A brief survey of tachinids from the Ozark Plateau of Missouri, USA

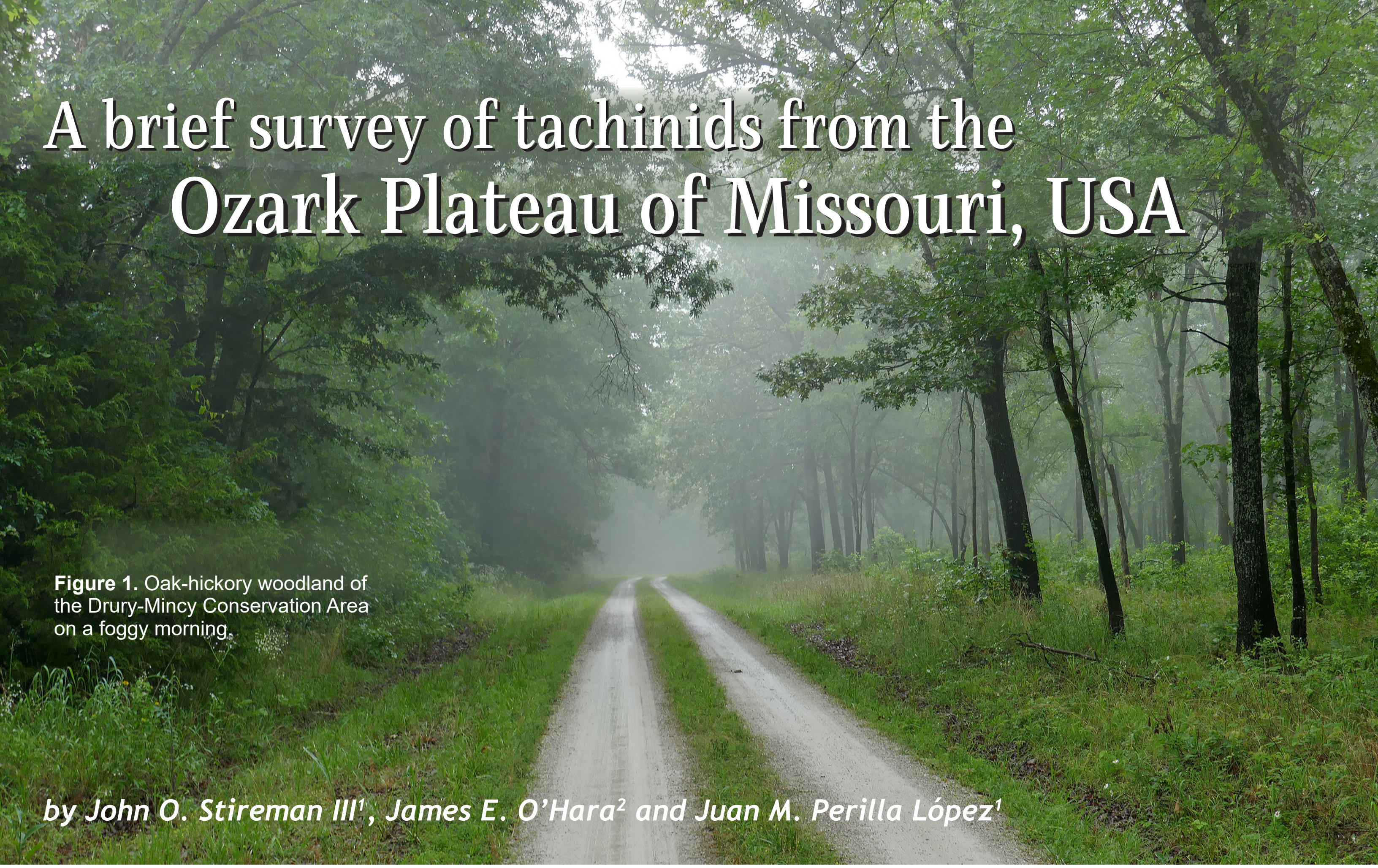

Figure 1. Oak-hickory woodland of the Drury-Mincy Conservation Area on a foggy morning.

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Introduction

In 2019, the North American Dipterists Society (NADS) field meeting was held from 3–7 June at the Bull Shoals Field Station in the Ozark Mountains of southern Missouri. This informal meeting is held every two years at varying locations in North America and primarily consists of field collecting and socializing with old and new dipterist colleagues, along with an evening of short presentations (e.g., see O'Hara & Stireman 2016, Stireman *et al*. 2018). The 2019 meeting was organized by Greg Courtney (Iowa State University) and David Bowles (Missouri State University), and an overview of the meeting was given in their report in the November 2019 issue of *Fly Times* (Courtney & Bowles 2019). Here, we describe and report results from our brief, but intensive, tachinid collecting efforts during the meeting, where as a group we were able to collect more than 1000 tachinid flies of a wide diversity of species over a six-day period.

The state of Missouri is somewhat centrally located in the "Midwest" region of the United States (Fig. 2). It occupies a transition zone of habitats, where temperate deciduous forest to the east and south transitions to tall grass prairie to the north and west. About two thirds of the state was historically forested and about half that area, mostly in the Ozark Highlands, remains forested (Raeker *et al*. 2011). The Ozark highland region of Southern Missouri is characterized by highly dissected forested hills and plateaus. The "Ozark mountains" are not truly mountains, but rather the remains of an ancient dome or plateau that has been eroding for many millions of years (McNab & Avers 1994), and even the highest points are less than 1000 m in elevation. Yet, they still represent the most extensive region of highlands in the United States between the Rocky Mountains to the west and the Appalachian Mountains to the east. The southern Ozark region that we visited was dominated by oak/hickory woodland (Fig. 1), with some areas of more open oak savanna, and occasional open grassy glades where bedrock is exposed and soils are thin. Apparently, during the last interglacial xerothermic period of high global temperatures (the Holocene Climate Optimum) about four to eight thousand years ago, many desert-adapted plants and animals invaded the Ozarks from the Southwest. Relict populations of a number of these species have persisted in the open sunny glades that are characteristic of the Ozarks (e.g., collared lizards, Templeton *et al*. 2001). Another notable characteristic of the area that we learned about is that it is a center of tick borne diseases, and the density of ticks was truly impressive. A short 20 m stroll through the underbrush would inevitably lead to 10, 20, or more unwelcome passengers. Luckily we were warned, and prepared ourselves with permethrin-treated clothing, which repelled the little arachnids quite effectively.

