

# **FINAL PERFORMANCE REPORT**



**Federal Aid Grant No. F16AF01215 OK-T-93-R-1**

**A Survey for Rare Mayfly and Caddisfly  
Species of Greatest Conservation Need**

**Oklahoma Department of Wildlife Conservation**

**Grant Period: January 1, 2017 through December 31, 2018**

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**Project Leader:** Rickey D. Cothran

### Executive Summary

Several species of aquatic insects (mayflies and caddisflies) have been recently added to the list of Species of Greatest Conservation Need. Many of the species have overlapping distributions making a comprehensive survey and effective way to determine their distribution in suitable habitat in Oklahoma. Our study objectives were to (1) attempt to recollect the three-toothed triaenodes caddisfly (*Triaenodes tridontus*) in Pushmataha County, OK. (2) Update the distribution of several caddisfly species (*Metrichia nigratta*, *Hydroptila protera*, *Mayatrichia pontia*, *Ochrotrichia robisoni*, *Ochrotrichia weddleae*, and *Triaenodes tridontus*) and mayfly species (*Apobaetis futilis*, *Nixe flowersi*, and *Tricorythodes curvatus*) by collecting within and beyond their poorly known ranges in Oklahoma. (3) Describe habitat characteristics and other species associated with the rare species we find.

We focused on SE Oklahoma for our *Triaenodes tridontus* survey based on previous collections in Pushmataha County. In addition to sampling streams in Pushmataha County, we also surveyed the Kiamichi and Little River watersheds in adjacent counties, McCurtain and LeFlore. We currently only have *Triaenodes* species-level identifications for the summer 2017 field season. Although several individuals from the genus were collected no *Triaenodes tridontus* were discovered. We have material that is currently being processed from the 2018 field season that may include *Triaenodes tridontus*. We also have aquatic samples from both field seasons that are being processed.

Our Arbuckle Region microcaddisfly survey was a success. This group of caddisflies is diverse in the region. The survey extended known distributions for two of the three hydroptilid species targeted. We also discovered other rare species in this family that were not targets of the current grant. We have SE Oklahoma hydroptilid identifications from the 2017 but not the 2018 field season. We collected over 1500 hydroptilids (9 genera and 15 confirmed species) from 13 sites in SE Oklahoma. However, all individuals surveyed were from widespread species (all G4 or G5 level taxa [indicating secure conservation status--not imperiled] NatureServe Conservation Status) and all had previously been collected in Oklahoma. Our 2018 survey was more extensive and this material will soon be sent to our taxonomic expert for identification to species.

Our mayfly survey did not collect *Tricorythodes curvatus* or *Apobaetis futilis*. We very likely collected the target *Nixe flowersi* in both the Spring Creek drainage and the Little River drainage. This species has been collected in Spring Creek but not the Little River. We also collected this species later in the season than it previously had been collected. The caveat to this discovery is that keys for this and many other mayfly species require male imago stages, which were extremely rare in our collections, making definitive identification impossible.

## **I. OBJECTIVES:**

1. We will attempt to recollect the three-toothed triaenodes caddisfly (*Triaenodes tridontus*) in Pushmataha County, OK.
2. We will update the distribution of several caddisfly species (*Metrichia nigratta*, *Hydroptila protera*, *Mayatrichia ponta*, *Ochrontrichia robisoni*, *Ochrontrichia weddleae*, and *Triaenodes tridontus*) and mayfly species (*Apobaetis futilis*, *Nixe flowersi*, and *Tricorythodes curvatus*) by collecting within and beyond their (poorly) known ranges in Oklahoma.
3. We will describe habitat characteristics and other species associated with the rare species we find.

Performance reports will include survey locations, associated species and relevant habitat information.

## **II. SUMMARY OF PROGRESS**

### **A. APPROACH**

#### **Arbuckle Region Survey**

The survey consisted of 64 samples at 61 different sites (see map; Figure 1; sites are listed in Table 1). Three pairs of samples were collected at the same site or in close proximity (i.e., sites 3 & 4, sites 9 & 48, and sites 29 & 50). Five counties were included in the survey: Murray County (37 sites); Johnston County (12 sites); Carter County (7 sites); Garvin County (6 sites); and Pontotoc (3 sites). All field work (beyond the first two sites) was done solely by Kambridge (Brown) Stephens.

The sampling period spanned two months in 2017 (8 June to 13 July) and 2018 (2 June to 19 July), except for two sites that were sampled on 17 May 2017. During the May sampling, we trialed sampling techniques (sweeping vegetation, blacklighting with a sheet and hand picking insects, and using black light traps) and selected using traps only as the most efficient and effective survey method.

Black lights attract a wide variety of night-flying insects, including caddisflies. Traps consisted of small hand-held, battery operated blacklights (13.5 cm long, 4 W bulb with overall length of the unit of 16 cm) placed on top of plastic boxes (internal dimensions: 13 x 13 x 3 cm), which collected the attracted insects in 70% ethanol. A mesh top (rectangular openings of 3 x 5 mm) was placed over the opening of the plastic container and beneath the light to prevent larger insects from entering the trap, as only small insects (microcaddisflies) were targeted in the Arbuckle-area portion of the overall study.

Sample sites were primarily at bridge locations or where roadways ran close to streams. Sites were only sampled one time, which allowed a greater number of sites to be

inventoried and reduced the capture at any one site. GPS coordinates were recorded for each site and checked for accuracy using Google Maps ([www.google.com](http://www.google.com)). Locations were mapped using the on-line site BatchGeo ([www.batchgeo.com](http://www.batchgeo.com)) and topographic maps (Roads of Oklahoma; Mapsco; 2008).

Black light traps were placed in the evening. In 2017, traps were picked up in the morning (3-4 hours of strong light; Dave Ruitter, personal communication). Traps collected numerous microcaddisflies and in 2018, traps were collected at night after a sampling time of 0.5 to 1.5 hours to reduce ‘take’.

Trap samples were sorted and microcaddisflies were sent to Dave Ruitter in Oregon for identification. A generous subsample was sent for very large samples. Taxonomy is largely based on features of adult male genitalia, which may require clearing of specimens or dissection. Females are associated with males and identification of females without males in the sample is tentative for some species. Because of the difficulty of identifying females, not all were identified and are listed as ‘unidentified’ for the genus (or even for the family). An additional challenge with identification is the occurrence of individuals that cannot be identified to species—especially when taxonomic features differ slightly from the standard description. Such individuals include variation within a species (including spatial variants), members of species complexes (where a ‘species’ includes several morphologically similar species), or potentially new species. These taxa are indicated by ‘nr’ (near) within the species designation or a species number for recognized variants and are considered ‘morphospecies’.

Most identified caddisflies were donated to the C.P. Gillette Museum of Arthropod Diversity at Colorado State University in Ft. Collins, which has an extensive aquatic insect collection and is a designated repository for invertebrates collected on federal lands (in this case, sites in the Chickasaw National Recreation Area). Dave Ruitter retained a few specimens.

