Mammoth Cave Research Symposia

10th Research Symposium 2013

Feb 14th, 2:50 PM

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Abstract
The order Trichoptera is an ecologically-important, diverse group of insects. We investigated the relative abundance and occurrence of these insects at Mammoth Cave National Park (MCNP). We focused our efforts on adults captured at blacklight traps placed across four forest habitats in MCNP on 14 nights during 2010-2011. Large-bodied Trichoptera (≥ 10 mm in length) were identified and enumerated, yielding 2,153 specimens of ≥ 45 species and 11 families. Unique captures were recorded at mixed deciduous-dominated, mixed conifer-dominated, and upland deciduous sites (13, 4, and 3 species, respectively). While composition of the assemblage varied across collection sites, as well as seasonally, members of the Hydropsychidae (*Hydropsyche* spp.) and Leptoceridae (*Ceraclea* spp.) were the most abundant groups. These two families constituted 93% of total abundance and 65% of species richness across all samples. In this study we detail abundance and richness patterns of Trichoptera across a forest landscape and examine habitats for which data are lacking.

Introduction
The order Trichoptera (caddisflies) is an ecologically-important, diverse group of insects that are widely distributed across North America (Morse 1993). The aquatic larvae of this order occupy a variety of lentic and lotic habitats and ecological niches and are frequently used by regulatory agencies as water quality indicators. The ecological and practical importance of the terrestrial, short-lived adults (<1 month lifespan) is less well known, but adult Trichoptera do serve as prey for vertebrates such as bats and birds. (Floyd et al. 2012). These factors underscore the importance of diversity assessments for this group in eastern North America, where fragmentation and human impacts on forest habitats are central concerns to land managers and conservationists (Yahner 2000). Consequently, diversity assessments for this and other conspicuous insect taxa are a valuable tool for stewards in establishing diversity benchmarks for management plans (Summerville et al. 1999, Floyd et al. 2012). Bearing this in mind, we sought to identify seasonal patterns of adult Trichoptera, and to document specific habitat affiliations for the species assemblage at Mammoth Cave National Park (MCNP).

Methods
Mammoth Cave National Park encompasses 23,000 ha in Barren, Hart, and Edmonson counties on the edge of the Crawford-Mammoth Cave Uplands of the Interior Plateau of Kentucky (Woods et al. 2002). Our survey efforts took place across an array of upland habitats and, to a lesser extent, along the floodplain of the Green River. Survey sites had been selected previously as part of a larger study investigating the impacts of prescribed fire and forest structure on bat and insect populations at MCNP. Specimens were collected across multiple sites in a given night (≥ 50 m apart) using 10 W blacklight traps (Universal Light Trap, Bioquip Products, Gardena, CA). As per

recommendations by Yela and Holyoak (1997) for sampling Lepidoptera, survey nights were fair with temperatures ≥ 16° C at sunset, no precipitation, and low wind. Blacklight traps were suspended 2.5 m above ground prior to dusk and operated throughout the entire night. A dichlorvos-based 'pest strip' (ca. 2×6-cm) was placed within each blacklight trap to subdue specimens. Following a survey night, Trichoptera ≥ 10 mm in length were isolated from the other insects captured and stored in 70% ethanol for later identification in the laboratory. Specimens were enumerated and identified to species level when possible (some female specimens and others of poor quality were left at genus or family). The abdomen of some specimens was removed and cleared in 10% KOH prior to examination to facilitate identification (Floyd et al. 2012). Specimens were identified using morphological characteristics and by making comparisons to existing data from the region (Floyd et al. 2012). Specimens were deposited with MCNP. Records were compiled, with forest habitats noted where specimens were collected. Delineation of habitats followed the Kentucky State Nature Preserves Commission's classification system, as defined in MCNP's Fire Management Plan (NPS 2012). Surveyed habitats included: mixed coniferous-dominant / deciduous forest, mixed deciduous-dominant / coniferous forest, mesic floodplain deciduous forest, and mesic deciduous upland forest.

