima</i> Ulmer, 1907	1 larva
		<i>Rhyacophila invaria</i> (Walker, 1852)	2 larvae, 1 pupa
	Thremmatidae	<i>Neophylax</i> species	2 larvae
KY:Edmonson Co., MACA Wet Prong 1, 6-7 Jun 2007, black light trap			
Trichoptera	Calamoceratidae	<i>Anisocentropus pyraloides</i> (Walker, 1852)	3 ♀, 1 ♂
	Glossosomatidae	<i>Glossosoma nigror</i> N Banks, 1911	4 ♀
	Hydropsychidae	<i>Diplectrona</i> species	3 ♀, 1 ♂
		<i>Hydropsyche betteni</i> HH Ross, 1938	3 ♀, 1 ♂
		<i>Hydropsyche simulans</i> HH Ross, 1938	7 ♂
		<i>Hydropsyche sparna</i> HH Ross, 1938	1 ♂
		<i>Hydroptila consimilis</i> Morton, 1905	17 ♀, 1 ♂
	Hydroptilidae	<i>Hydroptila</i> species	17 ♀
	Molannidae	<i>Molanna blenda</i> Sibley, 1926	2 ♂
	Philopotamidae	<i>Dolophilodes distincta</i> (Walker, 1852)	16 adults, 1 ♀, 1 ♂
	Polycentropodidae	<i>Polycentropus centralis</i> N Banks, 1914	1 ♂
	Rhyacophilidae	<i>Rhyacophila</i> species	8 ♀, 6 ♂
KY:Edmonson Co., MACA Wet Prong Headwaters, 28 Aug 2006, by hand			
Trichoptera	Rhyacophilidae	<i>Rhyacophila glaberrima</i> Ulmer, 1907	1 ♀, 2 ♂
KY:Edmonson Co., MACA Wet Prong Headwaters, 28-29 Aug 2006, black light trap			
Megaloptera	Corydalidae	<i>Chauliodes rastricornis</i> Rambur, 1842	1 ♀
Plecoptera	Leuctridae	<i>Leuctra</i> species	1 ♀
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i> species	1 ♀
		<i>Hydropsyche</i> species	2 ♀
	Leptoceridae	<i>Oecetis inconspicua</i> (Walker, 1852)	1 ♂
	Limnephilidae	<i>Pycnopsyche antica</i> (Walker, 1852)	2 ♀
	Philopotamidae	<i>Chimarra</i> species	1 ♀
		<i>Dolophilodes distincta</i> (Walker, 1852)	2 ♀, 1 ♂
	Phryganeidae	<i>Phryganea sayi</i> Milne, 1931	1 ♂
	Rhyacophilidae	<i>Rhyacophila glaberrima</i> Ulmer, 1907	3 ♀, 6 ♂
	Thremmatidae	<i>Neophylax concinnus</i> MacLachlan, 1871	1 ♀, 1 ♂
KY:Edmonson Co., MACA Wet Prong Headwaters, 6-7 Jun 2007, black light trap			
Megaloptera	Corydalidae	<i>Nigronia fasciatus</i> (Walker, 1853)	1 ♀
Trichoptera	Hydropsychidae	<i>Cheumatopsyche analis</i> (N Banks, 1903)	2 ♂
		<i>Cheumatopsyche oxa</i> HH Ross, 1938	2 ♂
		<i>Cheumatopsyche</i> species	4 ♀
	Hydroptilidae	<i>Hydroptila consimilis</i> Morton, 1905	2 ♂
	Leptoceridae	<i>Ceraclea</i> species	1 ♀
	Phryganeidae	<i>Ptilostomis ocellifera</i> (Walker, 1852)	1 ♀

Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera			
Order	Family	Species	Specimens
KY:Edmonson Co., MACA Wet Prong site 2, 6-7 Jun 2007, black light trap			
Trichoptera	Calamoceratidae	<i>Anisocentropus pyraloides</i> (Walker, 1852)	11 adults
	Hydropsychidae	<i>Hydropsyche betteni</i> HH Ross, 1938	1 ♂
	Leptoceridae	<i>Oecetis inconspicua</i> (Walker, 1852)	1 ♂
	Molannidae	<i>Molanna blenda</i> Sibley, 1926	2 ♀, 5 ♂
	Polycentropodidae	<i>Nyctiophylax moestus</i> N Banks, 1911	1 ♀, 3 ♂
	Psychomyiidae	<i>Lype diversa</i> (N Banks, 1914)	1 ♂
	Rhyacophilidae	<i>Rhyacophila glaberrima</i> Ulmer, 1907	1 ♂
		<i>Rhyacophila parantra</i> HH Ross, 1948	1 ♂
KY:Edmonson Co., MACA Wet Prong site 3, 6-7 Jun 2007, black light trap			
Plecoptera	Leuctridae	<i>Leuctra</i> species	2 ♀
KY:Hart Co., MACA Cooper Spring, 5 Jun 2007, by hand			
Plecoptera	Nemouridae	<i>Amphinemura nigritta</i> (Provancher, 1876)	1 ♂
Trichoptera	Hydropsychidae	<i>Diplectrona</i> species	1 ♀, 8 larvae
	Rhyacophilidae	<i>Rhyacophila parantra</i> HH Ross, 1948	2 ♀, 10 ♂
KY:Hart Co., MACA Cooper Spring, 5-6 Jun 2007, black light trap			
Megaloptera	Corydalidae	<i>Chauliodes pectinicornis</i> Linnaeus, 1783	1 ♀
Plecoptera	Perlidae	<i>Neoperla stewarti</i> Stark & Baumann, 1978	1 ♀
Trichoptera	Brachycentridae	<i>Micrasema</i> species	1 ♀
	Hydropsychidae	<i>Diplectrona</i> species	4 ♀, 5 ♂
	Hydroptilidae	Hydroptilidae species	17 ♀
		<i>Ochrotrichia eliaga</i> (HH Ross, 1941)	2 ♂
	Molannidae	<i>Molanna blenda</i> Sibley, 1926	2 ♂
	Odontoceridae	<i>Psilotreta rufa</i> (HA Hagen, 1861)	1 ♀, 1 ♂
	Philopotamidae	<i>Dolophilodes distincta</i> (Walker, 1852)	35 adults, 1 ♀
	Psychomyiidae	<i>Lype diversa</i> (N Banks, 1914)	1 ♀
	Rhyacophilidae	<i>Rhyacophila parantra</i> HH Ross, 1948	2 ♂, 2 pupae
	Thremmatidae	<i>Neophylax concinnus</i> MacLachlan, 1871	1 larva
KY:Hart Co., MACA Green River Dennison Ferry, 5 Jun 2007, sweeping			
Odonata	Coenagrionidae	<i>Argia moesta</i> (HA Hagen, 1861)	1 ♀
		<i>Argia tibialis</i> (Rambur, 1842)	1 ♀, 2 ♂
KY:Hart Co., MACA Green River Dennison Ferry, 5-6 Jun 2007, black light trap			
Odonata	Corduliidae	<i>Epithea cynosura</i> (T Say,1839)	1 ♀
		<i>Neurocordulia virginiensis</i> Davis, 1927	1 ♂
Plecoptera	Perlidae	<i>Neoperla stewarti</i> Stark & Baumann, 1978	12 ♀, 1 ♂
		<i>Perlinella ephyre</i> (Newman, 1839)	29 ♀
Trichoptera	Hydropsychidae	<i>Hydropsyche phalerata</i> HA Hagen, 1861	1 ♂
	Leptoceridae	<i>Ceraclea cancellata</i> (Betten, 1934)	4 ♂
		<i>Ceraclea flava</i> (N Banks, 1904)	2 ♂
		<i>Ceraclea tarsipunctata</i> (Vorhies, 1909)	1 ♂
		<i>Nectopsyche candida</i> (HA Hagen, 1861)	1 ♀
		<i>Nectopsyche exquisita</i> (Walker, 1852)	4 ♀, 3 ♂
		<i>Oecetis avara</i> (N Banks, 1895)	1 ♂
		<i>Oecetis cinerascens</i> (HA Hagen, 1861)	1 ♀
		Trichoptera_family	Trichoptera species
	MACA unknown location, unknown date		
Odonata	Corduliidae	<i>Neurocordulia obsoleta</i> (T Say,1839)	1 larva

Appendix 3. Non-Target Species Data

The records for 38 non-target taxa are presented in the tables 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 1 phylum, 2 classes, 9 orders, 17 families, and 30 genera. Some taxa are included in catchall groups that represent specimens that the authors did not identify, such as Amphipoda family, Amphipoda genus, and Amphipoda species. Most of the non-target taxa are terrestrial species. These are highlighted in the tables by a tan background.