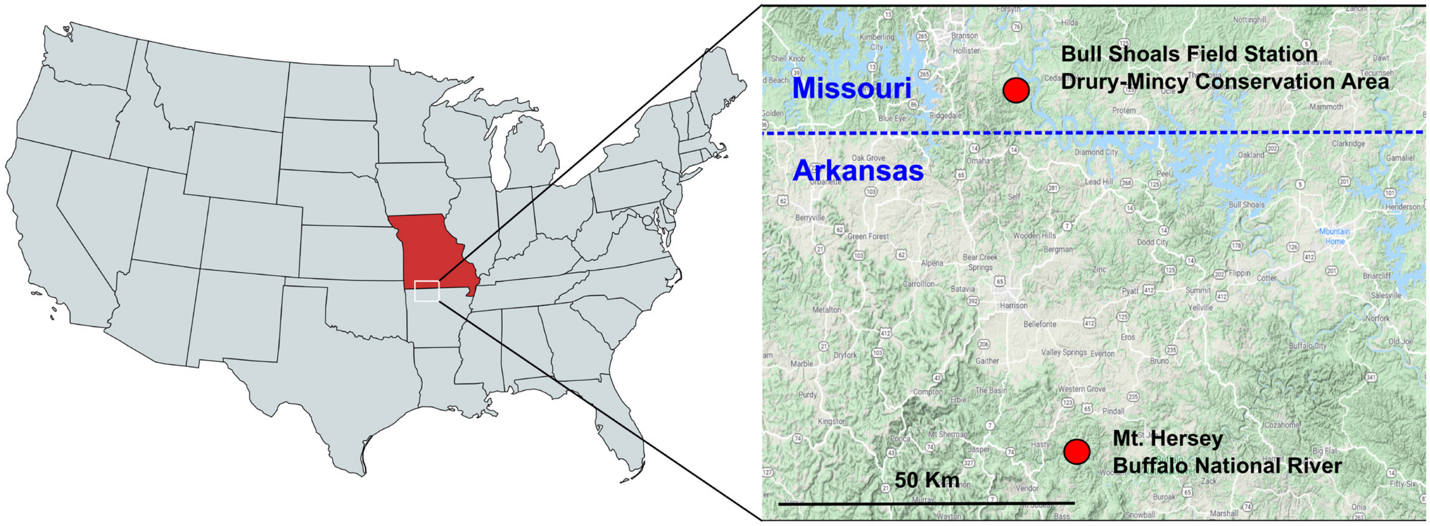

Figure 2. Map showing our collecting locations. On the map of the United States, the state of Missouri is indicated in red and the enlarged area of southern Missouri and northern Arkansas is outlined in white. Most collecting occurred in Missouri at the Bull Shoals Field Station/Drury-Mincy Conservation area, but some hand collecting was done near Mt. Hersey along the Buffalo National River in Arkansas.

Methods

Most of our collecting was focused around the Bull Shoals Field Station (BSFS; Taney County, Missouri) where the meeting was held and where many of us stayed. This field station, operated by the Missouri State University, is a small five-acre site surrounded by the Drury section of the much larger Drury-Mincy Conservation Area (5600 acres [2266 ha]). This conservation area is managed for hunting, recreation, and conservation and consists of forest/woodland, oak savanna, open glades and managed "wildlife food plots." Collecting permits for this conservation area (and for Buffalo National River, see below) were arranged by David Bowles.

Figures 3–6. 3. O'Hara's 6m Malaise trap, situated at a forest edge in an open wildlife food plot. **4**. Dahlem's 6m Malaise trap, situated in a semi-open area near the Bull Shoals Field Station's "Drury House". **5**. A view of the Buffalo National River in northern Arkansas where we spent a morning collecting tachinids. **6**. The "tachinid team" alongside the Buffalo National River in Arkansas. Left to right: Sarah Workman, Greg Dahlem (honorary member), John Stireman, Juan Manuel Perilla López and Jim O'Hara.

The primary collectors of Tachinidae (Fig. 6) included the authors (JOS, JMPL, JEOH) as well as undergraduate student Sarah Workman (Wright State University) and Greg Dahlem (sarcophagid specialist, Northern Kentucky University). Collecting in this area consisted of hand netting (primarily along gravel roads and trails) and Malaise traps, sometimes with the assistance of a sugaring solution sprayed on leaves. Four 6m Malaise traps were erected near the BSFS: one was located in the open at a forest edge and facing into a wildlife food plot (operated 2–5 June, JEOH; Fig. 3), a second was located about 1.2 km from the first beside a stream and was semi-shaded by trees for a good portion of the day (2–7 June, Cumming), a third was located in a semi-open area surrounded by woods near the field station's "Drury House" (3–5 June, JOS, JMPL & SW), and a final trap was located in the same area as the last (4 June and part of 5 June, Dahlem; we did not acquire all specimens from this trap; Fig. 4). All were operated with dry heads that were taken off nightly to prevent fouling of samples with moth scales except for the Cumming trap, which had alcohol-filled heads that were left on continuously. In addition, we were able to extract tachinids from collections of three 2m Townes-style Malaise traps with "wet" (alcohol) heads operated by D. Bowles from 27 May to 3 June 2019. These were located in a forest glade, woodland, and woodland near a small pond (Buttonbush pond). All traps were within the Drury section of the Drury-Mincy CA and within 3 km of the field station.

One late afternoon (4 June) and one morning (5 June) were spent hand collecting in the Bear Mountain area of the Mincy section of the Drury-Mincy CA about 7 km west of the BSFS. Our collecting here was mostly focused on a broad forested bluff that acted, to some degree, as a hilltop. In addition, a 6m Malaise trap (Dahlem's) was operated for a day in an open glade/savanna area in this area on 5 June. For the purposes of comparison, these Malaise trap samples are lumped with the hand collected samples from Bear Mountain.

We also spent half a day (4 June) collecting at a somewhat more distant site (about 65 km south of the BSFS) along the Buffalo National River in northern Arkansas (Hersey Mountain area; Searcy County, AR; Figs. 2, 5, 6). Collecting at this site consisted of hand netting, mostly along edges of a fallow field and in patches of sunlit vegetation adjacent to the Buffalo River. A number of species were collected from flowers and/or by sugar spraying vegetation in this area.

Specimens collected by or given to JEOH are housed in the Canadian National Collection of Insects (CNC) in Ottawa and those collected by or given to JOS are in the J.O. Stireman Collection (JOSC) at Wright State University in Dayton.