Results

We examined and identified a total of 2,153 Trichoptera, representing ≥ 45 species and 11 families (Table 1). These totals originated from 14 of 22 survey nights from August 2010 – September 2011 (n = 57 of 169 trap-nights). The most specimens were captured at mixed deciduous-dominant / coniferous sites (n = 1,145, from 16 trap-nights), followed by mixed coniferous-dominant / deciduous sites (n = 632, from 21 trap-nights). Fewer specimens were captured at mesic deciduous upland sites (n = 262, from 18 trap-nights) and mesic floodplain deciduous sites (n = 114, from 2 trap-nights). Hydropsychidae was the most cosmopolitan family, with *Cheumatopsyche pasella* Ross, *Hydropsyche alvata* Denning, and *Hydropsyche simulans* Ross recorded across all habitats. Leptocerid species, *Oecetis inconspicua* (Walker) and *Oecetis persimilis* (Banks), were also recorded across all habitats. Other taxa were more variable, and many records were unique to single habitats. Mixed deciduous-dominant / coniferous sites had the highest number of unique records (n = 13), primarily for leptocerids and hydropsychids (6 and 3 species, respectively). Mixed coniferous-dominant / deciduous sites also had unique records. These included singletons from four families: Leptoceridae (*Triaenodes tardus* Milne), Hydroptilidae, Philopotamidae (*Chimarra aterrima* Hagen), and Rhyacophilidae (*Rhyacophila parantra* Ross). Upland deciduous sites likewise had unique records; these included a lepidostomatid [*Lepidostoma griseum* (Banks)] and two limnephilids [*Pseudostenophylax uniformis* (Betten), and *Pycnopsyche guttifer* (Walker)]. No unique records were found in our sampling of mesic floodplain sites. This was likely attributable to the small number of trap-nights (n = 2). In terms of assemblage richness, leptocerids and hydropsychids dominated records from our surveys (Figure 1). While these two families formed > 65% of the species identified across all months, richness patterns for other families were variable across surveys. We found three families to be most abundant (Figure 2). Hydropsychidae and Leptoceridae dominated our records; these families formed 93% of the total specimens. Phryganeids were less abundant (4% of total specimens), but became prominent in the latter portion of the growing season. Two genera were most abundant in our surveys (Figure 3). A low incidence of

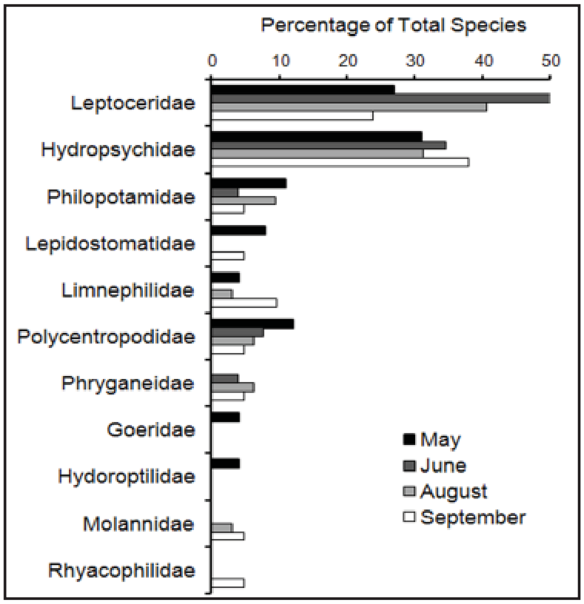

Figure 1: Percent composition of trichopteran families captured in blacklight traps from Mammoth Cave National Park, 2010-2011.

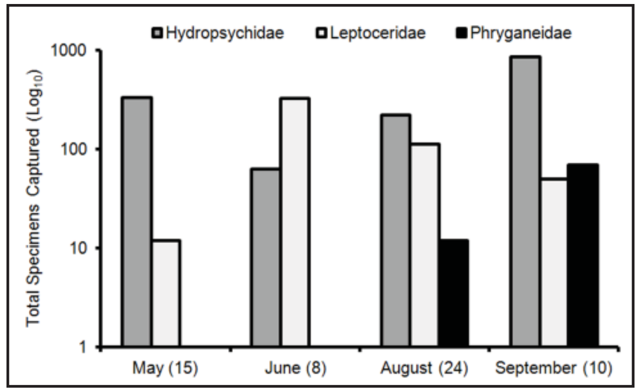

Figure 2: Abundance trends across months for major families of Trichoptera captured in blacklight traps at Mammoth Cave National Park, 2010-2011. Numbers of trap-nights for months are in parentheses.

