

## Bot Fly (Cuterebrid) Prevalence and Intensity in Southern Illinois *Peromyscus* Species and a Comparison to the Literature

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### ABSTRACT

Cuterebrid are parasitic organisms on small mammals in North America. While infections are believed to be common, little has been published regarding the population dynamics of these insects. This study was conducted on the impact of a cuterebrid species on *Peromyscus* spp. in upland hardwood forests in southern Illinois. Data were recorded and compiled to determine the species of cuterebrid present, the prevalence and intensity of infection, and possible causes for such a high infection rate. Infected individuals were trapped during late summer for three weeks. The species of cuterebrid was determined to be *Cuterebra fontinella* due to the seasonality of infection (late summer), location of infection (inguinal or genital region) within the host, and the species of host (*Peromyscus* spp.). Intensity was within the range of historical averages; however, prevalence was greater in this study than in previous similar studies. Though the exact cause is unknown, it is possible that an abnormally wet summer caused an increase in egg survivability before the peak infection season, leading to an increase in infection rates later in the year.

**Key words:** central hardwood region, *Cuterebra fontinella*, *Peromyscus*, parasitic organism

### INTRODUCTION

Bot flies are a group of parasitic insects found in wild mammals. These parasitic flies are included in the Cuterebridae (Sabrosky 1986) or the Cuterebrinae subfamily of the Oestridae (Wood 1987; Pape 2001). There are over 30 *Cuterebra* species that have evolved to be host-specific obligate parasites (Sabrosky 1986; Wood 1987). Each of these species typically parasitizes only one or just a few species of two separate groups: (1) New World rodents, which include mice, rats, chipmunks, tree squirrels, and voles; and (2) lagomorphs which are comprised of rabbits and hares (Slansky 2007). Once infected, some studies have reported that the host individuals are well adapted and have no negative side effects, while other studies cite a need for further research on the impacts of these parasitic insects (Jaffe et al. 2005, Cramer and Cameron 2006)

Previous studies have indicated that prevalence (percentage of individuals infected) varies depending on the species of bot fly (Margolis et al. 1982). However, intensity (number of parasites per individual host) is not as commonly reported. The objective of this study was to document the prevalence and intensity of bot fly infection on *Peromyscus* spp. in southern Illinois upland hardwood forests.

### METHODS

Six forested sites were established at Touch

of Nature Environmental Center (UTM: 16S 308552, 4167338) in Jackson County in southern Illinois. Study site elevation ranged from 150-180 m and the soils were primarily well-drained, silty, alfisols. Average winter temperatures in the study area range from -6.7 to -1.1 °C and summer temperatures from 15 to 27 °C. Average annual precipitation is 122 cm per year. Each of the forested sites consisted of a 0.5 ha area within which a trapping web was established

The results of this study are part of a larger two-year project. Data is only presented for the trapping period from between July 23 and August 9, 2013. This is the only period when cuterebrid larvae were observed and during this time each of the six sites was trapped once. Each site had fifty Sherman live traps (H. B. Sherman Traps, Tallahassee, FL; 7.5 x 9.0 x 23.0 cm) that were arranged in a trapping-web design. Trapping webs consisted of 12 transects that were 40 m in length, all extending from a central point in 30° increments. Traps were set along each transect at 10, 20, 30, and 40 m. Two additional traps were placed in the center of the web, resulting in 50 traps per web. For bait, birdseed was placed inside each trap. All trapping efforts met the Southern Illinois University Institutional Animal Care and Use Committee protocol standards. Trapping was conducted daily each morning, from Tuesday until Friday.

All trapped individuals were examined

for the presence of cuterebrid larvae and the intensity of infection within the host. Toe-clipping was used to identify individuals over the trapping period. Once all observations had been recorded and the specimen had been marked for recapture, the specimen was released in the same location that they were captured.

### RESULTS

A total of 91 *Peromyscus* spp. individuals were caught throughout the three weeks of trapping. Among all six sites, average prevalence was 71.55% and average intensity was 1.49 bot flies per individual host. Bot flies can be identified to species by determining their preferred host, infection area on the host's body, and the seasonal occurrence of the myiasis. During this study, cuterebrid larvae were only found in hosts during the July 23-August 9 trapping period. Unfortunately, previous trapping in the area had concluded on June 14 and therefore we are unable to pinpoint the specific time when the bot fly infections began. A high percentage of individuals were still infected at the end of the trapping season but no more trapping was conducted making the range of seasonal infection hard to determine. The preferred hosts of the suspected species of *Cuterebra* are *Peromyscus maniculatus* and *Peromyscus leucopus*. All the infected individuals caught had one or more bot flies in the inguinal area, near the genitals. No other locations on the host's body were

witnessed. With this information we determined that the species of *Cuterebra* being encountered was most likely *Cuterebra fontinella*. *Peromyscus leucopus* and *P. maniculatus* are hosts of *C. fontinella* (Catts 1982; Cogley 1991). Typically the larval stage of this parasitic species develops near the inguinal area, as well as the rump (Catts 1982; Cogley 1991). It also has a seasonal occurrence of myiasis during the months of August through October which coincides with the dates that our infected individuals were caught (Hensley 1976; Catts 1982).