Mammoth Cave National Park					
Non-Target Taxa Specimen Records					
Phylum	Class	Order	Family	Taxon	Specimens
KY:Edmonson Co., MACA 3 Springs, 15-16 Aug 2006, black light trap, CRParker & JLRobinson					
Arthropoda	Insecta	Coleoptera	Curculionidae	Curculionidae species	1 adult
			Dytiscidae	<i>Thermonectus basillaris</i> (Harris, 1829)	1 ♀
			Scarabaeidae	Scarabaeidae species	1 adult
KY:Edmonson Co., MACA 3 Springs, 15-16 Aug 2006, black light trap, JLRobinson & CRParker					
Arthropoda	Insecta	Orthoptera	Gryllacrididae	<i>Camptonotus carolinensis</i> (Gerstaecker, 1860)	1 ♂
KY:Edmonson Co., MACA 3 Springs, 27-28 Jul 2005, black light trap, CRParker					
Arthropoda	Insecta	Diptera	Tabanidae	<i>Tabanus turbidus</i> Wiedemann, 1828	1 ♂
		Orthoptera	Gryllidae	<i>Neoxabea bipunctata</i> (DeGeer, 1773)	1 ♂
KY:Edmonson Co., MACA Cinnamon Fern Bog, 29-30 Aug 2006, black light trap, JLRobinson & CRParker					
Arthropoda	Insecta	Orthoptera	Gryllidae	<i>Allonemobius socius</i> (Scudder)	1 ♀
			Tettigoniidae	<i>Microcentrum retinerve</i> (Burmeister, 1838)	1 ♂
				<i>Neoconocephalus triops</i> (Linnaeus, 1758)	1 ♂
KY:Edmonson Co., MACA First Creek Lake, 28-29 Jul 2005, black light trap, CRParker					
Arthropoda	Insecta	Diptera	Tabanidae	<i>Tabanus longus</i> Osten Sacken, 1876	1 ♀
				<i>Tabanus turbidus</i> Wiedemann, 1828	1 ♂
		Neuroptera	Ascalaphidae	Ascalaphidae species	2 adults
KY:Edmonson Co., MACA Good Spring, 5-6 Jun 2007, black light trap, CRParker & JLRobinson					
Arthropoda	Insecta	Blattaria	Blattellidae	<i>Parcoblatta virginica</i> (Brunner, 1865)	1 adult
		Coleoptera	Coleoptera	Coleoptera species	1 adult
		Diptera	Diptera	Diptera species	1 adult
KY:Edmonson Co., MACA Green River below Mile 189, 29-30 Aug 2006, black light trap, JLRobinson & CRParker					
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Copelatus glypticus</i> (Say, 1823)	1 adult
				<i>Ilybius biguttulus</i> (Germar, 1824)	1 ♂
			Heteroceridae	<i>Tropicus pusillus</i> (Say, 1823)	26 adults
		Orthoptera	Gryllidae	<i>Velarifictorus micado</i> (Saussure, 1877)	1 ♀
KY:Edmonson Co., MACA Green River mile 203.9, 7 Jun 2007, by hand, CRParker & JLRobinson					
Arthropoda	Insecta	Coleoptera	Coleoptera	Coleoptera species	1 adult
			Psephenidae	<i>Psephenus herricki</i> (DeKay, 1844)	2 larvae
KY:Edmonson Co., MACA Houchins Ferry, 28-29 Jul 2005, black light trap, CRParker					
Arthropoda	Insecta	Diptera	Tabanidae	<i>Tabanus fulvulus</i> Wiedemann, 1828	1 ♀
				<i>Tabanus turbidus</i> Wiedemann, 1828	1 ♂
KY:Edmonson Co., MACA middle Houchins Ferry Road, 16 Apr 2005, by hand, CRParker					
Arthropoda	Insecta	Coleoptera	Psephenidae	<i>Ectopria</i> species	1 indiv.
		Diptera	Stratiomyidae	<i>Euparyphus</i> species	1 larva
	Malacostraca	Amphipoda	Amphipoda	Amphipoda species	3 indivs.
		Isopoda	Asellidae	<i>Lirceus</i> species	1 indiv.

Non-Target Taxa Specimen Records					
Phylum	Class	Order	Family	Taxon	Specimens
KY:Edmonson Co., MACA pond in woods near Union City, 14-15 Aug 2006, black light trap, CRParker & JLRobinson					
Arthropoda	Insecta	Orthoptera	Gryllidae	<i>Neonemobius cubensis</i> (Saussure, 1874)	1 ♀
KY:Edmonson Co., MACA roadside spring Green River Ferry Road, 14-15 Aug 2006, black light trap, CRParker & JLRobinson					
Arthropoda	Insecta	Coleoptera	Scarabaeidae	<i>Phyllophaga obsoleta</i> (Blanchard, 1851)	1 adult
		Orthoptera	Tettigoniidae	<i>Scudderia furcata furcata</i> Brunner von Wattenwyl, 1878	1 ♂
KY:Edmonson Co., MACA Sloans Crossing Pond, 14-15 Aug 2006, black light trap, CRParker & JLRobinson					
Arthropoda	Insecta	Blattaria	Blatellidae	<i>Parcoblatta pensylvanica</i> (DeGeer, 1773)	1 adult
		Coleoptera	Scarabaeidae	<i>Phyllophaga ilicis</i> (Knoch, 1801)	1 adult
			<i>Phyllophaga quercus</i> (Knoch, 1801)	1 adult	
Hemiptera	Nepidae		<i>Ranatra australis</i> Hungerford, 1922	1 adult	
Orthoptera	Gryllidae		<i>Gryllus rubens</i> Scudder, 1902	1 ♂	
			<i>Neonemobius cubensis</i> (Saussure, 1874)	1 ♀	
		Tettigoniidae	<i>Scudderia furcata furcata</i> Brunner von Wattenwyl, 1878	1 ♂	
KY:Edmonson Co., MACA spring below Wilson Cemetery, 7-8 Jun 2007, black light trap, CRParker & JLRobinson					
Arthropoda	Insecta	Diptera	Diptera	Diptera species	1 adult
			Tabanidae	<i>Tabanus</i> species	1 adult
		Mecoptera	Bittacidae	<i>Bittacus</i> species	1 ♂
		Orthoptera	Tettigoniidae	<i>Atlantius</i> species	1 larva
KY:Edmonson Co., MACA upper Houchins Ferry Road, 16 Apr 2005, by hand, CRParker					
Arthropoda	Insecta	Coleoptera	Psephenidae	<i>Ectopria</i> species	1 larva
		Hemiptera	Veliidae	<i>Microvelia americana</i> (Uhler, 1884)	1 adult
	Malacostraca	Amphipoda	Amphipoda	Amphipoda species	3 indivs.
		Isopoda	Asellidae	<i>Lirceus</i> species	1 indiv.
KY:Edmonson Co., MACA Wet Prong Headwaters, 28-29 Aug 2006, black light trap, JLRobinson & CRParker					
Arthropoda	Insecta	Coleoptera	Dytiscidae	<i>Copelatus chevrolati renovatus</i> Guignot, 1952	1 ♀
			Heteroceridae	<i>Tropicus pusillus</i> (Say, 1823)	6 adults
			Scarabaeidae	<i>Aphodius</i> species	1 adult
		Orthoptera	Gryllidae	<i>Eunemobius carolinus</i> (Scudder, 1877)	1 ♂
KY:Hart Co., MACA Cooper Spring, 5-6 Jun 2007, black light trap, CRParker & JLRobinson					
Arthropoda	Insecta	Coleoptera	Coleoptera	Coleoptera species	1 adult
		Diptera	Tabanidae	<i>Tabanus</i> species	1 adult
KY:Hart Co., MACA Green River Dennison Ferry, 5-6 Jun 2007, black light trap, CRParker & JLRobinson					
Arthropoda	Insecta	Diptera	Tabanidae	<i>Tabanus</i> species	1 adult

Appendix 4. Species List

A list of all taxa found to occur in Mammoth Cave National Park (MACA) based on field collections of the present study. A total of 173 taxa are listed, of which 154 are aquatic. Of the aquatic species, 141 are target species, including 16 Ephemeroptera, 12 Odonata, 12 Plecoptera, 3 Megaloptera, and 98 Trichoptera. Terrestrial species are indicated by a tan highlight in the table. The tables include the genus, the species epithet, and the author, such as *Copelatus glyphicus* (Say, 1823). Entries such as *Ectopria* species indicate a taxon, in this case a genus of aquatic beetle, that was collected, but that could not be identified to species and for which no other representatives of the genus were found that could be identified to species. Since the genus *Ectopria* is clearly present in the park, this entry is included to recognize the presence of the genus in MACA.