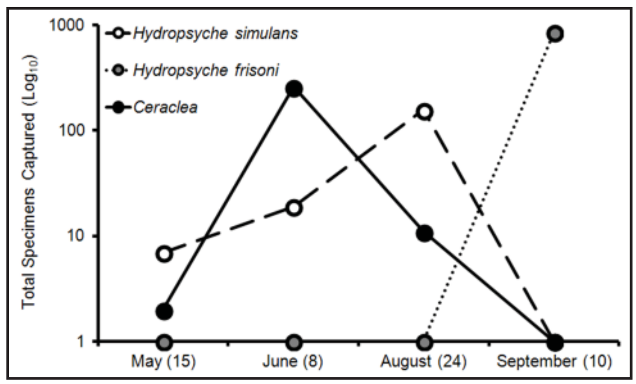

Figure 3: Abundance trends across months for major taxa of Trichoptera captured in blacklight traps at Mammoth Cave National Park, 2010-2011. Numbers of trap-nights for months are in parentheses.

Ceraclea spp. (Leptoceridae) was generally observed, but 252 specimens were captured at a mixed deciduous-dominant / coniferous site on 29 June 2011. The majority (n = 87) of these specimens that could be identified to species level were *Ceraclea flava* (Banks). Single specimens were also identified as *Ceraclea enodis* Whitlock and Morse and *Ceraclea maculata* (Banks) on that night. *Hydropsyche* species were variable in their occurrence across surveys. *Hydropsyche simulans* Ross was the most commonly captured species during May and June (albeit at low levels) and peaked in abundance during August. In contrast, Hydropsyche frisoni Ross was extremely abundant in multiple (n = 8) traps on 6 September 2010.

Discussion

This study increases our understanding of what invertebrate fauna are specific to MCNP over the growing season and also demonstrates that adult Trichoptera may occupy terrestrial habitats located away from aquatic environments. The relative richness of Leptoceridae peaked during the middle of the growing season while richness of Hydropsychidae remained more constant across our surveys. Less common families were either limited in their capture period or, as in the case of Phryganeidae, were dramatically more abundant during certain months (late summer to fall). Collectively, these data demonstrate shifts in the richness and abundance of taxa within the assemblage across a forest landscape. These seasonal records will facilitate targeted collection efforts in the future for specific taxa within the region.

While adult Trichoptera are typically most abundant near aquatic habitats (Petersen et al. 2004), broad terrestrial movement of these and other semi-aquatic insects is an integral component of their ecology that merits further study (Briers and Gee 2004, Didham et al. 2012). In most cases (n = 51 of 57 trap-nights) our surveys were conducted >100 m away from permanent water sources and riparian habitats, where larvae are found and where sampling for terrestrial adults typically takes place (Floyd et al. 2012). In this way, our study has also provided a unique survey of terrestrial habitats at MCNP and it has demonstrated that adult Trichoptera can be abundant in terrestrial ecosystems away from permanent water sources.

Acknowledgements
The authors thank T. Culbertson, K. Rose, and J. Winters for technical assistance. This research was supported by monies from the Joint Fire Sciences Program. The information reported in this paper (No. 13-09-009) is part of a project of the Kentucky Agricultural Experiment Station and is published with the approval of the Director.

Literature Cited

Briars, R.A., and J.H.R. Gee. 2004. Riparian forest management and adult stream insects. Hydrology and Earth Sciences 8: 545-549.

Didham, R.K., T.J. Blakely, R.M. Ewers, T.R. Hitchings, J.B. Ward, and M.J. Winterbourn. 2012. Horizontal and vertical structuring of the dispersal of adult aquatic insects in a fragmented landscape. Fundamental and Applied Limnology 180: 27-40.

Floyd, M.A., J.K. Moulton, G.A. Schuster, C.R. Parker, and J. Robinson. 2012. An annotated checklist of the caddisflies (Insecta: Trichoptera) of Kentucky. Journal of the Kentucky Academy of Science 73: 4-40.

Morse, J.C. 1993. A checklist of the Trichoptera of North America, including Greenland and Mexico. Transactions of the American Entomological Society 119: 47-93.

National Parks Service. Accessed 2012. Mammoth Cave National Park Fire Management Plan: December 2001. http://www.nps.gov/maca/parkmgmt/firemanagement.htm

Petersen, I., Z. Masters, A.G. Hildrew, and S.J. Ormerod. 2004. Dispersal of adult aquatic insects in catchments of differing land use. Journal of Applied Ecology 41: 934-950.

Summerville, K.S., J.J. Jacquot, and R.F. Stander. 1999. A preliminary checklist of moths in Butler County, Ohio. Ohio Journal of Science 99:66-76.

Woods, A.J., J.M. Omernik, W.H. Martin, G.J. Pond, W.M. Andrews, S.M. Call, J.A. Comstock, and D.D. Taylor. 2002. Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs). US Geological Survey, Reston, Virginia.