**DISCUSSION**

Multiple studies have examined at bot fly infection rates in *P. leucopus* and *P. maniculatus* throughout North America (Table 1). The reported prevalence from this study is considerably higher than almost all other bot fly field studies (Table 1). Wecker (1962), who conducted a small mammal trapping study in an oak-hickory forest in Michigan, had the closest prevalence values, ranging from 14.1-65.9%. Our values ranged from 50-82% which is considerably higher. Jaffe et al. (2005) reported prevalence over a 20 year trapping study in Pennsylvania. Overall, mean prevalence was 6.95% in *P. maniculatus*, 9.09% in *P. leucopus*. Prevalence peaked during the late summer and early fall season but was less than 50% for *P. maniculatus* and 60% for *P. leucopus*.

It is difficult to explain the higher prevalence rates observed in our study. Very little is known about the habitat preferences and associations of cuterebrid species, although seasonal and annual variations in prevalence have been reported (Jaffe et al 2005). It has been suggested that increased soil temperature during the months of April and May might have a positive effect on later populations (Sillman 1956). This is the time in which the cuterebrid eggs are within the soil and this may contribute to egg survivability (Dunaway et al. 1967). Another possible factor is the soil moisture during the months of high infestation, June through August (Layne 1963). We conducted a companion study in the previous year (2012) and small mammals were trapped within the same general area during the same time periods. During this time, no captures were witnessed to have a cuterebrid larvae present. Temperatures

**Table 1.** Comparisons of studies reporting prevalence (percent of infected individuals) for botfly infections in *Peromyscus leucopus* and *Peromyscus maniculatus*. Results of this study are shown in italics.

Location	Dates of Study	Sample Size	Prevalence (%)	Author
<i>Southern Illinois</i>	<i>July 2013 ‡</i>	<i>91</i>	<i>71.55</i>	<i>Hayes et al.</i>
Powdermill Biological Station, PA	1979 - 1998‡	1511*; 858*	6.95*; 9.09*	Jaffe et al., 2005
Ozarks, MO	Feb. 1961 - July 1962‡	661	0.3	Brown, 1965
Oak Ridge, TN	1958-1964	511 †	24.7 †	Dunaway et al., 1967
Ontario	Aug. - July 1958‡	66 †	31.8 †	Sealander, 1961
Ames, Iowa	1940	68 †	38.0 †	Dalmat, 1943
Massachusetts	1959‡	214 †	27.6 †	Abbott and Parsons, 1961
Michigan	May - Oct. 1958‡	72†	14.1-65.9 †	Wecker, 1962
Minnesota	Sept. 1956- Sept. 1958‡	1050 †	9.2 †	Timm and Cook, 1979
Central Illinois	July - Nov. 1997‡	551 †	8.9-24.3 †	Wolf and Batzli, 2000

\* *P. maniculatus* and *P. leucopus* numbers listed separately; † Only *P. leucopus* data included; ‡ Includes data only when bot flies present.

**Table 2.** Comparisons of studies reporting intensity (number of bots per host) for botfly infections in *Peromyscus leucopus* and *Peromyscus maniculatus*. Results of this study are shown in italics.

Location	Dates of Study	Sample Size	Intensity	Author
<i>Southern Illinois</i>	<i>July 2013</i>	<i>91</i>	<i>1.49</i>	<i>Hayes et al.</i>
Michigan	May-Oct. 1958	72	1.46†	Wecker, 1962
Minnesota	Sept. 1956-Sept. 1958	97	1.4†	Timm and Cook, 1979
Central Illinois	July-Nov. 1997	75	1.0-1.24†	Wolf and Batzil, 2000

† Only *P. leucopus* data included.

for May and April of 2012 were 2-3° higher than historical averages and precipitation for June-August was 5-9 cm lower compared to historical levels. In comparison, 2013 saw spring temperatures very close to historical ranges and higher precipitation levels. In June 2013 alone, southern Illinois received 17 cm of rainfall compared to the 11 cm historical averages. It is possible that moisture levels during the summer months may have increased *C. fontinella* populations later in the summer.

In the literature, intensity (number of bots per host) is often overlooked and rarely reported. However, some studies have made remarks on levels of intensity and our findings support these previous studies (Table 2). In our study intensity was 1.49 bots per host which is comparable to other studies, 1.40 bots per host (Wecker 1962) to 1.46 bots per host (Timm and Cook 1979). Wolf and Batzil (2000) reported slightly lower levels ranging from 1.00 and 1.24 bots per host in a hardwood forest in Illinois. All three studies used for comparison had similar sample sizes.

This study has provided evidence to support the possibility that increased summer

precipitation may increase populations of *C. fontinella* and the prevalence individuals on *Peromyscus* hosts. Further research is needed throughout the species range and among the different cuterebrid species to expand upon the effects of weather and host populations on cuterebrid population dynamics.

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