A permit (CHIC-2017-SCI-0003) was obtained for the sampling in the Chickasaw National Recreation Area and the final report associated with the permit was submitted in March 2018. Other sampling was on public right-of-ways or on private lands with landowner/manager permission.

### **Southeastern Oklahoma Survey**

The survey included 51 samples that were distributed across two years (2017 and 2018), two seasons (Spring and Summer), and three drainages (Kiamichi River [7 sites], Little River [9 sites], and Spring Creek [4 sites]). The Kiamichi sites were located in Pushmataha and LeFlore counties. The Little River sites were located in Pushmataha, LeFlore, and McCurtain counties (see Appendix 1 for site details).

At each sampling event we collected both aquatic and terrestrial samples to target immatures and adults, respectively. Aquatic sampling consisted of a combination of timed dip nets samples, hand picking in habitats expected to hold target taxa, and surber samples. Aquatic samples were preserved in 70% ETOH and all macroinvertebrates are in the process of being sorted to Order or Family (for target taxa). A number of abiotic

and biotic variables were collected at each site and will be used to determine predictors of species occurrences.

Terrestrial samples were collected at night using either manned or unmanned black light traps. We used similar unmanned light trapping methods explained in the Arbuckle Region Survey. Samples were sorted to Family and target caddisfly families were sent to Dave Ruitter for identification. Leptocerids in the genus *Triaenodes* from the 2017 sampling period have been identified to species. We are still currently working on other caddisfly identifications. Mayfly target families were examined by Peter Grant. Deposition of samples follow the methods described above for the Arbuckle Region survey.

## **B. RESULTS**

### **Arbuckle Survey Results**

A total of 5298 individual hydroptilids were identified at some level (most to species). This number comprised 8 genera and 37 species, including 4 morphospecies (Table 2). Microcaddisflies were found at all but **five** sampling sites (**59** of 64 sites). Microcaddisfly diversity was high and averaged 5.8 species/morphospecies (excluding unidentified taxa) per site. Indeed, 11 sites had 10 or more species/morphospecies despite a single sampling event at each site. Data are in Appendix 2.

Three species were targeted in this survey: *Hydroptila protera*; *Hydroptila ponta*; and *Metrichia nigrutta*. All three were found in the survey and results and discussion of each species follows:

(1) ***Hydroptila protera*** (Hydroptilidae): This species was originally described from the Turner Falls area (Murray County) from a 1937 collection; but was not re-collected in a collecting trip in the early 1990's (Moulton and Stewart 1996).

Our survey found 46 individual *H. protera* at a total of 10 sites (Figure 2a and Appendix 1). Three of these sites are in the Turner Falls area of Murray County (tributaries of Honey Creek at sites 25 and 28; Falls Creek at site 32), and two additional sites were fairly close but more northern tributaries of the Washita River: Lick Creek (site 31) and Colbert Creek (site 30).

The most interesting finding was a population of *H. procera* in tributaries of Wildhorse Creek (Fivemile, Eightmile, and Massey Creek; sites 59, 60, and 61; respectively); although only a single individual was collected at each of these three sites. This increases the known distribution from a single county (Murray County) to also include Carter County.

The 10<sup>th</sup> site with *H. procera* was on Delaware Creek (Johnston County), where 3 individuals were identified. This site is disjunct from the rest of the distribution and warrants further investigation.

The largest numbers of *H. protera* (10 or more individuals) were collected in an unnamed springbrook tributary of Honey Creek near Turner Falls (site 25), Colbert Creek (site 30), and Falls Creek (site 32).

(2) *Mayatrichia ponta* (Hydroptilidae): This species is known from several small Arbuckle streams. It was described from Honey Creek in the Turner Falls area and is also known from Travertine Creek in the Chickasaw National Recreation Area (both sites are in Murray County). Larvae live in small, rapidly flowing waters with gravel, cobble or bedrock substrates. Adults have been collected in February, May, June and August.

Our survey found 144 individual *M. ponta* at a total of 11 sites (Figure 2b and Appendix 1). In comparison to previous records, this species was not collected in the Turner Falls area but *M. ponta* was collected at 3 sites in or near Travertine Creek (sites 5 and 6 in Travertine Creek and site 12 in Rock Creek – all three in the Chickasaw National Recreation Area). Numbers collected in the Chickasaw National Recreation area were low (1 to 3 individuals per site).

In addition to the two known areas in Murray County, we documented a new population of *M. ponta* in two close-by tributaries of the Washita River: Colbert Creek (site 30) and Chigley Sandy Creek (site 34). These records are also significant for the higher number of collected individuals – 96 and 23 at Colbert Creek and Chigley Sandy Creek, respectively.

*M. ponta* was also documented in 5 samples from 4 sites in Johnston County, an eastward expansion of the known range. Note: 2 samples were from near-by sites on Pennington Creek and are considered as a single site. These 4 sites are widely distributed within the county and represent 3 different drainages. Pennington Creek (nearby samples 23 and 24) enters the Washita River not far above its confluence with Lake Texoma. Peter Sandy Creek (site 22) flows into the Blue River, which joins the Red River well below Lake Texoma. The Delaware Creek (site 19) and Mill Creek (site 16) are tributaries of the Clear Boggy Creek, which feeds into Muddy Boggy Creek, which joins the Red River well downstream the confluence with the Blue River.

A second distribution extension occurred westward with 5 individuals collected in Eightmile Creek (site 60) in Carter County.

(3) *Metrichia nigrutta* (Hydroptilidae): This is a species documented from several Arbuckle springs (Johnston County: unnamed spring near the town of Mill Creek and Cummins Spring; Murray County: Buffalo and Antelope Springs, Chickasaw National Recreation Area; Pontotoc County: Byrd's Mill Spring). Adults are easily distinguished by their black color and may be present in February through October. Adults can be observed moving on vegetation and stream bank rocks during the day.

This species was only collected at 4 sites and only 17 individuals were found (figure 2c and Appendix 1). Sites with *M. nigrutta* were primarily springs and included known sites: Cummins Spring (site 4) in Johnston County and Canyon Spring (site 1) and Byrd's Mill

Spring (site 15) in Pontotoc County. Note: permission to sample site 1 was based on calling the spring Canyon Spring, as the owner objects to the site name on topographic maps, which is Deadman Spring). The fourth site with *M. nigrutta* was Sheep Creek (site 17) in Johnston County.

The paucity of sites for this ‘widespread’ species may have resulted from survey timing, as adults for *M. nigrutta* are reported as occurring over a 9-month period and perhaps this species more typically emerges at times other than the survey months of June and July. The larger size and black color are consistent with emergence during cooler periods, as these traits are shared with winter emerging stoneflies. Daytime activity is also consistent with ‘winter’ emergence and might decrease trap capture. We conclude that this species may have been inadequately sampled by our survey methods and the apparent reduction in range that was indicated by our survey should be investigated.

(4) Interesting occurrences of other, non-target microcaddisfly species.

Although most collected species are considered widespread and common, two categories of distributions merit mention—three rare species that were not survey targets and four species not listed as occurring in Oklahoma on the NatureServe web site.

(A) Rare species.