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

List of all taxa collected in Mammoth Cave National Park (MACA). Entries such as “*Ectopria* species” indicate a genus that was represented only by individuals that could not be identified to species, but otherwise represent a valid record of that genus from MACA.

Phylum Arthropoda		Class Insecta	
Order	Family	Taxon	Common Name
Blattaria	Blatellidae	<i>Parcoblatta pensylvanica</i> (DeGeer, 1773)	Pennsylvania Wood Cockroach
		<i>Parcoblatta virginica</i> (Brunner, 1865)	Virginia Wood Cockroach
Coleoptera	Dytiscidae	<i>Copelatus chevrolati renovatus</i> Guignot, 1952	Predaceous Diving Beetle
		<i>Copelatus glyphicus</i> (Say, 1823)	Predaceous Diving Beetle
		<i>Ilybius biguttulus</i> (Germar, 1824)	Predaceous Diving Beetle
		<i>Thermonectus basillaris</i> (Harris, 1829)	Predaceous Diving Beetle
		<i>Tropicus pusillus</i> (Say, 1823)	Variegated Mud-loving Beetle
	Psephenidae	<i>Ectopria</i> species	False Water Penny Beetle
		<i>Psephenus herricki</i> (DeKay, 1844)	Water Penny Beetle
	Scarabaeidae	<i>Aphodius</i> species	Aphodine Dung Beetle
		<i>Phyllophaga ilicis</i> (Knoch, 1801)	Scarab Beetle
		<i>Phyllophaga obsoleta</i> (Blanchard, 1851)	Scarab Beetle
		<i>Phyllophaga quercus</i> (Knoch, 1801)	Scarab Beetle
Diptera	Stratiomyidae	<i>Euparyphus</i> species	Soldier Fly
	Tabanidae	<i>Tabanus fulvulus</i> Wiedemann, 1828	Horse Fly
		<i>Tabanus longus</i> Osten Sacken, 1876	Horse Fly
		<i>Tabanus turbidus</i> Wiedemann, 1828	Horse Fly
Ephemeroptera	Ameletidae	<i>Ameletus lineatus</i> Traver, 1932	Painted Minnow Mayfly
	Caenidae	<i>Caenis</i> species	Small Squaregill Mayfly
	Ephemerellidae	<i>Ephemerella</i> species	Spiny Crawler Mayfly
		<i>Eurylophella funeralis</i> (J McDunnough, 1925)	Spiny Crawler Mayfly
	Ephemeridae	<i>Ephemera guttulata</i> Pictet, 1843	Common Burrowing Mayfly
		<i>Hexagenia limbata</i> (Serville, 1829)	Common Burrowing Mayfly
	Heptageniidae	<i>Maccaffertium</i> species	Flat-headed Mayfly
		<i>Stenacron interpunctatum</i> (Say, 1839)	Flat-headed Mayfly
		<i>Stenonema femoratum</i> (Say, 1823)	Flat-headed Mayfly

Phylum Arthropoda		Class Insecta		
Order	Family	Taxon	Common Name	
	Isonychiidae	<i>Isonychia</i> species	Brushy-legged Minnow Mayfly	
	Leptohyphidae	<i>Tricorythodes</i> species	Little Stout Crawler Mayfly	
	Leptophlebiidae	<i>Habrophlebiodes americana</i> (Banks, 1903)	Pronggill Mayfly	
		<i>Leptophlebia</i> species	Pronggill Mayfly	
		<i>Paraleptophlebia debilis</i> (Walker, 1853)	Pronggill Mayfly	
		<i>Paraleptophlebia</i> species	Pronggill Mayfly	
	Potamanthidae	<i>Anthopotamus</i> species	Hacklegill Mayfly	
	Hemiptera	Nepidae	<i>Ranatra australis</i> Hungerford, 1922	Water Scorpion
		Veliidae	<i>Microvelia americana</i> (Uhler, 1884)	Little Water Strider
	Mecoptera	Bittacidae	<i>Bittacus</i> species	Hanging Scorpionfly
Megaloptera	Corydalidae	<i>Chauliodes pectinicornis</i> Linnaeus, 1783	Fishfly	
		<i>Chauliodes rastricornis</i> Rambur, 1842	Fishfly	
		<i>Nigronia fasciatus</i> (Walker, 1853)	Fishfly	
Odonata	Aeshnidae	<i>Epiaeschna heros</i> (Fabricius, 1798)	Swamp Darner	
	Calopterygidae	<i>Calopteryx</i> species	Jewelwing	
	Coenagrionidae	<i>Argia moesta</i> (Hagen, 1861)	Powdered Dancer	
		<i>Argia tibialis</i> (Rambur, 1842)	Blue-tipped Dancer	
		<i>Enallagma exsulans</i> (Hagen, 1861)	Stream Bluet	
		<i>Ischnura posita</i> Hagen, 1861	Fragile Forktail	
	Corduliidae	<i>Epitheca cynosura</i> (Say, 1839)	Common Baskettail	
		<i>Neurocordulia obsoleta</i> (Say, 1839)	Umber Shadowdragon	
		<i>Neurocordulia virginienensis</i> Davis, 1927	Cinnamon Shadowdragon	
	Gomphidae	<i>Hagenius brevistylus</i> Selys, 1854	Dragonhunter	
	Libellulidae	<i>Erythemis simplicicollis</i> (Say, 1839)	Eastern Pondhawk	
	Petaluridae	<i>Tachopteryx thoreyi</i> (Hagen in Selys, 1857)	Gray Petaltail	
	Orthoptera	Gryllacrididae	<i>Camptonotus carolinensis</i> (Gerstaecker, 1860)	Leaf-rolling Cricket
		Gryllidae	<i>Allonemobius socius</i> (Scudder)	Ground Cricket
			<i>Eunemobius carolinus</i> (Scudder, 1877)	Carolina Ground Cricket
			<i>Gryllus rubens</i> Scudder, 1902	Southeastern Field Cricket
			<i>Neonemobius cubensis</i> (Saussure, 1874)	Cuban Ground Cricket
			<i>Neoxabea bipunctata</i> (DeGeer, 1773)	White Tree Cricket
			<i>Velarifictorus micado</i> (Saussure, 1877)	Japanese Burrowing Cricket
Tettigoniidae			<i>Atlanticus</i> species	Eastern Shieldback
			<i>Microcentrum retinerve</i> (Burmeister, 1838)	Angularwinged Katydid
		<i>Neoconocephalus triops</i> (Linnaeus, 1758)	Broad-tipped Conehead	
		<i>Scudderia furcata furcata</i> Brunner von Wattenwyl, 1878	Fork-tailed Bush Katydid	
Plecoptera		Chloroperlidae	<i>Sweltsa</i> species	Sallyfly
		Leuctridae	<i>Leuctra alta</i> James, 1974	Alta Needlefly
			<i>Leuctra grandis</i> Banks, 1906	Grand Needlefly
	<i>Leuctra sibleyi</i> Claassen, 1923		Brook Needlefly	
	Nemouridae	<i>Amphinemura nigritta</i> (Provancher, 1876)	Little Black Forestfly	
		<i>Soyedina vallicularia</i> (Wu, 1923)	Valley Forestfly	
	Perlidae	<i>Acroneuria frisoni</i> Stark & Brown, 1991	Central Stone	
		<i>Neoperla stewarti</i> Stark & Baumann, 1978	Multispine Stone	
		<i>Perlesta</i> species	Stone	
		<i>Perlinella drymo</i> (Newman, 1839)	Striped Stone	
		<i>Perlinella ephyre</i> (Newman, 1839)	Vernal Stone	
	Perlodidae	<i>Diploperla robusta</i> Stark & Gaufin, 1974	Robust Springfly	
Trichoptera	Brachycentridae	<i>Micrasema bennetti</i> Ross, 1947	Short-horned Caddisfly	
	Calamoceratidae	<i>Anisocentropus pyraloides</i> (Walker, 1852)	Thick-horned Caddisfly	
	Dipseudopsidae	<i>Phylocentropus lucidus</i> (Hagen, 1861)	Buried Tube Caddisfly	
	Glossosomatidae	<i>Agapetus minutus</i> Sibley, 1926	Saddle-case Making Caddisfly	
		<i>Glossosoma nigrior</i> Banks, 1911	Saddle-case Making Caddisfly	
		<i>Protoptila palina</i> Ross, 1941	Saddle-case Making Caddisfly	
	Goeridae	<i>Goera fuscata</i> Banks, 1905	Armored Caddisfly	
		<i>Goera stylata</i> Ross, 1938	Armored Caddisfly	
		<i>Goerita betteni</i> Ross, 1962	Armored Caddisfly	
		Helicopsychidae	<i>Helicopsyche borealis</i> (Hagen, 1861)	Snail-case Making Caddisfly
Hydropsychidae	<i>Cheumatopsyche analis</i> (Banks, 1903)	Retreat-making Caddisfly		