Specimen Identification

About half of the specimens were identified by JEOH with reference to specimens in the CNC and using DNA sequence data from COI gene "barcodes," which were generated for 190 specimens. This included specimens from the Malaise trap samples of G. Dahlem and J. Cumming. The remainder were identified by JOS, with assistance from JMPL. These were identified using available keys, comparison with specimens in the JOSC, comparison with images of specimens collected by JEOH, and with reference to the DNA sequencing results of JEOH. This included the wet trap samples collected by D. Bowles. Because specimens were not sorted and identified together (i.e., JEOH and JOS identified species separately), there may be errors in matching up specimens between collectors even with the exchange of images and information. However, the more likely source of error is that we assumed that similar but distinct species were the same rather than inferring that members of the same species were different. Thus, our results are likely conservative with respect to the total richness of species as well as to differences in species collected by different methods and collectors. We were unable to definitively match a number of our species with a named species either due to lack of available specimens of species in our collections or because the specimens do not appear to match any named species in the genus. Some of these appear to be undescribed species (see Appendix 1).

Analysis

A species rarefaction curve and extrapolated species richness were estimated using iNEXT (Chao *et al*. 2016). The R programming environment (R core team 2018) was used to examine and visualize species abundance distributions and overlap among collecting methods, traps, and sites (particularly the package *VennDiagram* (Chen 2018)).

Results and Discussion

Together we collected, sorted, and identified 1091 tachinid specimens belonging to an estimated 161 species over a six day period (Appendix 1). Most of the species were represented by only one or a few individuals with a handful of abundant species (Fig. 7a), including *Cylindromyia binotata* (N=77), *Siphona illinoiensis* (N=65), *Myiopharus* sp. nr. *infernalis* (N=59), and *Copecrypta ruficauda* (N=50). The lack of an obvious asymptote of the individual-based rarefaction curve indicates that many more species likely occur in this area at this time of the year (Fig. 7b). Indeed, when extrapolated to twice the observed sample size of 1091 individuals, over 200 species of tachinids would be expected to be collected.

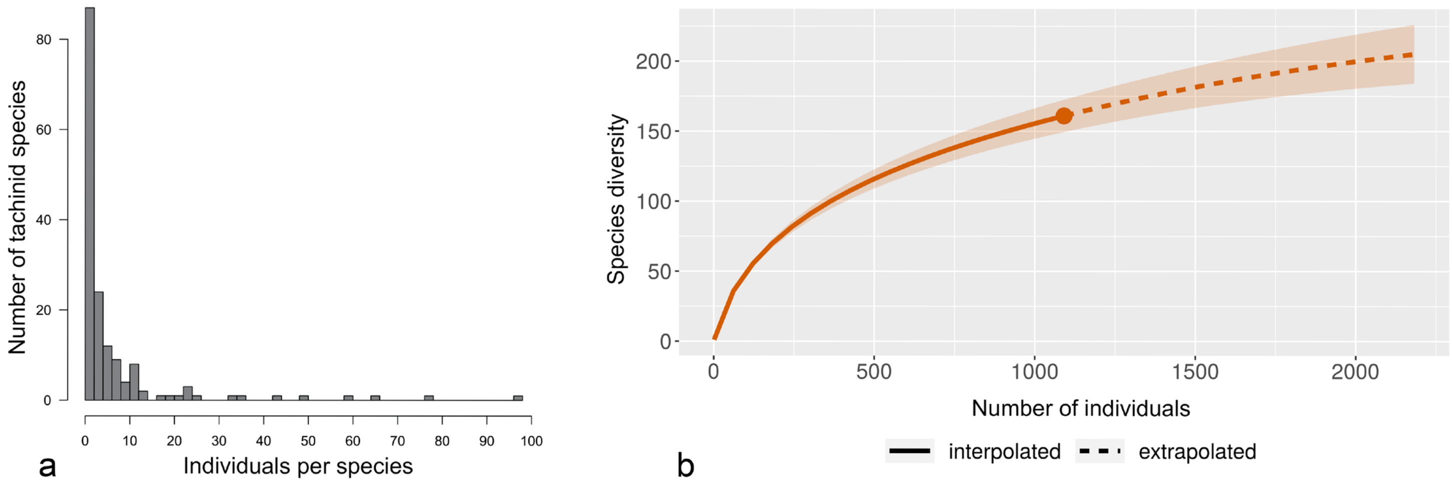

Figure 7. a. The distribution of abundances of all the tachinid species collected illustrating the large number of species represented by only one or two individuals with a few common species. **b**. A rarefaction curve of species accumulation relative to number of individuals with extrapolation to twice the observed sample size.

In terms of species richness, the tachinid fauna was dominated by Exoristinae, with 96 species, followed by Tachininae (32), Dexiinae (19), and Phasiinae (14) (Fig. 8a). However, several genera of Tachininae were quite abundant (e.g., *Archytas*, *Copecrypta*, *Siphona*, *Paradidyma*) as well as the phasiine genus *Cylindromyia*. Representive species from each subfamily are illustrated in Figure 9. Among the Exoristinae, the tribe Blondeliini was best represented, followed by the Goniini and Eryciini (Fig. 8b).

A slight majority of all the specimens were male (57.4%), but sex ratios of collected specimens varied widely among species. Considering only species with N≥10, sex ratios ranged from all or nearly all male (e.g., *Phebellia curriei*, *Aplomya theclarum*, *Masiphya confusa*), approximately even (e.g., *Ginglymia* nr. *acrirostris*, *Archytas* nr. *instabilis*), to >80% female (e.g., multiple species of *Lespesia*, *Paradidyma singularis* complex). Malaise traps might be expected to catch more host-searching females moving through the landscape, but we saw no clear evidence of this. Both hand and trap samples were similarly slightly male biased.