- *Cernotina oklahoma* has a G rank of G2G3 and occurs in OK, TX and OH. This species was found at one site (site 34, Chigley Sandy Creek in Murray County).

- *Hydroptila melia* has a G rank of G2G3. Ranked S2 in Texas, the species is unranked in Oklahoma, the only other state listed for this species by NatureServe. Our survey found the species at 10 sites.

- *Neotrichia edalis* has a G rank of G3G4 and is unranked in 4 states, including Oklahoma. We collected this species at 2 sites.

- *Ochrotrichia capitana* has a G rank of G1G3, is ranked as S2? in Texas, the only state listed in the distribution on the NatureServe web site. We collected the species from 3 sites.

(B) Species not listed as occurring in Oklahoma on the NatureServe web site. Species with distributions not listing Oklahoma are necessarily new state records. Unlisted species may have unpublished museum records or published records not yet reflected on the NatureServe web site.

- *Hydroptila arctia*. This G5 species is a western species, with its eastern limit in Texas (and evidently Oklahoma; with 2 sites).

- *Hydroptila argosa*. Oklahoma is similarly on the eastern edge of this species range (with 1 site). The closest occurrence according to NatureServe is indicated as Colorado.

- *Hydroptila modica*. The distribution of this G3G5 species is spotty with records from Arizona, Washington and Oregon. Oklahoma would add to this disjunct distribution. The species was found at a single site.

- *Neotrichia osmena*. This G3G4 species is ranked as S1 in Arizona and is unranked in Colorado, Utah, and Wyoming. The species was found at a single site in this survey.

- *Ochrotrichia capitana*. With a G rank of G1G3, this species is also listed above as a rare species. NatureServe lists a distribution of only Texas (S2?), which would make a

new Oklahoma record a major increase in distribution. The species was collected at 3 sites.

### **Southeastern Oklahoma Survey Results**

For the leptocerid caddisfly samples, only *Triaenodes* spp. collected from the 2017 field season have been processed and identified to species. *Triaenodes* were collected at three of seven sites in the Kiamichi drainage and one of nine sites in the Little River drainage. Spring Creek was not sampled in 2017. None of the *Triaenodes* collected in 2017 were *T. tridentatus*.

For hydroptilid caddisflies we have species identifications for the summer 2017 field season. We collected 1525 individuals from 13 sites. Nine genera and 15 confirmed species were collected (Figure 3). However, all individuals surveyed were from widespread species (all G4 or G5 level taxa [indicating secure conservation status--not imperiled] for NatureServe Conservation Status) and all had previously been collected in Oklahoma. Our 2018 survey was more extensive and this material will soon be sent to our taxonomic expert, Dave Ruiters, for identification to species.

For the adult mayfly samples from manned and unmanned light traps, we found no specimens of *Tricorythodes*, including the target species *Tricorythodes curvatus*, in our samples. As stated in our proposal, this species has been found in Texas and Missouri but not yet in Oklahoma. Adults of this species were collected June through August in the other two states, so we collected during the appropriate months. If we collect again, we might light trap early in the morning, starting in the dark before sunrise, at sites where *Tricorythodes* nymphs were collected.

*Apobaetis* (target species was *Apobaetis futilis*) adults belong to a group of mayflies that have large eyes that diverge anteriorly in the males and they also lack hind wings. So, this group is pretty easy to identify. We identified a few specimens with these characteristics. Only one specimen was a male imago and it keyed to *Plauditus*. We also collected a few subimagos with these characteristics, but they do not appear to be *Apobaetis*. This genus has a large projection between the base of the forceps and the subimaginal specimens do not show that character. If we look for this species again, we will review the literature on the three species in this genus to see if others have developed a successful method for collecting adult males.

We likely collected specimens that may be *Nixe flowersi* at on site in the Little River drainage and three sites in the Spring Creek drainage. We are still working on mapping the species occurrences to these sites. The problem is these specimens are all male subimagos, so it is difficult to be confident of the species identification. *Nixe flowersi* is a very pale species and these subimagos are also pale. Adult specimens of this species have been collected in Spring Creek (Cherokee County) in June (McCafferty et al. 1997). Our light trapping took place in early August possibly extending the flying period of adults by two months.



Although species-level identifications are incomplete, we have begun to explore family-level abundance patterns in the adult caddisfly data set. This work has been spear-headed by undergraduate students that were supported by the grant. They have presented this research at the Southwestern Oklahoma State University Scholarly Activity and Research Fair and the Oklahoma Academy of Sciences Technical Meeting, and plan to do so at Oklahoma Research Day in March 2019.

We have discovered that unmanned light traps are particularly successful at collecting microcaddisflies (Figure 4). We also found that leptocerid abundance was higher in the Little River drainage than the Kiamichi and Spring Creek drainages (Figure 5). We explored seasonal and stream order patterns in family-level abundances and found no significant trends in the data. As more samples are processed, we will continue to look for patterns in both the immature and adult data sets.

### C. Conclusions

Overall conclusions from the Arbuckle Region microcaddisfly survey:

1. Hydroptilids are both abundant and speciose across the greater Arbuckle region.
2. Known distributions (based on published records) were expanded for 2 of the 3 targeted species (*Hydroptila protera* and *Mayatrichia ponta*). The design of the survey may have impacted the collection of the third targeted species (*Metrichia nigratta*); hence the distribution found in our survey may be incomplete.
3. For non-target microcaddisfly species, potential new distribution records (in comparison to NatureServe distributions) and the occurrence of rare species in the survey indicate the usefulness of surveys beyond targeted species and indicate additional species that may be of conservation interest (e.g., *Ochrotrichia capitana*).
4. The amount of new information gained in this survey highlights the need for additional surveys both within the Arbuckle area and more generally in Oklahoma.

Overall conclusions from the Southeast Oklahoma Region survey:

1. The 2017 field season did not produce any of the target caddisfly species. Several individuals in the genus *Triaenodes* were collected in 2017 although none were the target species *Triaenodes tridontus*. We are in the process of processing our adult caddisfly samples from the 2018 field season and will send them to Dave Ruiter in the coming months.
2. The SE Oklahoma Region was not the primary target for the hydroptilids, but our 2017 survey found several species, although not as many as the Arbuckle Region. Our 2018 survey of the Kiamichi and Little River drainages was more expansive and so we might be able to extend the ranges of some of the targeted hydroptilids. These samples will be sent to Dave Ruiter in the coming months. It is unlikely that completing the identification of remaining samples will reveal the presence of target *Triaenodes* species as none have been found to date in completed samples.
3. Our mayfly survey very likely collected the target *Nixe flowersi*, however, definitive identification requires male imago stages, which were not available in our samples.
4. We very likely collected the target *Nixe flowersi* in the Spring Creek drainage.
5. We have a fair amount of sorting and identification ahead of us. The grant relied heavily on Dave Ruiter's expertise for caddisfly identifications. We collected a

tremendous amount of material and prioritized the Arbuckle Region identifications based on past information about species occurrences. Completion of sorting and identification of all remaining samples is not likely to expand or change current known ranges of targeted hydroptilids.