Phylum Arthropoda		Class Insecta	
Order	Family	Taxon	Common Name
		<i>Cheumatopsyche campyla</i> Ross, 1938	Retreat-making Caddisfly
		<i>Cheumatopsyche harwoodi</i> Denning, 1948	Retreat-making Caddisfly
		<i>Cheumatopsyche oxa</i> Ross, 1938	Retreat-making Caddisfly
		<i>Cheumatopsyche pasella</i> Ross, 1941	Retreat-making Caddisfly
		<i>Diplectrona metaqui</i> Ross, 1970	Retreat-making Caddisfly
		<i>Diplectrona modesta</i> Banks, 1908	Retreat-making Caddisfly
		<i>Hydropsyche betteni</i> Ross, 1938	Retreat-making Caddisfly
		<i>Hydropsyche cheilonis</i> Ross, 1938	Retreat-making Caddisfly
		<i>Hydropsyche orris</i> Ross, 1938	Retreat-making Caddisfly
		<i>Hydropsyche phalerata</i> Hagen, 1861	Retreat-making Caddisfly
		<i>Hydropsyche scalaris</i> Hagen, 1861	Retreat-making Caddisfly
		<i>Hydropsyche simulans</i> Ross, 1938	Retreat-making Caddisfly
		<i>Hydropsyche sparna</i> Ross, 1938	Retreat-making Caddisfly
	Hydroptilidae	<i>Agraylea multipunctata</i> Curtis, 1834	Micro-caddisfly
		<i>Hydroptila armata</i> Ross, 1938	Micro-caddisfly
		<i>Hydroptila consimilis</i> Morton, 1905	Micro-caddisfly
		<i>Hydroptila coweetensis</i> Hurn, 1985	Micro-caddisfly
		<i>Hydroptila delineata</i> Morton, 1905	Micro-caddisfly
		<i>Hydroptila gunda</i> Milne, 1936	Micro-caddisfly
		<i>Hydroptila kuehnei</i> Hou, Hou, & Harris, 1998	Micro-caddisfly
		<i>Hydroptila remita</i> Bickel & Morse, 1954	Micro-caddisfly
		<i>Hydroptila spatulata</i> Morton, 1905	Micro-caddisfly
		<i>Hydroptila vala</i> Ross, 1938	Micro-caddisfly
		<i>Ochrotrichia eliaga</i> (Ross, 1941)	Micro-caddisfly
		<i>Ochrotrichia riesi</i> Ross, 1944	Micro-caddisfly
		<i>Ochrotrichia tarsalis</i> (Hagen, 1861)	Micro-caddisfly
		<i>Orthotrichia aegerfasciella</i> (Chambers, 1873)	Micro-caddisfly
		<i>Orthotrichia cristata</i> Morton, 1905	Micro-caddisfly
		<i>Oxyethira pallida</i> (Banks, 1904)	Micro-caddisfly
	Lepidostomatidae	<i>Lepidostoma sackeni</i> (Banks, 1936)	Scale-mouthed Caddisfly
	Leptoceridae	<i>Ceraclea cancellata</i> (Betten, 1934)	Long-horned Caddisfly
		<i>Ceraclea enodis</i> Whitlock & Morse, 1994	Long-horned Caddisfly
		<i>Ceraclea flava</i> (Banks, 1904)	Long-horned Caddisfly
		<i>Ceraclea maculata</i> (Banks, 1899)	Long-horned Caddisfly
		<i>Ceraclea tarsipunctata</i> (Vorhies, 1909)	Long-horned Caddisfly
		<i>Leptocerus americanus</i> (Banks, 1899)	Long-horned Caddisfly
		<i>Nectopsyche candida</i> (Hagen, 1861)	Long-horned Caddisfly
		<i>Nectopsyche exquisita</i> (Walker, 1852)	Long-horned Caddisfly
		<i>Nectopsyche pavidata</i> (Hagen, 1861)	Long-horned Caddisfly
		<i>Oecetis avara</i> (Banks, 1895)	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>Setodes incertus</i> (Walker, 1852)	Long-horned Caddisfly
		<i>Triaenodes injustus</i> (Hagen, 1861)	Long-horned Caddisfly
		<i>Triaenodes tardus</i> Milne, 1934	Long-horned Caddisfly
	Limnephilidae	<i>Isonychia punctatissima</i> (Walker, 1852)	Northern Caddisfly
		<i>Pseudostenophylax uniformis</i> (Betten, 1934)	Northern Caddisfly
		<i>Pycnopsyche antica</i> (Walker, 1852)	Stickbait Caddisfly
		<i>Pycnopsyche gentilis</i> (McLachlan, 1871)	Stickbait Caddisfly
		<i>Pycnopsyche guttifer</i> (Walker, 1852)	Stickbait Caddisfly
		<i>Pycnopsyche luculenta</i> (Betten, 1934)	Stickbait Caddisfly
	Molannidae	<i>Molanna blanda</i> Sibley, 1926	Molannid Caddisfly
	Odontoceridae	<i>Psilotreta rufa</i> (Hagen, 1861)	Large Sturdy-case Caddisfly
	Philopotamidae	<i>Chimarra aterrima</i> Hagen, 1861	Finger-net Caddisfly
		<i>Chimarra obscura</i> (Walker, 1852)	Finger-net Caddisfly
		<i>Dolophilodes distincta</i> (Walker, 1852)	Winter Caddisfly
		<i>Wormaldia moesta</i> (Banks, 1914)	Finger-net Caddisfly