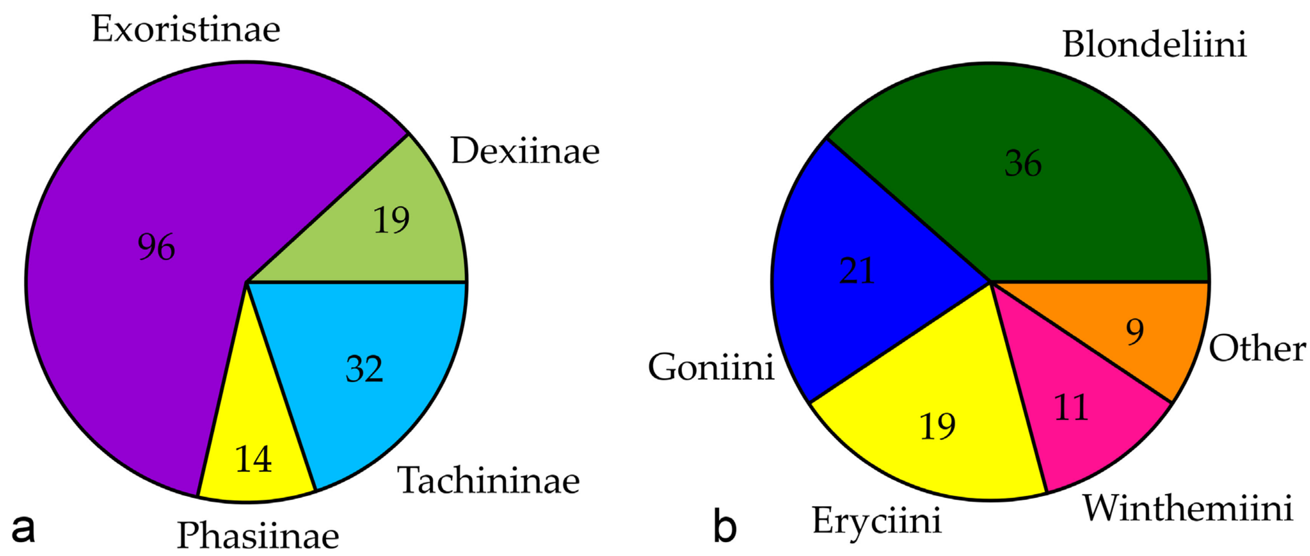

Figure 8. a. Proportions and numbers of species collected belonging to each of the four subfamilies of Tachinidae. **b**. Proportions and numbers of species collected belonging to various tribes of the subfamily Exoristinae.

Overlap among methods, sites, and traps

Nearly half (519) of all individuals were collected by hand netting, however the four large 6m Malaise traps collected more total species (117 versus 98 by hand; Fig. 10a). The three smaller Malaise traps collected the smallest number of species (28). A comparison of the overlap in species by collecting methods indicates that many species were collected only by hand or only with Malaise traps, with only about half of species (57) being collected by both methods. These results highlight the importance of using multiple collecting methods to obtain a representative sample of the tachinid fauna in an area. In particular, smaller taxa, like *Siphona*, tend to be under-represented by hand collecting. On the other hand, certain species appear to avoid traps in some way. For example, *Euhalidaya genalis* (Fig. 9b), a parasitoid of Phasmida, was only collected by hand (N=12). *Winthemia rufopicta* was also underrepresented in Malaise traps. We collected 98 individuals of this abundant species, however about 86% of them were collected by hand. These apparent biases suggest that we should use caution in inferring community composition and relative abundances of species from trap samples or hand collecting.

We also found a lot of variation in abundance and species composition among Malaise traps. Traps varied in the size of their catch, with JEOH's trap, which was located in a sunny location, catching many more individuals and correspondingly more species than the other two traps we compared (Fig. 10b). Each of the four 6m Malaise traps collected appreciable numbers of species that none of the other traps collected (Fig. 10b; Dahlem's trap is omitted for ease of visualization). Less than 10% of species collected by Malaise traps were found in all of the three traps compared. Part of this variation among traps is likely due to small sample sizes (i.e., catch numbers), such that if traps were run longer and more effectively sampled the communities at the trap sites there would be more overlap in species among them. However, some of the variation may be due to the different placement/microhabitat of the traps (e.g., sun versus shade, forest edge versus forest interior). Interestingly, when comparing just flies that were hand collected among individual collectors who were generally collecting in the same sites at the same times, we found similar patterns. For example, collectors JOS, JMPL and S. Workman each hand collected from 16–23 species that none of the other two collected, representing over 40% of the total species collected by each of them. This may reflect "sampling error" (as above), but also different search and collecting strategies, different attention to microhabitats in the same area (e.g., ground verses forest understory), and some differences in exactly where in an area each of us was collecting (e.g., different sides of the same hilltop).