#### **D. Acknowledgements**

We are especially grateful to Dave Ruiter, who identified and counted the microcaddisflies without his expertise this project would not have been possible. We also thank all the landowners and managers who allowed site access. We would also like to thank David Castellanos, Amy Hofeld, Skyler Mills, Ruchina Shakya, Theresa Stein, and Gwen Ukeje for their work in the field and laboratory. The Oklahoma Biological Station served as a research base during the summer of 2017 and 2018. Housing was also provided the Nature Conservancy at the Pontotoc Ridge Preserve and the Oklahoma State University Kiamichi Research Station near Idabel, OK.

### **III. RECOMMENDATIONS**

Light trapping methods that were used to collect the adult stages of mayflies were successful, both manned and unmanned light traps. The vast majority of specimens we collected, however, were female subimagos, which need to molt one more time to the imaginal stage. Most species descriptions are based on the male imago. Subimagos often do not quite have the exact color pattern of the imago and body parts often have different shapes.

While using the manned light traps, collectors used forceps to capture specimens and placed those specimens in alcohol. If we use the manned light trap technique again, specimens will be collected but placed in a large plastic container with moist paper towels. That environment allows most subimagos to molt to the imaginal stage during the following 24-hours and should provide more male imagos for identification.

### **IV. SIGNIFICANT DEVIATIONS**

No significant deviations.

### **V. EQUIPMENT**

No equipment was purchased on the grant.

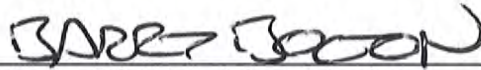
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**DATE:** May 13, 2019

APPROVED BY:



Fisheries Division Administration  
Oklahoma Department of Wildlife Conservation



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## VII. REFERENCES

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## VIII. TABLES AND FIGURES

Table 1. List of the 64 sampled sites. In addition to site information, the number of individuals collected for each of the three targeted species (*Hydroptila procera*, *Mayatrichia ponta*, and *Metrichia nigrutta*) are given for the appropriate sites.

Site #	County	Site name	Date	Latitude	Longitude	<i>H. procera</i>	<i>M. ponta</i>	<i>M. nigrutta</i>
1	Pontotoc	Canyon/Deadman Spr	17-May-17	34.54504	-96.6008			1
2	Pontotoc	Canyon Crk	17-May-17	34.54527	-96.6007			
3	Johnston	Cummins Spring	13-Jul-17	34.4525	-96.6281			
4	Johnston	Cummins Spring	13-Jul-17	34.45252	-96.6276			12
5	Murray	Travertine Crk	8-Jun-17	34.50448	-96.9695		1	
6	Murray	Travertine Crk	8-Jun-17	34.50424	-96.9699		1	
7	Murray	Pavilion Spring	8-Jun-17	34.50369	-96.9686			
8	Murray	Hillside Spring	8-Jun-17	34.50287	-96.9692			
9	Murray	Buckhorn Creek	8-Jun-17	34.42622	-96.9505			
10	Murray	Buckhorn Creek	8-Jun-17	34.41441	-96.9684			
11	Murray	Buckhorn Creek	8-Jun-17	34.40928	-96.9511			
12	Murray	Rock Creek	14-Jun-17	34.50381	-96.9717		3	
13	Murray	Antelope Spring	14-Jun-17	34.50481	-96.9414			
14	Murray	Buffalo Spring	14-Jun-17	34.50258	-96.9393			
15	Pontotoc	Byrd's Mill Spring	22-Jun-17	34.59446	-96.666			1
16	Johnston	Mill Creek	22-Jun-17	34.60669	-96.6435		5	
17	Johnston	Sheep Creek	22-Jun-17	34.60241	-96.5998			3
18	Johnston	Little Blue Creek	22-Jun-17	34.46297	-96.6213			
19	Johnston	Delaware Creek	22-Jun-17	34.44861	-96.5547	3	5	
20	Johnston	Diamond Spr Br.	22-Jun-17	34.42167	-96.6356			
21	Johnston	Pecan Creek	22-Jun-17	34.36111	-96.6225			
22	Johnston	Peter Sandy Creek	22-Jun-17	34.36131	-96.5754		1	
23	Johnston	Pennington Creek	13-Jul-17	34.3535	-96.7105		3	
24	Johnston	Pennington Creek	13-Jul-17	34.35115	-96.7105		1	
25	Murray	unnamed springbrook	13-Jul-17	34.43282	-97.1467	14		
26	Murray	unnamed	13-Jul-17	34.43333	-97.1472			
27	Murray	unnamed	13-Jul-17	34.42361	-97.1444			
28	Murray	unnamed	13-Jul-17	34.42341	-97.1464	3		
29	Murray	Red Branch Crk	2-Jun-18	34.49896	-97.1779			
30	Murray	Colbert Crk	2-Jun-18	34.49217	-97.1751	10	96	
31	Murray	Lick Crk	2-Jun-18	34.46404	-97.1473	1		

32	Murray	Falls Crk	2-Jun-18	34.42888	-97.1059	10		
33	Murray	Dry Sandy Crk	2-Jun-18	34.46281	-97.1282			
34	Murray	Chigley Sandy Crk	2-Jun-18	34.51364	-97.122		23	
35	Murray	Vines Branch	12-Jun-18	34.42045	-97.0757			
Site #	County	Site name	Date	Latitude	Longitude	<i>H. procera</i>	<i>M. ponta</i>	<i>M. nigritta</i>
36	Murray	Rock Crk	12-Jun-18	34.39733	-97.03742			
37	Murray	Rock Crk	12-Jun-18	34.51584	-96.9685			
38	Murray	Board Hollow	12-Jun-18	34.36402	-97.0275			
39	Murray	Whiskey Crk	13-Jul-18	34.52135	-97.2182			
40	Murray	Oil Crk	12-Jun-18	34.3626	-96.9508			
41	Murray	Chili Crk	12-Jun-18	34.4093	-96.9508			
42	Murray	Dry Crk	12-Jun-18	34.43693	-96.9333			
43	Murray	Wilson Crk	12-Jun-18	34.48959	-96.9652			
44	Murray	Guy Sandy Crk	12-Jun-18	34.50675	-97.034			
45	Murray	Mill Crk	22-Jun-18	34.50967	-96.8983			
46	Murray	Pennington Crk	22-Jun-18	34.52058	-96.8525			
47	Johnston	Threemile Crk	22-Jun-18	34.4406	-96.8293			
48	Murray	Buckhorn Crk	22-Jun-18	34.42629	-96.9508			
49	Murray	Denmark Crk	22-Jun-18	34.36138	-96.9785			
50	Garvin	Red Branch Crk	29-Jun-18	34.49899	-97.1778			
51	Garvin	Negro Sandy Crk	29-Jun-18	34.67673	-97.1254			
52	Garvin	Turkey Sandy Crk	29-Jun-18	34.65153	-97.1185			
53	Garvin	Kickapoo Sandy Crk	29-Jun-18	34.65147	-97.0821			
54	Garvin	W Branch Chigley Crk	29-Jun-18	34.65145	97.050077			
55	Garvin	E Branch Chigley Crk	29-Jun-18	34.65136	-97.0175			
56	Carter	Flat Crk	13-Jul-18	34.49246	-97.4396			
57	Murray	Garrison Crk	13-Jul-18	34.52139	-97.254			
58	Murray	Squirrel Crk	13-Jul-18	34.52141	97.287116			
59	Murray	Fivemile Crk	13-Jul-18	34.52127	-97.3149	1		
60	Carter	Eightmile Crk	13-Jul-18	34.49984	97.358308	1	5	
61	Carter	Massey Crk	13-Jul-18	34.49254	-97.3808	1		
62	Carter	Buzzard Crk	19-Jul-18	34.30356	-97.12			
63	Carter	Philips Crk	19-Jul-18	34.3327	-97.1634			
64	Carter	Caddo Cr	19-Jul-18	34.2458	-97.1434			