Yahner, R.H. 2000. Eastern deciduous forest: Ecology and wildlife conservation, Second Edition. University of Minnesota Press, Minneapolis, Minnesota. 295 pp.

Yela, J.L., and M. Holyoak. 1997. Effects of moonlight and meteorological factors on light and bait trap catches of noctuid moths. Environmental Entomology 2: 1283-1290.

Table 1: A checklist of Trichoptera collected in blacklight traps at Mammoth Cave National Park, 2010-2011. Records are stratified across months, with habitats reported where species were captured: mixed coniferous-dominant / deciduous forest (CD), mixed deciduous-dominant / coniferous forest (DC), mesic floodplain deciduous forest (F), and mesic deciduous upland forest (U). Taxa represented by a single specimen are denoted by an asterisk. Species representing new county records (following details of Floyd et al. 2012) are denoted by "†".

Taxon	May	June	August	September
GOERIDAE				
Goera stylata Ross	CD, U			
HYDROPSYCHIDAE				
Ceratopsyche / Hydropsyche sp.		DC	CD, U	
Cheumatopsyche sp.	CD, DC, F, U	DC		
Cheumatopsyche analis (Banks)	CD, DC,	DC		CD
Cheumatopsyche campyla Ross	CD, DC,		CD, DC	CD
Cheumatopsyche pasella Ross	CD, DC, F, U	DC, U		CD, DC
Diplectrona modesta Banks		CD, U	CD	U
Hydropsyche aerata Ross*†				DC
Hydropsyche alvata Denning	F	CD, DC, U	CD, DC	DC
Hydropsyche betteni Ross			CD	U
Hydropsyche frisoni Ross			DC	CD, DC, U
Hydropsyche orris Ross*	DC			
Hydropsyche phalerata Hagen*			DC	
Hydropsyche rossi Flint, Voshell, & Parker†		CD, U	DC	
Hydropsyche simulans Ross	CD, DC, F	CD, DC	CD, DC, U	
HYDROPTILIDAE				
Hydroptilid sp. *	CD			
LEPIDOSTOMATIDAE				
Lepidostoma sp.	F, U			
Lepidostoma griseum (Banks)* †				U
Lepidostoma togatum (Hagen)	CD, U			
LEPTOCERIDAE				
Ceraclea sp.	DC, U	DC	DC	
Ceraclea enodis Whitlock & Morse		DC	CD, DC	
Ceraclea flava (Banks)		CD, DC, U		
Ceraclea maculata (Banks)*		DC		
Ceraclea transversa (Hagen)*			DC	
Leptocerus americanus (Banks)*	DC			

Table 1: Continued

Taxon	May	June	August	September
Nectopsyche sp.		DC	DC	
Nectopsyche exquisita (Walker)*		DC		
Nectopsyche pavida (Hagen)*		DC		
Oecetis avara (Banks)* †			DC	
Oecetis cinerascens (Hagen)			DC	CD, U
Oecetis ditissa Ross			CD, DC, U	CD, DC, U
Oecetis inconspicua (Walker)	CD, DC, U	DC, U	CD, DC, U	CD, DC, U
Oecetis nocturna Ross			CD, DC, U	CD, DC, U
Oecetis persimilis (Banks)	F	U	CD, DC	CD, DC
Setodes incertus (Walker)		DC	CD, DC	
Triaenodes sp.	DC	U	CD, DC	
Triaenodes tardus Milne*	CD			
LIMNEPHILIDAE				
Pseudostenophylax uniformis (Betten) †	U			
Pycnopsyche antica (Walker)			CD	U
Pycnopsyche guttifer (Walker)				U
MOLANNIDAE				
Molanna blenda Sibley			CD	CD, U
PHILOPOTAMIDAE				
Chimarra sp.	DC, U	U	DC, U	
Chimarra aterrima Hagen*				CD
Chimarra obscura (Walker)	U		DC, U	
Dolophilodes distincta (Walker)	F		U	
PHRYGANEIDAE				
Agrypnia vestita (Walker)		U	CD, U	CD, DC, U
Phryganea sayi Milne			CD, DC, U	
POLYCENTROPODIDAE				
Polycentropodid sp.	U	DC, U	CD, U	
Polycentropus centralis Banks	U		DC	CD
Polycentropus cinereus Hagen*		DC		
Polycentropus crassicornis Walker*	DC			
RHYACOPHILIDAE				
Rhyacophila parantra Ross*				CD