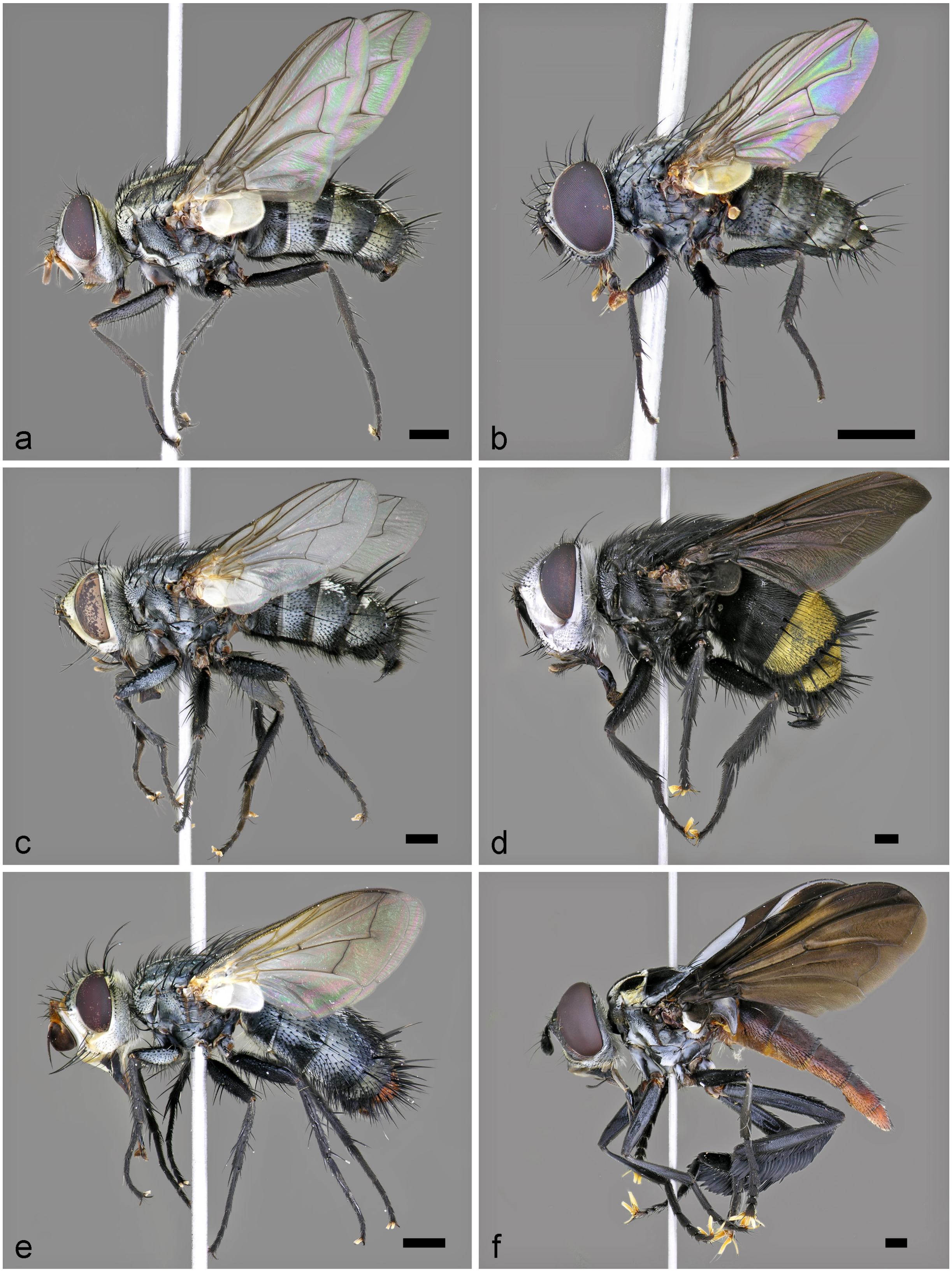

Figure 9. Representative tachinid species collected in the southern Ozark Plateau. **a**. *Billaea sibleyi* (West) (Dexiinae: Dexiini). **b**. *Euhalidaya genalis* (Coquillett) (Exoristinae: Blondeliini), a parasitoid of walking sticks. **c**. *Gueriniopsis* sp. MO1 (Exoristinae: Exoristini). **d**. *Belvosia borealis* Aldrich (Exoristinae: Goniini), among the largest tachinids we collected. **e**. *Copecrypta ruficauda* (van der Wulp) (Tachininae: Tachinini), one of the more abundant tachinines in the area. **f**. *Trichopoda lanipes* (Fabricius) (Phasiinae: Gymnosomatini), a colorful species of bug-killing flies that can reach impressive size. Right legs of specimens in **a**, **b** and **d** removed for DNA preservation. Scale bars = 1.0 mm.

Finally, we found that though there was some overlap in species among the three major sites where we collected, many species were only collected at a single site (Fig. 10c). By far the most species (127) were collected around the BSFS. where almost all the trapping and much of the hand collecting was done. Collecting at Bear Mountain and Buffalo River was mostly by hand, which may explain some of the variation in species collected, but local habitat may also play a role. The Buffalo River site was lowland, with collecting focused on herbaceous plants growing near the river and along the edges of an open mowed field nearby. Flowers at this site attracted relatively large numbers of Phasiinae and other anthophilous taxa. In contrast, most collecting at Bear Mountain was focused on a wooded hilltop/bluff favoring forest species and those that visit hilltops for mating.

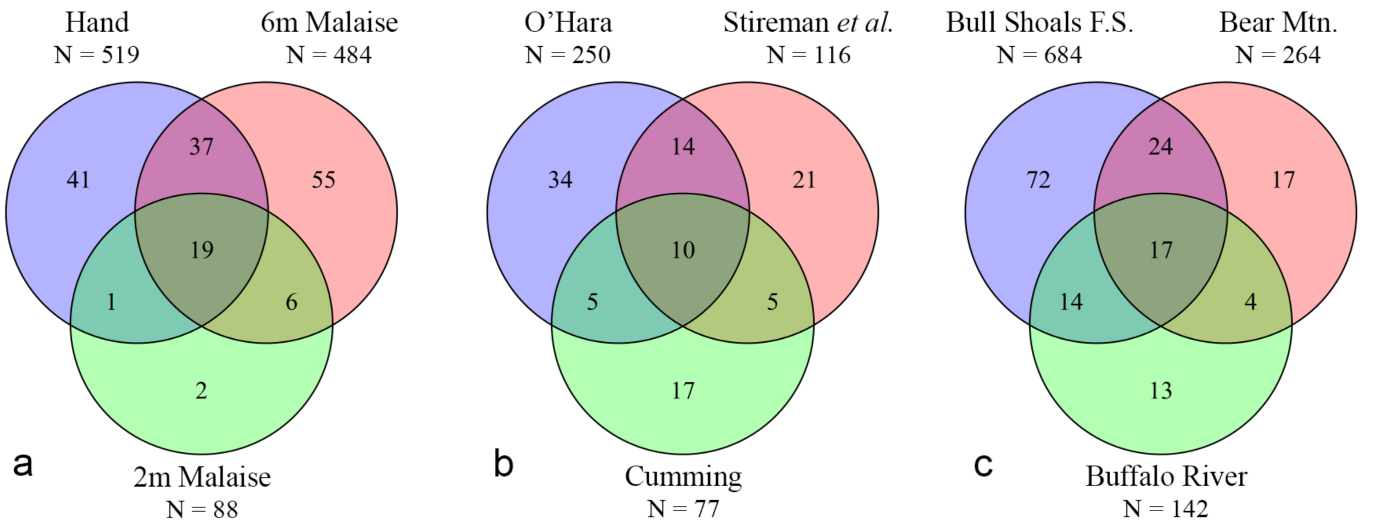

Figure 10. a. Comparison of the overlap in species by collecting method (hand netting, 6m Malaise traps, and 2m Malaise traps). N=total number of individuals collected using each method. **b**. Comparison of the overlap in species from three of the four Malaise traps, all in the vicinity of the Bull Shoals F.S. N=total number of individuals from each trap. Dahlem's Malaise trap, from which only 18 specimens were acquired from the Bull Shoals F.S., is omitted for clarity. **c**. Comparison of the overlap in species from the three major sites where we collected. Values indicate the combined totals from hand collecting and Malaise traps. N=total number of individuals from each site.

Notes on certain taxa

Several of the species we collected were rare or at least rarely collected, and as mentioned previously, a number of them may represent undescribed species (e.g., in *Celatoria*, *Neoethilla*, *Ceromya* and possibly other genera). Below, we provide notes on a few of the taxa that we collected.

***Archytas* nr. *instabilis*.** This species was abundant in the area. Its CO1 barcode places it close to, but distinct from, *A. instabilis*, but morphologically, it appears more similar to *A. aterrimus* (Rob.-Des.). It may represent a new species that was hidden within the latter.

Anoxynops aldrichi is a common tachinid in eastern North America, but apparently has not been previously recorded from Missouri.