Table 2. Microcaddisfly taxa list for the Arbuckle-area sites, with the number of sites (of 64) in which each taxon was collected. Information on G ranks and State notes is from NatureServe ([www.explorer.natureserve.org](http://www.explorer.natureserve.org)). Ranks range from 1 (very rare; at risk) to 5 (common and widespread); S (state) ranks are listed for species with small distributions (SNR = state not ranked). Species collected but not listed as occurring in Oklahoma on Natureserve are indicated and, for these species, notes indicate NatureServe-reported occurrences near Oklahoma.

Taxon*	# of sites	G rank	State notes
<i>Cernotina calcea</i>	4	G5	widespread
<i>Cernotina oklahoma</i>	1	G2G3	SNR for OH, OK, TX
<i>Cernotina spicata</i>	6	G5	widespread
<i>Cernotina</i> unidentified	4		
<i>Hydroptila ajax</i>	24	G5	widespread
<i>Hydroptila</i> species nr <i>ajax</i>	6		
<i>Hydroptila amoena</i>	1	G5	widespread
<i>Hydroptila angusta</i>	22	G5	widespread
<i>Hydroptila arctica</i>	2	G5	widespread; not listed in OK (E edge of range is shared with TX)
<i>Hydroptila argosa</i>	1	G5	widespread; not listed in OK (E edge of range; closest is CO)
<i>Hydroptila armata</i>	18	G5	widespread
<i>Hydroptila consimilis</i>	17	G5	widespread
<i>Hydroptila grandiosa</i>	1	G5	widespread
<i>Hydroptila hamata</i>	17	G5	widespread
<i>Hydroptila melia</i>	10	G2G3	OK: SNR; TX: S2
<i>Hydroptila</i> sp 08 (nr <i>melia</i> )	8		
<i>Hydroptila modica</i>	1	G3G5	not listed in OK; disjunct distribution: AZ; OR; WA
<i>Hydroptila protera</i>	10	G1G2	OK: SNR; TX: SNR
<i>Hydroptila tarsalis</i>	1	NGR	possibly <i>Ochrotrichia tarsalis</i> ?
<i>Hydroptila waubesiana</i>	38	G5	widespread
<i>Hydroptila</i> sp 09	1		
<i>Hydroptila</i> unidentified	9		
<i>Mayatrichia ayama</i>	9	G5	widespread
<i>Mayatrichia ponta</i>	11	G2G4	OK: SNR; WY: SNR
<i>Mayatrichia</i> species	1		
<i>Metrichia nigritta</i>	4	G5	OK: SNR; TX: SNR; AZ: S1
<i>Neotrichia edalis</i>	2	G3G4	IL, MO, OK, TX (all SNR)
<i>Neotrichia minutisimella</i>	2	G5	widespread
<i>Neotrichia okopa</i>	3	G5	widespread
<i>Neotrichia osmena</i>	1	G3G4	not listed for OK; AZ: S1; CO,UT, WY (all 3 SNR)

<i>Neotrichia vibrans</i>	2	G5	widespread
<i>Neotrichia</i> unidentified	3		
<i>Ochrotrichia capitana</i>	3	G1G3	not listed for OK; TX: S2?
Taxon	# of sites	G rank	State notes
<i>Ochrotrichia spinosa</i>	2	G5	widespread
<i>Ochrotrichia stylata</i>	8	G5	widespread
<i>Ochrotrichia</i> nr <i>stylata</i>	6		
<i>Ochrotrichia tarsalis</i>	20	G5	widespread
<i>Ochrotrichia</i> unidentified	4		
<i>Orthotrichia aegerfasciella</i>	34	G5	widespread
<i>Orthotrichia cristata</i>	25	G5	widespread
<i>Orthotrichia</i> unidentified	10		
<i>Oxyethira aculea</i>	2	G5	widespread
<i>Oxyethira pallida</i>	42	G5	widespread
<i>Oxyethira</i> unidentified	1		
Hydroptilidae unidentified	7		

\*Unidentified taxa are generally females. G ranks and State notes are not applicable to genus or family –level taxa; nor to morphospecies .

Figure 1. Map of sampling sites.