Phylum Arthropoda		Class Insecta	
Order	Family	Taxon	Common Name
	Phryganeidae	<i>Agrypnia vestita</i> (Walker, 1852)	Phryganeid Caddisfly
		<i>Oligostomis ocelligera</i> (Walker, 1852)	Phryganeid Caddisfly
		<i>Phryganea cinerea</i> Walker, 1852	Phryganeid Caddisfly
		<i>Phryganea sayi</i> Milne, 1931	Phryganeid Caddisfly
		<i>Ptilostomis ocellifera</i> (Walker, 1852)	Phryganeid Caddisfly
	Polycentropodidae	<i>Cynellus fraternus</i> (Banks, 1905)	Fine-net Caddisfly
		<i>Neureclipsis crepuscularis</i> (Walker, 1852)	Trumpet-net Caddisfly
		<i>Nyctiophylax moestus</i> Banks, 1911	Fine-net Caddisfly
		<i>Plectrocnemia cinerea</i> (Hagen, 1861)	Fine-net Caddisfly
		<i>Polycentropus carolinensis</i> Banks, 1905	Fine-net Caddisfly
		<i>Polycentropus centralis</i> Banks, 1914	Fine-net Caddisfly
		<i>Polycentropus confusus</i> Hagen, 1861	Fine-net Caddisfly
		<i>Polycentropus elarus</i> Ross, 1944	Fine-net Caddisfly
	Psychomyiidae	<i>Lype diversa</i> (Banks, 1914)	Fine-net Caddisfly
		<i>Psychomyia flavida</i> Hagen, 1861	Fine-net Caddisfly
	Rhyacophilidae	<i>Rhyacophila acutiloba</i> Morse & Ross, 1971	Free-living Caddisfly
		<i>Rhyacophila banksi</i> Ross, 1944	Free-living Caddisfly
		<i>Rhyacophila carolina</i> Banks, 1911	Free-living Caddisfly
		<i>Rhyacophila fenestra</i> Ross, 1938	Free-living Caddisfly
		<i>Rhyacophila glaberrima</i> Ulmer, 1907	Free-living Caddisfly
		<i>Rhyacophila invaria</i> (Walker, 1852)	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
	Thremmatidae	<i>Neophylax concinnus</i> MacLachlan, 1871	Dog-faced Caddisfly
		<i>Neophylax fuscus</i> Banks, 1903	Dog-faced Caddisfly
		<i>Neophylax wigginsi</i> Sykora & Weaver, 1978	Dog-faced Caddisfly
Phylum Arthropoda		Class Malacostraca	
Order	Family	Taxon	Common Name
Isopoda	Asellidae	<i>Lirceus</i> species	Isopod

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 45 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, MACA^(L) indicates that a record for MACA 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

Appalachian Highlands Monitoring Network

• 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

Cumberland Piedmont Monitoring Network

• 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

and rated on large geographic scales, such as global, which covers the entire range of a species, or national, which assess the species' 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
G1	Critically imperiled — 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).
G2	Imperiled — 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).
G3	Vulnerable — 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). 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 hygroptetric 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
Lotic erosional (running-water riffles)	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.
Lotic depositional	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).
Lentic limnetic (standing water)	Open water	On the surface or in the water column of lakes, bogs, ponds.
Lentic littoral (standing water, shallow shore area)	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.
Lentic profundal (standing water, basin)	Sediments	Fine sediments (fine sand, silt and clay) mixed with organic matter of the deeper basins of lakes.
Beach zone	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
Skaters	Adapted for “skating” on the surface where they feed as scavengers on organisms trapped in the surface film (example: Hemiptera: Gerridae - water striders).
Swimmers	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).
Clingers	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).
Sprawlers	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).
Climbers	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).

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Burrowers	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).
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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 (General category based on feeding mechanism)	SUBDIVISION OF FUNCTIONAL GROUP		General Particle Size Range of Food (microns)
	Dominant Food	Feeding Mechanism	
Shredders	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	
Collectors	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
Scrapers	Periphyton - attached algae and associated material	Herbivores - grazing scrapers of mineral and organic surfaces	<10 ³
Macrophyte Piercers	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
Predators	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.

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

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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
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.)		

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Provinces of Canada			
Code	Province	Code	Province
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
Central American Countries			
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 December 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 December 2010.
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- McCafferty, P. W. (Editor). 2010. Mayfly Central. <http://www.entm.purdue.edu/mayfly/index.php> Accessed on 17 December 2010.
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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 *Habrophlebiodes* Ulmer - [Habitat — Lotic erosional and depositional: Habit — Swimmers, clingers, sprawlers: Trophic — Scrapers, Collectors-gatherers] The genus *Habrophlebiodes* contains four species each in the Oriental and Nearctic Realms. Three species occur in the Southeast, one of which was found in the parks.

Species	Parks	States	Elevation Range	Rankings	Tolerance Value	Flight Dates
<i>Habrophlebiodes americana</i> (N Banks, 1903)	BLRI, GRSM ^(L) , GUCO, KIMO, MACA	AL, IL, IN, KY, MX, NC, NH, NT, NY, OH, ON, QC, PU, QT, SC, TC, TN, VA, WI	212-1025 m	G5	1.0	6 June - 26 August (April - October)

Comments — A tolerance value of 1.0 is established for this species. Subimago and adult stages generally last less than 24 hours each. Larva up to 6 mm in length, forewing up to 6.5 mm. We have 13 collections and 32 specimens of this species.

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 debilis</i> (Walker, 1853)	BLRI, LIRI, MACA	AL, CA, GA, IA, KY, MA, MI, NC, NH, NY, OH, OK, ON, QC, SC, SD, TN, VA, WI, WV, YK	161-1575 m	G5	0.9	8 May - 25 June (July - October)

Comments — Berner (1975) considered *P. debilis* to be scarce in the Southeast. We have 5 collections and 18 specimens of this species. Forewing up to 9 mm in length.

Infraorder Scaphodonta 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 lake shore 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 guttulata</i> Pictet, 1843	BISO, BLRI, GRSM ^(L) , MACA	KY, NC, SC, TN, VA	161-960 m	G5	2.0	1 May - 26 July (May - June)

Comments — This species was common in LeConte Creek, GRSM, in the mid-1980s, having impressive hatches of the strikingly marked adults each spring. Hurricane Hugo, in 1989, resulted in extraordinarily high flows in LeConte Creek, causing great scouring of the streambed. Since that storm, *E. guttulata* has not been seen in LeConte Creek (although the species is still found elsewhere in the Park). We have 33 collections and 101 specimens of this species.

Suborder Pisciforma McCafferty

minnow, brush-legged, and flat-headed mayflies

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 Palearctic 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 *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
<i>Maccaffertium exiguum</i> (JR Traver, 1933)	BISO ^(L) , BLRI, LIRI, MACA ^(L) , NISI, OBRI ^(L)	AL, AR, FL, GA, IA, IL, IN, KY, LA, MI, MN, MO, MS, NC, NE, NY, OH, OK, SC, SD, TN, TX, VA, WI, WV	157-867 m	G5	1.9	5 June - 29 August (May - August)
Comments — This species inhabits the middle reaches of medium sized rivers (Lewis, 1974). Larvae are found in medium to large streams on rocks and debris (Flowers and Hilsenhoff, 1975). In a Coastal Plain river in Georgia, Jacobi and Benke (1991) found <i>M. exiguum</i> to have an asynchronous multivoltine life-history pattern. Larva up to 10 mm in length, male forewing up to 9 mm. We have 13 collections and 220 specimens of this species.						
<i>Maccaffertium pudicum</i> (HA Hagen, 1861)	BISO ^(L) , BLRI, CHCH, COWP, GRSM ^(L) , MACA ^(L) , OBRI ^(L) , SHIL	AL, DC, GA, IL, IN, KY, MA, MD, NC, NH, NY, PA, SC, TN, VA, VT, WV	152-1480 m	G5	2.0	1 May - 30 October (April - October)
Comments — We have 152 collections and 1,350 specimens of this species.						

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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, CUGA, GRSM ^(L) , KIMO, MACA ^(L) , NISI, OBRI ^(L)	AL, GA, IA, IN, KY, MS, NC, NY, OH, PA, QC, SC, TN, VA, WV	150-1786 m	G5	1.1	1 May - 31 September
Comments — Larva up to 12 mm in length; adult forewing up to 12 mm.						

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. The arrangement used here is followed by most North American workers today (Paulson and Dunkle, 2012).

During this study, we found 12 species, 7 genera, and 5 families of dragonflies in MACA.

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) Fawn Darner	BISO ^(L) , BLRI, CARL, COWP, CUGA, GRSM ^(L) , GUCO, LIRI, MACA ^(L) , OBRI ^(L)	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 August (May - October)
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.						