***Aplomya theclarum*.** This species is certainly a complex of multiple, morphologically similar species based both on genetic sequence data and morphology. At least three morphospecies were present in our collections.

Billaea sibleyi (Fig. 9a), which we collected resting on tree trunks on the Bear Mountain hilltop, was only recorded from New York and Quebec in O'Hara & Wood (2004) but has since been recognized from Ohio and Ontario (JEOH, unpubl. data).

***Carcelia* n. sp.** belongs to subgenus *Euryclea* Robineau-Desvoidy. This subgenus has 14 species in the Old World and was not known from the New World until an undescribed species was discovered in the Gila National Forest in New Mexico (O'Hara 2012). This species has since been found in Arizona and our Missouri specimens belong to it as well, further expanding its known range. The basal setae on the postpronotum are arranged in a triangle in this species and in other members of the subgenus, but form a nearly straight line in other North American *Carcelia* species. Because of the positioning of these setae and the presence of one or more setae on the posteroapical margin of the hind coxa, *Carcelia* n. sp. keys to *Hyphantrophaga* Townsend in Wood (1987).

***Ceromya* n. sp.** One male specimen of this species was caught in Cumming's Malaise trap. There is one female of this species in the CNC, coincidentally caught in G. Dahlem's 6m Malaise trap while it was operating in his backyard on the outskirts of Cincinnati, Ohio in 2015. This species is close to the Holarctic *C. bicolor* (Meigen), and these two species differ from other Nearctic *Ceromya* in having wing veins R_1 and CuA_1 bare. The abdomen of *C. bicolor* is entirely yellow (or yellow with a black median vitta, although this might indicate another undescribed species) whereas the abdomen of *Ceromya* n. sp. has a black band on the posterior third of syntergite 1+2 to segment 5 and a black median vitta.

***Gueriniopsis* sp. MO1** (Fig. 9c) is a relatively rarely collected genus and our two specimens appear to differ morphologically from the one described species, *G. setipes*.

***Hypertrophomma opacum*.** This small, widespread, goniine species is infrequently collected. The specimen is a first for JOS.

***Lespesia* spp.** We collected an apparent seven species of this genus. Reliable identifications are difficult in this genus despite relatively recent taxonomic attention (e.g., Sabrosky 1980). There are undoubtedly cryptic species complexes and other undescribed species.

***Myiopharus* spp.** We collected eight apparent species of this morphologically diverse genus. These small, beetle-attacking, blondeliines are represented by many species in the New World, and it is apparent that at least several undescribed species exist in America north of Mexico. They can be difficult to identify, due in part to the sexual dimorphism wherein males may look quite different from females. Interestingly, the genus contains species in which females may possess or lack piercing ovipositors.

Paradidyma singularis appears to be a complex of multiple species based on COI barcode data and the specimens included within the complex here probably represent two species. A number of additional undescribed species in the genus are known from North America.

Trichopoda lanipes and ***T. pennipes*.** These flower-visiting, bug-parasitizing tachinids are conspicuously colored with varying amounts of yellow and black. Larger specimens that are mostly black with yellow along the wing base are generally identified as *T. lanipes* (Fig. 9f) and smaller specimens with a mostly yellow abdomen and entirely black wing are regarded as *T. pennipes*. There is, however, variation in size and color between these extremes and COI barcodes are virtually the same for all morphotypes. More sophisticated molecular analyses are needed to explain why coloration is so varied and barcodes so similar, and whether there is one species or two.

***Vibrissina* cf. *leibyi*.** We collected several specimens of what appear to be *V. leibyi*, but the one sequenced specimen is genetically quite distant from other sequenced *Vibrissina* species. This, along with some previous genetic studies (Burington 2017) suggest the possibility that the genus *Vibrissina* may be paraphyletic.

***Winthemia* spp.** Of the 11 species of Winthemiini we collected, nine belong to the genus *Winthemia*. Despite multiple revisions of North American species (e.g., Reinhard 1931, Guimarães 1972), this genus is one of the most difficult in which to make practical identifications. Several of the named species appear to represent species complexes (e.g., one or more of our unidentified species likely corresponds to *W. quadripustulata* (Fabricius)) and there appear to be several undescribed species. Even with keys and comparisons with "reliably" identified specimens it can be difficult to assign a name and male genitalia of this genus are notably homogenous with relatively little apparent variation. This problem becomes even more severe as one moves towards the tropics where a multitude of species exist.There are undoubtedly multiple species hidden within named species, and other undescribed species as well, as in *Lespesia*. Both of these genera have likely experienced recent bursts of speciation in the New World with relatively little associated morphological diversification.

***Zelia* spp.** We collected four species of *Zelia*, only one of which we can definitively match to a named species. This is yet another genus that we know includes several undescribed species in North America (e.g., see O'Hara & Stireman 2016).

Acknowledgments

We would like to thank Sarah Workman (Wright State University, Dayton), Greg Dahlem (Northern Kentucky University, Highland Heights), Jeff Cumming (CNC, Ottawa) for sharing their tachinid specimens with us. (Sarah Workman, who is an undergraduate student and has limited collecting experience, was especially impressive, catching a number of specimens and species that was on par with veteran collectors.) At least two specimens were donated by Jon Gelhaus (Academy of Natural Sciences of Drexel University, Philadelphia), and we thank him for those. We would also like to thank and acknowledge Greg Courtney (Iowa State University, Ames) and David Bowles (Missouri State University, Springfield) for planning and organizing the 2019 NADS meeting, and David additionally for setting up the three smaller Malaise traps and allowing us to extract tachinids from the samples.

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Appendix 1. Table of species

Tachinid species and morphospecies collected from the southern Ozark Plateau, 2–7 June 2019. Tentative identifications are indicated by "cf.", species that are similar to named taxa but appear distinct are indicated by "nr.", species that we are unsure of are left as "sp." or "sp. MO#", and species that are clearly undescribed (i.e., new) are indicated by "n. sp." Note however, that each of these categories may include undescribed species. M=males, F=females, Total=total specimens. Site occurrences are given in the right columns: BS-T=Bull Shoals Field Station, Malaise traps, BS-H=Bull Shoals Field Station, hand netted, Bear=Bear Mountain area, Mincy section of the Drury-Mincy Conservation Area, and AR=Mt. Hersey area, Buffalo National River, Arkansas.