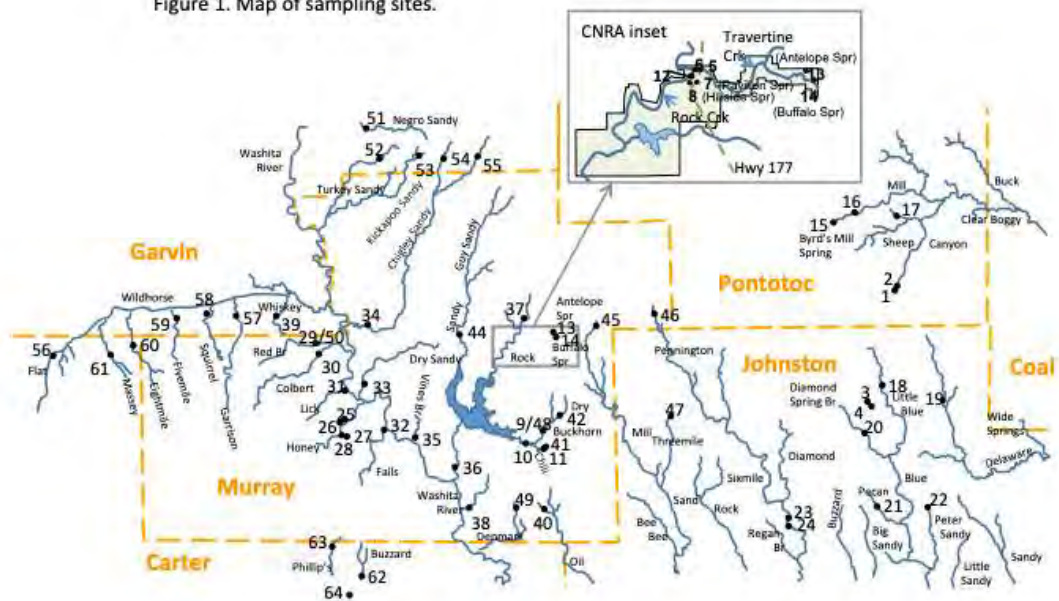




Figure 2a

*Hydroptila protera*

Red circles show the historic distribution

Red dots are survey sites where collected

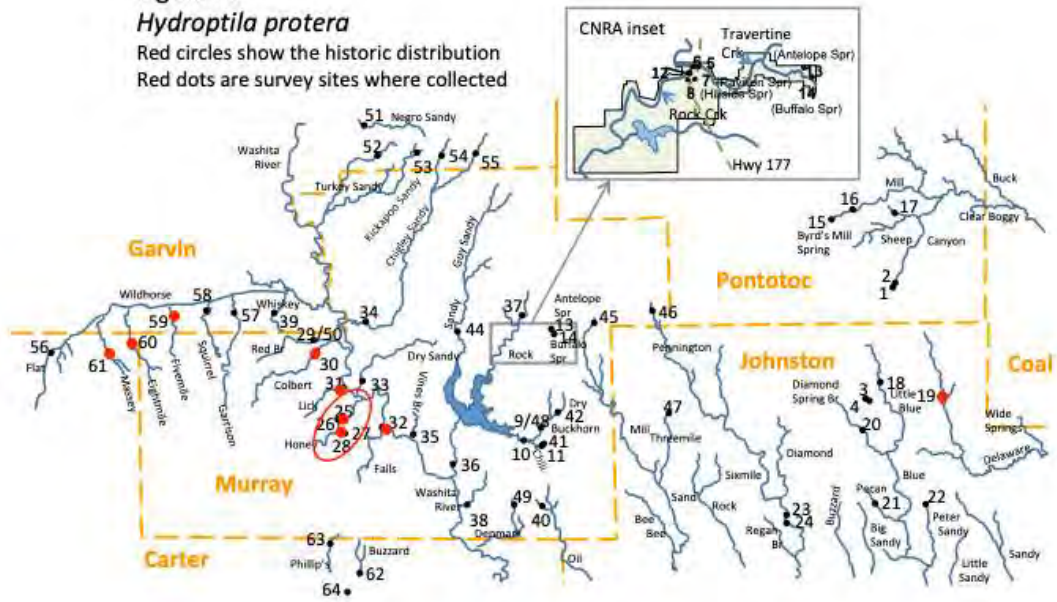


Figure 2b

*Mayatrichia penta*

Red circles show the historic distribution

Red dots are survey sites where collected

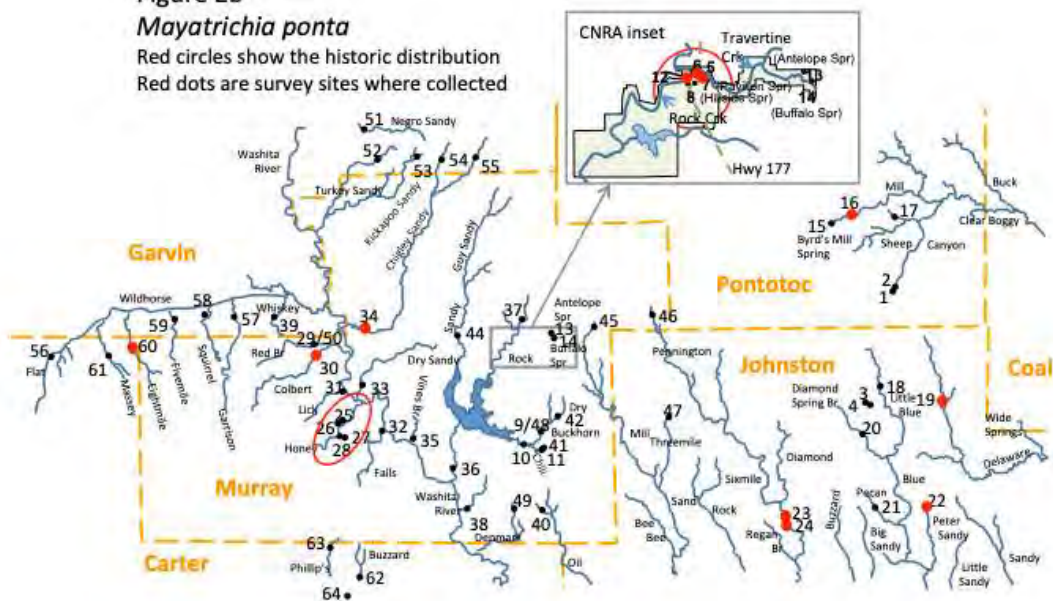


Figure 2c

*Metrichia nigritta*

Red circles show the historic distribution  
Red dots are survey sites where collected

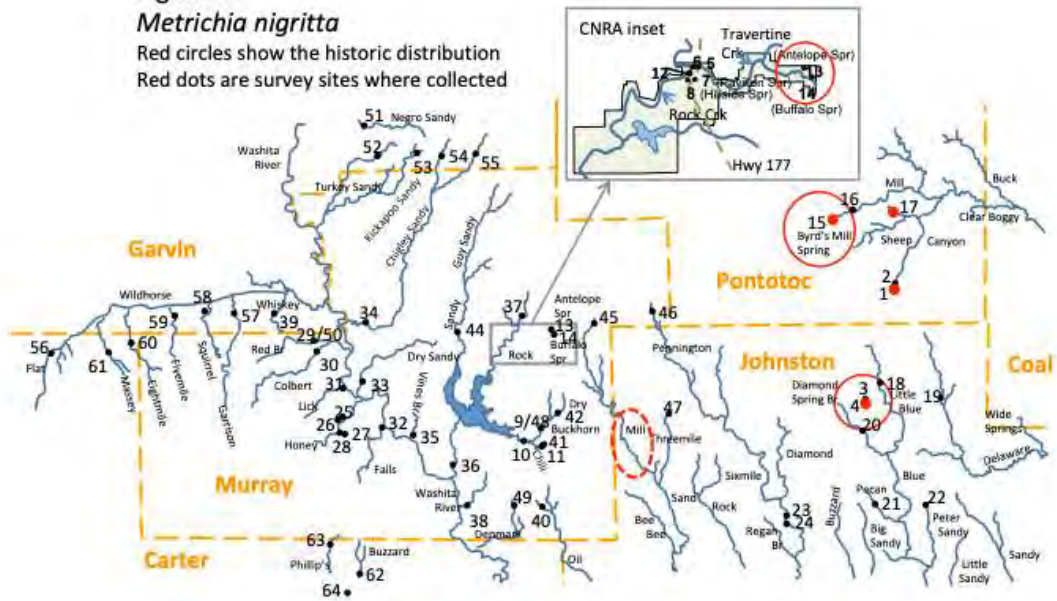




Figure 3. Hydroptilid results from the SE Oklahoma Region 2017 survey. Red and blue markers indicate Little River and Kiamichi River drainage sites, respectively. SP is a spring sample and SU is a summer sample. First number in series is the number of genera collected followed by species and individuals. Sites without data were sampled in 2018. All sites were resampled in 2018 both spring and summer for each site, so the 2018 data represent a more complete survey. These samples are currently being identified to species. Raw data used to produce this map are provided in Appendix 3. The map was produced using BatchGeo.