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 are 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 mouth parts. 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 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 grandis</i> N Banks, 1906 Grand Needlefly	BISO ^(L) , BLRI, GRSM ^(L) , LIRI, MACA	AL, KY, MA, ME, NB, NC, PA, TN, VA, WV	221-1757 m	G4	2.5	2 March - 30 July
Comments — We have 28 collections and 82 specimens of this species.						
<i>Leuctra sibleyi</i> Claassen, 1923 Brook Needlefly	BISO, BLRI, GRSM ^(L) , MACA , RUCA	CT, DE, IL, IN, KY, MA, MD, ME, NB, NC, NY, OH, ON, PA, QC, TN, VA, WI, WV	218-1944 m	G5	2.5	5 March - 30 June (May - July)
Comments — This species lives in cool spring streams. Larva up to 9 mm in length, adult up to 11 mm in length. We have 25 collections and 110 specimens of this species.						

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 make 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).

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 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. nigrrior*, and keys to the Eastern species.

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

Comments — Adults have been collected in every month except January and February, but greatest adult emergence is through the summer months. Georgian and Wallace (1983) found *G. nigrrior* 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. nigrrior* in 436 collections totaling 2,608 specimens from 13 parks during this study, which indicates that it is not at risk regionally.

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. Much of our current understanding of hydroptilid biology is based on laboratory studies by Nielsen (1948). 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.

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. Also, 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.

Species	Parks	States	Elevation Range	Rankings	Tolerance Value	Flight Dates
<i>Hydroptila spatulata</i> KJ Morton, 1905	BLRI, MACA	AL, AR, DE, IL, IN, KY, MB, MD, MI, MN, MO, NH, NY, OH, OK, PA, QC, TN, VA, WI	238-668 m	G5	6.2	18 -29 July (May - September)

Comments — This common species will undoubtedly be found in other parks, but it is included in this table because it was found in just two parks. It prefers larger streams and rivers. We have 3 collections and 14 specimens of this species.

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Genus *Ochrotrichia* Mosely - [Habitat - Lotic erosional and depositional: Habit - Clingers (purse-type case of silk and fine mineral): Trophic - Collectors gatherers, piercers herbivores] This is a large genus with about 170 known species restricted to the Neotropics and North America. About 76 species are known in North America, and 20 are known from the Southeast. Larvae make typical purse cases, usually with sand grains but sometimes with algae. A few species make cases in which one side is fashioned as the “floor” of the case, without sand grains, and the case sits flat on the substrate. This type is often found on nearly vertical rock faces that are consistently wet by a film of water, often just deep enough to keep the cases covered. Some species are found in intermittent streams. The genus has a tolerance value of 7.2.

Species	Parks	States	Elevation Range	Rankings	Tolerance Value	Flight Dates
<i>Ochrotrichia riesi</i> HH Ross, 1944	BLRI, MACA	AL, IL, IN, MO, TN, VA	177-374 m	G3, ALS1	7.2	7 June - 18 July (April - October)
Comments — This is one of the species that makes a specialized case which lies flat on the substrate. We have 1 specimen from BLRI and 14 from MACA .						

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 acutiloba</i> JC Morse & HH Ross, 1971	BLRI, GRSM ^(L) , GUCCO, MACA	KY, MA, ME, NC, NH, NY, SC, TN, VA, VT, WV	221-1656 m	G5	1.0	5 June (April - June)
Comments — A new record for Kentucky (Floyd and others, 2012). Larvae inhabit streams 2-9 m in width. Larva up to 20 mm in length, adult up to 10 mm. We have 27 collections and 69 specimens of this species.						
<i>Rhyacophila carolina</i> N Banks, 1911	BISO, BLRI, CARL, CHCH, COWP, CUGA ^(L) , FODO, GRSM ^(L) , KIMO, LIRI, MACA , OBRI ^(L) , SHIL ^(L) , STRI	AL, CT, DE, FL, GA, KY, MA, ME, MO, NB, NC, NE, NH, NJ, NY, OH, ON, PA, QC, SC, TN, VA, VT, WV	114-1715 m	G5	1.0	21 March - 5 November (April - September)
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 October. Larva up to 16 mm in length. We have 325 collections and 1,543 specimens of this species.						
<i>Rhyacophila glaberrima</i> G Ulmer, 1907	BISO, BLRI, CARL, CHCH, CUGA ^(L) , FODO, GRSM ^(L) , LIRI, MACA , OBRI, RUCA, SHIL ^(L)	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	4.3	20 March - 6 November (July - October)
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.						

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Species	Parks	States	Elevation Range	Rankings	Tolerance Value	Flight Dates
<i>Rhyacophila parantra</i> HH Ross, 1948	BISO, BLRI, CUGA, MACA , OBRI	IN, KY, MO, OH, QC, TN, VA, WV	161-869 m	G4	1.0	5 April - 28 July (May - June)
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.						
<i>Rhyacophila torva</i> HA Hagen, 1861	BISO, BLRI, CARL, COWP, CUGA ^(L) , GRSM ^(L) , 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	1.59	23 February - 21 September (February - September)
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.						

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 five families from the study area are annulipalpian. Annulipalpia are characterized by making fixed nets that 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 Diplelectroninae, 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 Diplelectroninae Ulmer

Genus *Diplectronea* 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>Diplectronea metaqui</i> HH Ross, 1970	ABLI, BISO, BLRI, CHCH, GRSM ⁽¹⁾ , LIRI, MACA , OBRI, RUCA, SHIL	CT, GA, IL, IN, KY, MO, NC, OH, PA, SC, TN, VA	124-1483 m	G4, NCS1	2.0	(February - December)
Comments — The larva has a very distinctive “thumb” on the left mandible, which has made it seem clearly to be a single species (Ross, 1970). However, barcoded specimens seem to fall into two distinct groups (Harvey and others, 2012). Further study is required. Larvae are found in spring seeps very close to the source. <i>Diplectronea modesta</i> larvae replace <i>D. metaqui</i> larvae just a few meters downstream. Adult up to 10 mm in length. We have 30 collections and 101 specimens of this species, as recognized by the mandible.						
<i>Diplectronea modesta</i> N Banks, 1908	BISO, BLRI, CARL, CHCH, COWP, CUGA, FODO, GRSM ⁽¹⁾ , 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	(March - September)
Comments — This “species” is a complex of at least five forms (Harvey and others, 2012). These forms are distinct on the basis of 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 “ <i>Diplectronea</i> species.” We suggest that this species be considered of special interest because of the current taxonomic uncertainty. Studies of the biology of <i>D. modesta</i> 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.						

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 to be 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 harwoodi</i> DG Denning, 1949	BLRI, COWP, CUGA, GRSM ^(L) , 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 September (May - September)

Comments — Although widespread and found in seven parks, *C. harwoodi* is considered imperiled in Alabama. We have 57 collections and 2,816 specimens of this species.

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 phalerata</i> HA Hagen, 1861	BLRI, FODO, MACA	AL, DC, DE, FL, GA, IA, IL, IN, KS, KY, MA, MD, MI, MN, MS, NC, NJ, NY, OH, ON, PA, QC, SC, TN, VA, WI, WV	114-668 m	G5, ALS1	3.7	6 June - 15 September (May - October)

Comments — [*scalaris* species group] Widespread mostly east of the Mississippi River, in very wide, warm water rivers with extensive riffle areas. It is considered critically imperiled in Alabama. We have 5 collections and 10 specimens of this species. Larvae up to 13 mm in length, adults 9-10 mm in length.

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 *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 cinerea</i> (HA Hagen, 1861)	BISO, BLRI, CHCH, COWP, CUGA, FODO, GRSM ^(L) , KIMO, LIRI, MACA , OBRI, SHIL, STRI	AB, AK, AL, AR, BC, CO, CT, DC, DE, FL, IA, ID, IL, IN, KS, KY, LA, MA, MB, MD, ME, MI, MN, MO, MS, MT, NB, NC, ND, NE, NH, NS, NT, NY, OH, OK, ON, OR, PA, QC, SC, SD, SK, TN, TX, UT, VA, VT, WA, WI, WV	114-1660 m	G5	2.0	30 March - 11 October (March - October)
Comments — This is a very common and widespread species, known in 13 parks and likely to occur in all parks in the study area. We have 157 collections and 769 specimens of this species.						