Species	M	F	**Total**	BS-T	BS-H	Bear	AR
SUBFAMILY DEXIINAE							
Tribe Dexiini							
Billaea sibleyi (West)	10	1	**11**	x		x	
Prosenoides sp. MO1	1	0	**1**			x	
Ptilodexia nr. *conjuncta* (van der Wulp)	0	1	**1**			x	
Zelia metalis (Reinhard)	**0**	**1**	**1**	**x**			
Zelia sp. MO1	0	2	**2**	x		x	
Zelia sp. MO2	0	1	**1**	x			
Zelia sp. MO3	1	0	**1**		x		
Tribe Epigrimyiini							
Beskia aelops (Walker)	2	0	**2**	x		x	
Epigrimyia illinoensis Robertson	23	2	**25**	x			x
Tribe Sophiini							
Cordyligaster septentrionalis Townsend	0	1	**1**			x	
Tribe Voriini							
Campylocheta sp. MO2	1	0	**1**	x			
Campylocheta plathypenae (Sabrosky)	0	4	**4**	x		x	
Campylocheta semiothisae (Brooks)	2	0	**2**	x			
Chaetonopsis spinosa (Coquillett)	2	0	**2**	x			
Chaetoplagia atripennis Coquillett	3	1	**4**	x			
Periscepsia sp. MO1	2	1	**3**	x			
Spathidexia sp. MO1	0	1	**1**	x			
Thelaira americana Brooks	2	1	**3**	x	x		
Voria ruralis (Fallén) complex	0	2	**2**		x	x	
SUBFAMILY EXORISTINAE							
Tribe Acemyini							
Ceracia dentata (Coquillett)	**1**	**0**	**1**	**x**			
Tribe Blondeliini							
Admontia sp. MO1	1	0	**1**	x			
Anisia nr. *gilvipes* (Coquillett)	7	4	**11**	x			
Anisia optata (Reinhard)	4	7	**11**	x	x		
Anisia serotina (Reinhard)	6	5	**11**	x		x	x

Species	M	F	**Total**	BS-T	BS-H	Bear	AR
Anisia nr. *optata* (Reinhard)	3	0	**3**	x			
Anoxynops aldrichi (Curran)	1	0	**1**		x		
Blondelia hyphantriae (Tothill)	1	0	**1**			x	
Blondelia sp. nr. *polita* (Townsend)	1	7	**8**	x	x		
Blondelia sp. *MO2*	0	2	**2**	x			
Celatoria diabroticae (Shimer)	10	1	**11**	x			x
Celatoria n. sp.	0	1	**1**	x			
Chaetonodexodes vanderwulpi (Townsend)	0	2	**2**	x			
Cryptomeigenia demylus (Walker)	0	1	**1**				x
Cryptomeigenia dubia Curran	0	1	**1**		x		
Eucelatoria dimmocki (Aldrich) grp.	0	7	**7**	x		x	x
Euhalidaya genalis (Coquillett)	5	7	**12**		x	x	
Lixophaga cf. *diatraeae (Townsend)*	1	0	**1**		x		
Lixophaga fasciata Curran	0	1	**1**			x	
Lixophaga mediocris Aldrich	0	4	**4**	x			
Lixophaga sp. MO3	0	1	**1**	x			
Lixophaga variabilis (Coquillett)	2	2	**4**	x	x		
Medina barbata (Coq.)/*quinteri* (Tnsd.)	1	6	**7**	x	x	x	
Medina sp. MO2	1	0	**1**	x			
Myiopharus ancilla (Walker)	1	1	**2**	x			x
Myiopharus cf. *dorsalis* (Coquillett)	0	3	**3**	x			
Myiopharus doryphorae (Riley)	1	2	**3**	x	x		
Myiopharus sp. MO3	0	1	**1**			x	
Myiopharus nr. *aberrans* (Tnsd.)/*sedulus* (Rnh.)	0	2	**1**	x			x
Myiopharus nr. *americanus* (Bigot)	0	1	**1**	x			
Myiopharus sp. MO5	0	1	**1**	x			
Myiopharus nr. *infernalis* (Townsend)	26	33	**59**	x	x	x	
Opsomeigenia (cf.) sp. MO1	0	1	**1**			x	
Oswaldia conica (Reinhard)	1	7	**8**	x	x		
Thelairodoria setinervis (Coquillett)	0	1	**1**	x			
Vibrissina cf. *leibyi* (Townsend)	0	3	**3**	x			
Vibrissina nr. *aurifrons* (Curran)	0	1	**1**				x
Tribe Eryciini							
Aplomya theclarum (Scudder) complex	32	2	**34**	x	x	x	
Aplomya theclarum (Scudder) complex sp. 2	4	1	**5**	x		x	
Aplomya theclarum (Scudder) complex sp. 3	0	1	**1**	x			
Carcelia cf. *yalensis* Sellers	1	0	**1**		x		
Carcelia formosa (Aldrich & Webber)	2	1	**3**	x			
Carcelia inflatipalpis (Aldrich & Webber)	1	2	**3**	x		x	
Carcelia n. sp.	1	2	**3**	x			
Drino bakeri (Coquillett)	1	2	**3**	x		x	x
Drino sp. MO2 (cf. *incompta* (van der Wulp))	3	0	**3**			x	
Drino sp. MO4	0	1	**1**	x			
Eunemorilla alearis (Reinhard)	2	0	**2**	x			