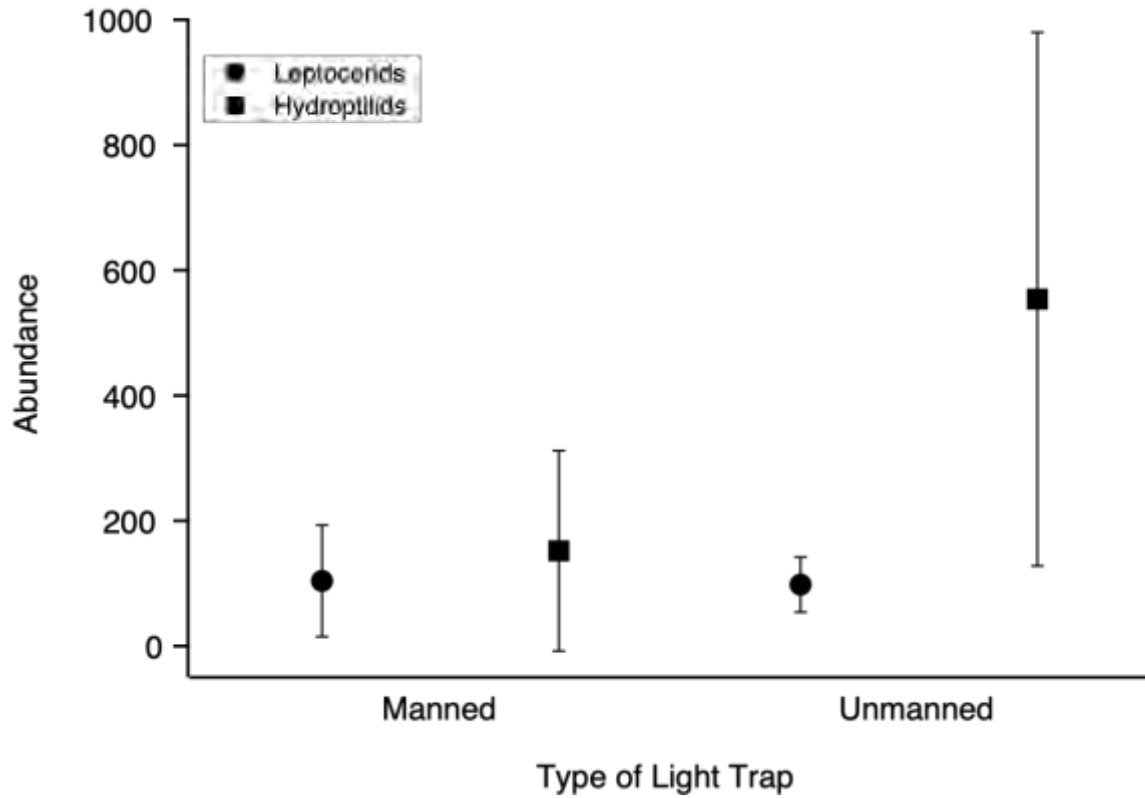


Figure 4. Family-level abundance collected in manned and unmanned light traps during the summer of 2018. Markers are means and error bars are 88% confidence intervals. Non-overlapping error bars signify statistical significance at  $\alpha = 0.05$ .

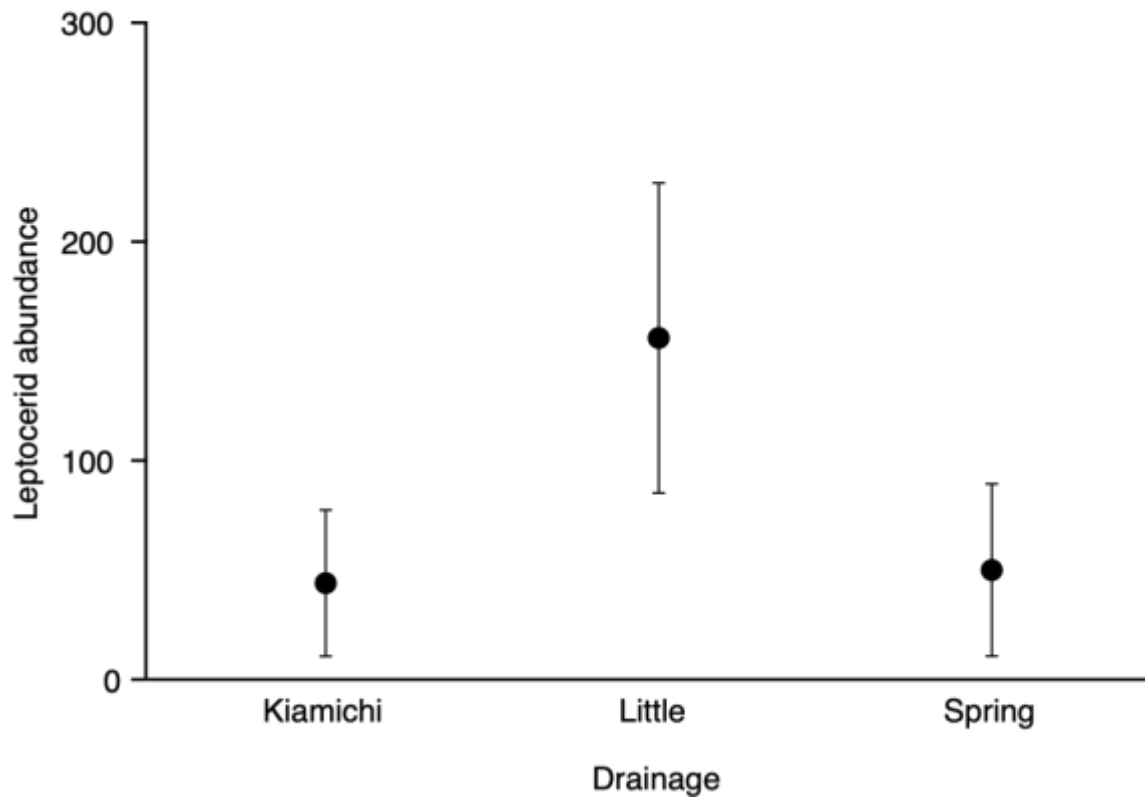


Figure 5. Numbers of individuals in the caddisfly family Leptoceridae in manned and unmanned light trap samples collected from three drainages sampled in the southeast Oklahoma survey. Markers are means and error bars are 88% confidence intervals. Non-overlapping error bars signify statistical significance at  $\alpha = 0.05$ .

## **IX. APPENDIX**

Appendix 1. Site information for the SE Oklahoma survey.

Appendix 2. Trap counts for microcaddisflies collected from 64 sites in the greater Arbuckle region of Oklahoma. Counts among sites are not directly comparable because of differences in trapping time and occasional subsampling. Sites are listed in Table 1.

Appendix 3. Raw data for the SE Oklahoma 2017 hydroptilid survey effort.