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 ^(L) , BLRI, CARL, CHCH, COWP, CUGA, FODO, GRSM ^(L) , KIMO, LIRI, MACA , NISI, OBRI, RUCA, SHIL ^(L)	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 March - 16 October (April - September)
Comments — Widespread and common in North America, and throughout the study area. We have 103 collections and 734 specimens of this species.						
<i>Chimarra obscura</i> F Walker, 1852	ABLI, BISO ^(L) , BLRI, CHCH, COWP, GRSM ^(L) , KIMO, LIRI, MACA , NISI, OBRI, SHIL ^(L) , STRI	AL, AR, CT, DE, FL, GA, IL, IN, KS, KY, LB, MA, MB, MD, ME, MI, MN, MO, MS, NE, NF, NH, NJ, NS, NY, OH, OK, ON, PA, QC, SC, TN, TX, VA, VT, WI, WV	109-668 m	G5	2.7	8 May - 14 October (May - September)
Comments — Parker and Voshell (1982) studied the life history of this species in Virginia. The populations were bivoltine at three study localities (indeterminate at the fourth). Larvae were primarily detritivores, with more than 85% of their gut contents composed of detritus. We have 96 collections and 4,796 specimens of this species.						

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, CUGA, GRSM ^(L) , KIMO, LIRI, MACA , OBRI, RUCA, SHIL ^(L)	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 December
Comments — A common and widespread species. We have 248 collections and 788 specimens of this species.						

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 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 that 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. Also, 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. Because of this, we have chosen to include all species of *Ceraclea*, even those that do not have established tolerance values and would be excluded from the table on other grounds.

Species	Parks	States	Elevation Range	Rankings	Tolerance Value	Flight Dates
<i>Ceraclea cancellata</i> (C Betten, 1934)	BISO, BLRI, CHCH, FODO, GRSM ⁽¹⁾ , KIMO, LIRI, MACA , NISI, OBRI, SHIL ⁽¹⁾ , STRI	AK, AL, AR, BC, CT, DE, FL, GA, IL, IN, KS, KY, LA, MA, MB, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NY, OH, OK, ON, PA, QC, SC, TN, VA, WI, WV, YT	105-668 m	G5, NCS1	2.2	9 May - 15 August (April - September)
Comments — This species is considered critically imperiled in North Carolina. Cases are made of sand and are “cornucopia shaped.” We have 50 collections and 3,862 specimens of this species. Larva up to 7 mm in length, case up to 8 mm, adult up to 12 mm.						

Mammoth Cave National 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>Ceraclea flava</i> (N Banks, 1904)	BISO ^(L) , BLRI, GRSM ^(L) , MACA , OBRI ^(L) , SHIL ^(L)	AL, AR, DC, DE, IA, IL, IN, KS, KY, MI, MN, MO, MS, NC, NH, NY, OH, OK, ON, PA, SC, TN, TX, VA, WI, WV	120-417 m	G5	2.6	29 May - 26 July (April - July)
Comments — Larvae make a flattened case that has wide dorsolateral flanges, much like those of <i>C. ancylus</i> . Populations studied by Resh (1976b) appeared to be univoltine. This species seems to prefer large, slow-moving streams. Larva up to 5 mm in length, case up to 6 mm, adult up to 9 mm. We have 20 collections and 656 specimens of this species.						
<i>Ceraclea tarsipunctata</i> (CT Vorhies, 1909)	BISO, BLRI, CHCH, CUGA, FODO, GRSM ^(L) , 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 August (April - August)
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 We have 53 collections and 789 specimens of this species. Larva up to 8 mm in length, case up to 9 mm, adult up to 11 mm.						
Genus <i>Nectopsyche</i> Müller - [Habitat - Lentic vascular hydrophytes, lotic erosional and depositional (vascular hydrophytes): Habit - Climbers swimmers (case long, slender, primarily of mineral and vegetation pieces, may have long balance sticks): Trophic - Shredders herbivores (chewers), collectors gatherers (predators [engulfers])] This New World genus has fewer than 60 species. Fifteen species are found in North America, with three found in the parks. Unlike so many caddisflies, <i>Nectopsyche</i> adults are strikingly marked, being delicately colored white or yellow with dark bands or spots. Haddock (1977) reviewed the North American species, and provided illustrations and keys to the larvae. Glover and Floyd (2004) updated Haddock's results with information on new species and additional information on other species. Larvae of some species may be carnivorous, at least opportunistically; however, most larvae feed primarily on vascular plants and detritus (Wiggins, 1996).						
Species	Parks	States	Elevation Range	Rankings	Tolerance Value	Flight Dates
<i>Nectopsyche exquisita</i> (F Walker, 1852)	BLRI, CHCH, COWP, GRSM ^(L) , KIMO, MACA , NISI	AL, AR, CT, DC, DE, FL, GA, IL, IN, KS, KY, MA, MB, MD, ME, MI, MN, MO, MS, NB, NC, ND, NE, NH, NJ, NS, NY, OH, OK, ON, PA, QC, SC, TN, TX, VA, VT, WI, WV	138-739 m	G5	2.5	9 May - 19 August (April - October)
Comments — Larvae occur in lakes and rivers, most often among aquatic vegetation, root mats, and on submerged woody debris. We have 20 collections and 122 specimens of this species. Larva up to 15 mm in length, case up to 28 mm, adult up to 17 mm.						
<i>Nectopsyche pavidia</i> (HA Hagen, 1861)	BISO ^(L) , BLRI, CHCH, COWP, KIMO, LIRI, MACA , NISI, OBRI, STRI	AL, AR, CT, DC, FL, GA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, NH, NJ, NY, OH, OK, ON, QC, SC, TN, TX, VA, WI, WV, WY	134-1039 m	G5	2.8	9 May - 16 September (April - September)
Comments — In addition to the states and provinces listed above, <i>N. pavidia</i> has been found as far south as Panama. Unlike <i>N. candida</i> and <i>N. exquisita</i> , <i>N. pavidia</i> is yellow with small scattered dark spots across the wings. Larvae tend to be found in lakes and slow moving rivers. Cases are made entirely of plant material, with overlapping pieces, flattened dorsoventrally, and strongly tapered. We have 37 collections and 879 specimens of this species. Larva up to 8 mm in length, case up to 9 mm, adult up to 10 mm.						

Mammoth Cave National Park

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

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 to be 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, and 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, CUGA, FODO, GRSM ⁽¹⁾ , 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 September (April - October)

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.”

Genus *Setodes* Rambur - [Habitat - Lotic erosional and depositional, lentic littoral: Habit - Sprawlers clingers, burrowers (case curved, stout or slender, mineral): Trophic - Collectors gatherers (particles include algae and animals), predators (engulfers)] More than 300 species of *Setodes* are known, the majority in the Oriental region. Nine are known from North America, but only two were found during the parks survey. Cases of all species are very similar, being made of small, flat sand grains shaped into straight or slightly curved cylinders without taper. Larvae burrow into fine sand deposits (Merrill and Wiggins, 1971). Larvae apparently omnivorous, feeding on filamentous algae and small invertebrates (Merrill and Wiggins, 1971). Holzenthal (1982) reviewed the adults of the North American species of *Setodes*. Larvae up to 8.5 mm in length, case up to 8.5 mm, adult up to 8 mm.

Species	Parks	States	Elevation Range	Rankings	Tolerance Value	Flight Dates
<i>Setodes incertus</i> (F Walker, 1852)	ABLI, BISO, BLRI, CHCH, COWP, MACA	AL, CT, GA, KY, MA, MD, ME, MI, MN, NC, NH, NJ, NY, ON, PA, QC, SC, TN, VA, WI, WV	153-1039 m	G5, ALS1	0.9	9 May - 30 August (June - August)

Comments — Alabama has ranked *S. incerta* critically imperiled. It is widespread in the East and was found in six parks. We have 13 collections and 45 specimens of this species.

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, CUGA, GRSM ^(L) , KIMO, LIRI, MACA , OBRI, SHIL ^(L)	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 October (March - October)
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.						