Species	M	F	**Total**	BS-T	BS-H	Bear	AR
Lespesia aletiae (Riley) sp. MO1	2	11	**13**	x	x	x	x
Lespesia aletiae (Riley) sp. MO2	2	10	**12**	x		x	x
Lespesia anisotae (Webber)/*datanarum* (Tnsd.)	2	2	**4**		x	x	
Lespesia cf. *pholi* (Webber)	0	1	**1**	x			
Lespesia cf. *sabroskyi* Beneway	0	1	**1**			x	
Lespesia nr. *aletiae* (Riley) sp. MO3	1	0	**1**	x			
Lespesia schizurae (Townsend)	1	1	**2**			x	
Phebellia curriei (Coquillett)	19	0	**19**	x			
Siphosturmia melampyga (Coquillett)	0	3	**3**		x	x	
Tribe Ethillini							
Neoethilla n. sp.	0	1	**1**	x			
Tribe Euthelairini							
Neomintho celeris (Townsend)	7	2	**9**	x		x	
Tribe Exoristini							
Chetogena sp. MO2	2	3	**5**			x	x
Chetogena scutellaris (van der Wulp)	3	2	**5**	x	x		x
Exorista cf. *dydas (Walker)*	0	1	**1**			x	
Gueriniopsis sp. MO1	1	1	**2**				x
Tachinomyia variata Curran	1	1	**2**	x			
Tribe Goniini							
Allophorocera celeris (Coquillett)	0	3	**3**	x			
Allophorocera sp. MO2	0	1	**1**	x			
Atacta brasiliensis Schiner	1	1	**2**	x			
Atacta crassiceps Aldrich	0	1	**1**			x	
Belvosia bifasciata (Fabricius)	4	2	**6**	x		x	x
Belvosia borealis Aldrich	7	0	**7**	x		x	
Belvosia unifasciata (Robineau-Desvoidy)	12	1	**13**	x	x		x
Blepharipa fimbriata (van der Wulp)	3	1	**4**	x	x	x	x
Euceromasia spinosa Townsend or sp. nr.	3	2	**5**	x	x		x
Eumea caesar (Aldrich)	2	8	**10**	x		x	x
Gonia sp. MO1	1	0	**1**		x		
Houghia coccidella (Townsend)	0	1	**1**	x			
Houghia setipennis Coquillett	2	3	**5**	x	x		x
Hypertrophomma opacum Townsend	1	0	**1**			x	
Hyphantrophaga cf. *euchaetiae* (Sellers)	3	1	**4**	x		x	
Hyphantrophaga sp. MO2	0	3	**3**				x
Hyphantrophaga sp. nr. *virilis* (Ald. & Web.)	0	1	**1**				x
Hyphantrophaga virilis (Ald. & Web.) complex	1	6	**7**	x		x	x
Leschenaultia reinhardi Toma & Guimarães	0	2	**1**			x	x
Leschenaultia nr. *reinhardi* Toma & Guimarães	0	1	**1**			x	
Spallanzania hesperidum (Williston)	0	1	**1**		x		
Tribe Masiphyini							
Masiphya confusa Aldrich	21	2	**23**	x	x	x	

Species	M	F	**Total**	BS-T	BS-H	Bear	AR
Tribe Winthemiini							
Hemisturmia parva (Bigot)	0	1	**1**	x			
Nemorilla cf. *insolens* Aldrich & Webber	0	1	**1**			x	
Winthemia nr. *rufopicta* (Bigot)	0	1	**1**			x	
Winthemia nr. *rufopicta* (Bigot) sp. 2	1	1	**2**	x		x	
Winthemia rufopicta (Bigot)	65	33	**98**	x	x	x	x
Winthemia sinuata Reinhard complex sp. 1	9	0	**9**			x	x
Winthemia sinuata Reinhard complex sp. 2	8	0	**8**	x	x		
Winthemia nr. *sinuata* Reinhard	2	4	**6**	x		x	x
Winthemia sp. MO3	0	1	**1**				x
Winthemia sp. MO4	0	1	**1**				x
Winthemia sp. MO5	0	2	**2**	x		x	
SUBFAMILY PHASIINAE							
Tribe Cylindromyiini							
Cylindromyia binotata (Bigot)	49	28	**77**	x	x	x	x
Cylindromyia fumipennis (Bigot)	0	1	**1**	x			
Cylindromyia propusilla Sabrosky & Arnaud	14	10	**24**	x	x	x	x
Hemyda aurata (Robineau-Desvoidy)	1	1	**2**	x	x		
Tribe Gymnosomatini							
Gymnoclytia immaculata (Macquart)	2	3	**5**	x	x	x	
Gymnoclytia occidua (Walker)	14	3	**17**	x			x
Gymnoclytia unicolor (Brooks)	1	0	**1**	x			
Gymnosoma par Walker	1	1	**2**	x	x		
Trichopoda lanipes (Fabricius)	1	1	**2**				x
Trichopoda pennipes (Fabricius)	8	3	**11**	x			x
Xanthomelanodes arcuatus (Say)	4	2	**6**	x	x		x
Tribe Phasiini							
Phasia aeneoventris (Williston)	0	3	**3**	x			x
Phasia purpurascens (Townsend)	0	1	**1**		x		
Tribe Strongygastrini							
Strongygaster triangulifera (Loew)	3	3	**6**	x			x
SUBFAMILY TACHININAE							
Tribe Graphogastrini							
Phytomyptera melissopodis (Coquillett)	1	8	**9**	x	x	x	
Phytomyptera sp. MO1	1	1	**2**			x	
Phytomyptera sp. MO3	0	1	**1**	x			
Tribe Leskiini							
Clausicella geniculata (Townsend)	0	1	**1**	x			
Clausicella nr. *opaca* (Coquillett)	0	1	**1**	x			
Clausicella setigera (Coquillett)	1	0	**1**	x			
Clausicella turmalis (Reinhard)	0	2	**2**	x			
Genea aurea James	0	3	**3**	x			

Species	M	F	**Total**	BS-T	BS-H	Bear	AR
Genea brevirostris (James) or nr.	0	1	**1**	x			
Genea pavonacea (Reinhard)	1	5	**6**	x		x	
Ginglymia nr. *acrirostris* (Townsend)	12	10	**22**	x	x	x	x
Tribe Megaprosopini							
Microphthalma disjuncta (Wiedemann)	1	0	**1**	x			
Tribe Minthoini							
Paradidyma affinis Reinhard	0	2	**2**	x			
Paradidyma cf. *apicalis* Reinhard	1	0	**1**		x		
Paradidyma sp. MO2	0	1	**1**	x			
Paradidyma petiolata Reinhard	5	3	**8**	x			
Paradidyma singularis (Townsend) complex	6	29	**35**	x	x		x
Tribe Polideini							
Chromatocera cf. *setigena* (Coquillett)	0	1	**1**	x			
Chrysotachina alcedo (Loew)	1	1	**2**		x	x	
Euscopolia dakotensis Townsend	0	1	**1**				x
Tribe Siphonini							
Ceromya americana (Townsend)	5	2	**7**	x			
Ceromya n. sp.	1	0	**1**	x			
Siphona (unknown subgenus) sp. MO1	0	1		1	x		
Siphona illinoiensis Townsend	48	17	**65**	x			x
Tribe Tachinini							
Archytas apicifer (Walker)	16	8	**24**	x	x	x	x
Archytas metallicus (Robineau-Desvoidy)	1	0	**1**				x
Archytas nr. *instabilis* Curran	23	20	**43**	x	x	x	x
Copecrypta ruficauda (van der Wulp)	38	12	**50**	x	x	x	x
Deopalpus nr. *torosus* (Reinhard)	3	0	**3**	x	x		
Juriniopsis adusta (van der Wulp)	0	1	**1**				x
Peleteria sp. MO1	6	0	**6**	x			
Totals	**626**	**465**	**1091**				