Taxon	Site number													
	15	16	17	18	19	20	21	22	23	24	25	26	27	28
<i>Cernotina calcea</i>														
<i>Cernotina oklahoma</i>														
<i>Cernotina spicata</i>														
<i>Cernotina unidentifed</i>														
<i>Hydroptila ajax</i>			1			2			5	9	26			8
<i>Hydroptila species nr ajax</i>		1	5				1				6			3
<i>Hydroptila amoena</i>											1			
<i>Hydroptila angusta</i>			21	2	1	5			9	7				
<i>Hydroptila arctia</i>		5												
<i>Hydroptila argosa</i>														
<i>Hydroptila armata</i>			13		1	2			5	17				1
<i>Hydroptila consimilis</i>				1										6
<i>Hydroptila grandiosa</i>														
<i>Hydroptila hamata</i>						1		1		2				2
<i>Hydroptila melia</i>		1		1		1		3	62	18				
<i>Hydroptila sp 08 (nr melia )</i>		13	18	7		10								
<i>Hydroptila modica</i>														
<i>Hydroptila protera</i>					3			1			14			3
<i>Hydroptila tarsalis</i>			121											
<i>Hydroptila waubesiana</i>			19	1	3	1		1	8	5				2
<i>Hydroptila sp 09</i>			2											
<i>Hydroptila unidentifed</i>					141	24		56						
<i>Mayatrichia ayama</i>									2	2				
<i>Mayatrichia ponta</i>		5			5			1	3	1				
<i>Mayatrichia unidentifed</i>														
<i>Metrichia nigritta</i>	1		3											
<i>Neotrichia edalis</i>									3	2				
<i>Neotrichia minutisimella</i>														
<i>Neotrichia okopa</i>									6					
<i>Neotrichia osmena</i>														
<i>Neotrichia vibrans</i>								1						
<i>Neotrichia unidentifed</i>										1	2			
<i>Ochrotrichia capitana</i>					129	1		1						
<i>Ochrotrichia spinosa</i>														1
<i>Ochrotrichia stylata</i>		27		12		1	2	14	5	10				
<i>Ochrotrichia nr stylata</i>			1		1									
<i>Ochrotrichia tarsalis</i>		4			1	1			24	15				1
<i>Ochrotrichia unidentifed</i>														
<i>Orthotrichia aegerfasciella</i>			9	1	14	1		7	3	6				
<i>Orthotrichia cristata</i>														
<i>Orthotrichia unidentifed</i>														
<i>Oxyethira aculea</i>														
<i>Oxyethira pallida</i>				2	94	37		14	16	7	1			
<i>Oxyethira unidentifed</i>														
<i>Hydroptilidae unidentifed</i>									500	300				

Taxon	Site number													
	29	30	31	32	33	34	35	36	37	38	39	40	41	42
<i>Cernotina calcea</i>	3	12		2										
<i>Cernotina oklahoma</i>						24								
<i>Cernotina spicata</i>		4												
<i>Cernotina unidentifed</i>		5										2		
<i>Hydroptila ajax</i>				1		17		3		1				
<i>Hydroptila species nr ajax</i>														
<i>Hydroptila amoena</i>														
<i>Hydroptila angusta</i>	3	1						1						
<i>Hydroptila arctia</i>	1													
<i>Hydroptila argosa</i>														
<i>Hydroptila armata</i>	1							2						
<i>Hydroptila consimilis</i>		3		1		1								
<i>Hydroptila grandiosa</i>														
<i>Hydroptila hamata</i>			6	1		37		1						
<i>Hydroptila melia</i>		2												
<i>Hydroptila sp 08 (nr melia )</i>														
<i>Hydroptila modica</i>		2												
<i>Hydroptila protera</i>		10	1	10										
<i>Hydroptila tarsalis</i>														
<i>Hydroptila waubesiana</i>	6	2	1			1	2	7		2				1
<i>Hydroptila sp 09</i>														
<i>Hydroptila unidentifed</i>			52									13		10
<i>Mayatrichia ayama</i>	3	8	6			8	24							
<i>Mayatrichia ponta</i>		96				23								
<i>Mayatrichia unidentifed</i>														
<i>Metrichia nigritta</i>														
<i>Neotrichia edalis</i>														
<i>Neotrichia minutisimella</i>							1							
<i>Neotrichia okopa</i>		1												
<i>Neotrichia osmena</i>														
<i>Neotrichia vibrans</i>														
<i>Neotrichia unidentifed</i>														
<i>Ochrotrichia capitana</i>														
<i>Ochrotrichia spinosa</i>														
<i>Ochrotrichia stylata</i>														
<i>Ochrotrichia nr stylata</i>														
<i>Ochrotrichia tarsalis</i>	1					5								
<i>Ochrotrichia unidentifed</i>														
<i>Orthotrichia aegerfasciella</i>		1	1	4			7	5					5	5
<i>Orthotrichia cristata</i>		7		2		1	5			2	1			1
<i>Orthotrichia unidentifed</i>												8		
<i>Oxyethira aculea</i>														
<i>Oxyethira pallida</i>	22	49	7	3	1	18		400		3	2	7	4	30
<i>Oxyethira unidentifed</i>														
<i>Hydroptilidae unidentifed</i>		250		65		212	85			60				





			Hydroptila												Oxyethra						Orthotrichia		Mayatrachia		Ithytrichia		Protophila		Neotrichia		Cernotina		Ochrotrichia																	
Nature Serve Conservation Rank			H. armata GS			H. hamata GS			H. grandiosa GS			H. angusta GS			H. ampelna GS			H. waubesaiana GS			H. sp.			Ox. sp.		Ox. pallida GS		Ox. arcuata GS		Ox. novaezota G4/G5		Dr. aegerfasciella GS		Dr. cristata GS		M. ayama GS		I. clovata GS		P. eggs GS		N. sp.		C. sp.		C. cistea GS		Ox. sp.		
Site	Drainage	Site Info	Date	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total	Site Totals	
1	Little River	Ludlow	7/9/17	1	10	11				1	1																																						63	
2	Little River	Nolia	7/9/17																																															0
3	Little River	Cloudy Creek	8/8/17	4	269	273	1	253	254																																									568
4	Little River	South Holly Creek	8/8/17		2	2		5	5																																								11	
5	Little River	Yachus Creek	8/9/17					22	22																																									27
6	Little River	Lufkasa Creek	8/9/17	1	0	7		5	5																																								39	
7	Little River	Briar Branch (LFC)	8/9/17																																														0	
8	Little River	Glover River	8/9/17					1	1																																								0	
9	Kiamichi River	Dry Creek	5/16/17					11	11																																								12	
10	Kiamichi River	Peal Creek	5/17/17		1	1		2	2																																								59	
11	Kiamichi River	Big Cedar	5/17/17																																														0	
9	Kiamichi River	Dry Creek	6/8/17	3	3	3		17	20																																								561	
12	Kiamichi River	Pine Creek	7/3/17		1	1		1	1																																								3	
13	Kiamichi River	E. Big Cedar	7/3/17		42	42		2	52	54																																						154		
14	Kiamichi River	Middle One Creek	7/8/17		9	9			6	6																																						19		
15	Kiamichi River	Crum Creek	7/8/17					1	1																																							1		
Totals				10		366		950		1		4		11		1		91		20		1		8		28		4		14		1		1		1		3		8		2				1525				