Family Odontoceridae Wallengren

large sturdy-case maker caddisflies

Odontoceridae is a small family of just over 100 species and 14 genera with a Worldwide distribution. In North America thirteen species are known representing six genera. Two genera and six species are found in the study area. Larvae make very sturdy stone cases, reinforced with extra silk, particularly in the genus *Psilotreta* (Wiggins, 1996). They are burrowers in sand and gravel, emerging at night to feed on detritus. See the discussion below under *Psilotreta*.

Subfamily Odontocerinae Wallengren

Genus *Psilotreta* Banks - [Habitat - Lotic erosional (gravel, detritus) and depositional (detritus), (lentic erosional): Habit - Burrowers (case curved, smooth, coarse mineral): Trophic - Scrapers, collectors gatherers] The approximately 50 species of *Psilotreta* are predominately Oriental and eastern Palearctic. Six species are found in eastern North America. Larvae are burrowers in coarse sand. Different species are found in springs, seeps, streams, or rivers. The cases are unusually strong and resistant to crushing (Wiggins, 1996). The coarser sand grains that make the bulk of the case are supplemented with smaller grains internally to fill the gaps, and are held securely in place by thick silk. In general outline, the cases are slightly curved and tapered, very much like the cases of *Agarodes* and *Fattigia* (family Sericostomatidae, below). However, sericostomatid cases are made of smaller and more uniform sand grains and appear to have a very smooth outline, and are not unusually resistant to crushing. The differences between the cases are intriguing, since *Psilotreta*, *Agarodes*, and *Fattigia* have very similar habitats and behaviors, being burrowers in sandy substrates (not sprawlers as given by (Merritt and others, 2008). By comparison with *Psilotreta*, the cases of *Agarodes* and *Fattigia* seem to be very delicate. Parker and Wiggins (1987) revised *Psilotreta* and provided keys to the Nearctic larvae and adults. *Psilotreta* has a genus level tolerance value of 0.0.

Species	Parks	States	Elevation Range	Rankings	Tolerance Value	Flight Dates
<i>Psilotreta rufa</i> HA Hagen, 1873	BISO, BLRI, GRSM ⁽¹⁾ , MACA	AL, CT, DE, KY, MA, MS, NC, NY, PA, TN, VA, VT	218-869 m	G5, NCS3	0.0	16 April - 17 July (April - July)

Comments — This species prefers small streams at lower elevations than *P. rossi*. We have 18 collections and 53 specimens of this species. Larva up to 12 mm in length, case up to 12 mm, adult up to 13 mm.

Family Goeridae Ulmer

armored caddisflies

This family often has been treated as a subfamily within the Limnephilidae. The general 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 fuscula</i> N Banks, 1905	BLRI, GRSM ^(L) , MACA	GA, MA, ME, NC, NY, PA, QC, SC, TN, VA, VT	218-1025 m	G5	0.1	7 April - 15 September (April - June)
Comments — Larvae of <i>G. fuscula</i> occur in two color forms with many intermediates. In one form the sclerites are primarily yellow, in the other form the sclerites are mostly black, and the intermediates vary in the amount of black present on the yellow background. Larvae occur in streams ranging from approximately 1 m up to 10 m in width, on the upper surface of rocks, where they scrape periphyton for food. Adults normally emerge early, but our records include individuals collected in September. This species was designated as threatened by the Invertebrate Taxa Review Committee of the South Carolina Heritage Trust Program (Floyd and Morse, 1993). Larva up to 11 mm in length, adult up to 11 mm. We have 54 collections and 273 specimens of this species.						
<i>Goera stylata</i> HH Ross, 1938	BISO, MACA	AL, CT, IN, KY, MA, MI, NH, NY, OH, ON, PA, TN, VA, WI, WV	173-318 m	G5, ALS2	0.1	19 April - 6 June (May - June)
Comments — Larvae of <i>G. stylata</i> , like those of the other species of <i>Goera</i> found in the parks, are variable in the color of the sclerites. Flint (1960) noted that northern populations tended to be mostly black and southern populations tended to be mostly yellow. Unlike <i>G. fuscula</i> , <i>G. stylata</i> larvae are rarely found in streams more than about 1 m in width. Larva up to 10 mm in length, adult up to 11 mm. We have 5 collections and 8 specimens of this species.						

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 sackeni</i> (N Banks, 1936)	BLRI, GRSM ^(L) , MACA	CT, KY, MA, ME, MI, NC, ND, NF, NH, NS, NY, OH, ON, PA, QC, TN, VT, WI, WV	183-1094 m	G5	0.9	5 October (July - September)
Comments — Larva unknown. Adult up to 9 mm in length. We have 2 collections and 2 specimens of this species.						

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 punctatissima</i> (F Walker, 1852)	BLRI, CHCH, CUGA, GRSM ⁽¹⁾ , 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	30 August - 26 October (August - November)

Comments — This species is included here because Alabama has ranked this species 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. punctatissima* first appeared in October 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 November, and 5th instars appearing by the end of December. Following ice melt in early April, larvae migrated from the water to the stream banks, where they remained mostly without moving and without feeding until July. Then they sealed their cases and pupated. Adults first appeared at the end of July, and continued to emerge into August. We have 29 collections and 113 specimens of this species. Case made of pieces of bark and leaves, slightly tapered and curved. Larva up to 20 mm in length, adult up to 18 mm.

Subfamily Limnephilinae Kolenati

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 ^(L) , BLRI, CUGA ^(L) , GRSM ^(L) , KIMO, MACA , OBRI ^(L) , SHIL ^(L)	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 June - 27 October (June - November)
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.						
<i>Pycnopsyche gentilis</i> (R McLachlan, 1871)	BISO ^(L) , BLRI, CUGA ^(L) , GRSM ^(L) , 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 November (July - October)
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, and 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.						
<i>Pycnopsyche guttifer</i> (F Walker, 1852)	BISO ^(L) , BLRI, CUGA ^(L) , GRSM ^(L) , 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 November (August - October)
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.						

Mammoth Cave National 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 luculenta</i> (C Betten, 1934)	BLRI, CUGA ^(L) , FODO, GRSM ^(L) , MACA , OBRI, SHIL ^(L)	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 August - 20 December (August - November)
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 over 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.						

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.

Genus *Phryganea* Linnaeus - [Habitat - Lotic depositional and lentic (detritus and vascular hydrophytes): Habit - Climbers (case a spirally arranged, tapered cylinder constructed of leaf pieces): Trophic - Shredders herbivores and detritivores (chewers), predators (engulfers)] A Holarctic genus of eight species. Two species are found in North America and both were collected in this survey. Larvae prefer lakes and marshes, and have been taken from 100 m depth in Lake Superior (Selgeby, 1974). Larvae tend to be omnivorous.

Species	Parks	States	Elevation Range	Rankings	Tolerance Value	Flight Dates
<i>Phryganea sayi</i> LJ Milne, 1931	ABLI, BISO, BLRI, CARL, COWP, KIMO, LIRI, MACA , OBRI, SHIL ^(L)	AL, AR, CT, DC, DE, IL, IN, KS, KY, MA, MD, ME, MI, MO, NC, ND, NJ, NY, OH, ON, PA, QC, SC, SK, TN, VA, WI, WV	124-1080 m	G5, ALS1	6.0	25 May - 13 October (May - September)
Comments — This is one of the largest caddisflies in the Southeast. It is considered critically imperiled in Alabama. We have 39 collections and 107 specimens of this species. Adult forewing length 18-22 mm; mature larvae up to 43 mm; case up to 56 mm.						

Family Helicopsychidae Ulmer

snail-case maker caddisflies

Helicopsychid larvae are instantly recognizable by their unique cases which 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 ^(L) , BLRI, CHCH, CUGA, GRSM ^(L) , KIMO, MACA , NISI, OBRI ^(L)	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, NE, 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 October (May - October)

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 very wide 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*. But, 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 scrappers, *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.

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, as empty pupal cases of the prior generation persist and can be found together with 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 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 October (September - October)

Comments — A variable species morphologically and ecologically, limited barcoding data indicate that it is genetically well defined. In Alabama, *N. concinnus* is considered critically imperiled. We have 30 collections and 115 specimens of this species. Larva up to 10 mm in length, case up to 11 mm, adult up to 11 mm.

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