# Differential parasitism of *Peromyscus maniculatus* and *Peromyscus truei* by *Cuterebra* larvae

Jeffrey B. Llewellyn
*University of Nevada, Reno*

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# DIFFERENTIAL PARASITISM OF *PEROMYSCUS MANICULATUS* AND *PEROMYSCUS TRUEI* BY *CUTEREBRA* LARVAE

Jeffrey B. Llewellyn[1]

ABSTRACT.— During a 21-month field study of sympatric *Peromyscus maniculatus* (Deer Mouse) and *Peromyscus truei* (pinyon mouse), 12/152 (7.9 percent) *P. maniculatus* and 1/45 (2.2 percent) *P. truei* were parasitized by *Cuterebra* larvae. Both parasitized *P. maniculatus* and *P. truei* and nonparasitized *P. maniculatus* selected different habitats in the community. Differential parasitism of *P. maniculatus* and *P. truei* was possibly caused by host specificity of *Cuterebra*, whereas differential parasitism of *P. maniculatus* may have been due to habitat selection.

Cuterebrid flies are widely distributed in North and South America where their larvae are found embedded in the subcutaneous tissues of many rodents (chipmunks, deer mice, wood rats, etc.), rabbits, and sometimes cats, dogs, deer, cattle, humans, and other mammals (Sillman and Smith 1959, Catts 1965). They have also been found in birds (Artmann 1975). Frequently, certain species of *Peromyscus* (deer mice) harbor *Cuterebra* (botfly) larvae while other species of *Peromyscus* apparently do not. Why one species is parasitized, but a second closely related species is not parasatized, is not fully understood.

During a 21-month field study of sympatric *Peromyscus maniculatus* (deer mouse) and *Peromyscus truei* (pinyon mouse), differential parasitism of the two species by *Cuterebra* larvae was found. Whitaker (1968) suggested that differential parasitism of *Peromyscus* may be caused by a species not being in the right place under the proper conditions to be parasitized, or *Cuterebra* will not parasitize certain species. Previous field investigators have found a correlation between the habitat and parasitism of a species, and laboratory experiments have shown a strong degree of host specificity by *Cuterebra*. I suggest that these two factors caused certain *P. maniculatus*, but not *P. truei*, to be parasitized.

## MATERIALS AND METHODS

Sympatric populations of *P. maniculatus* and *P. truei* were monitored from April 1975 through December 1976 by live trapping in a permanent 1.4 hectare study plot at an elevation of 2025 meters. The study plot was located in the Geiger Grade portion of the Virginia Range, which is situated about 18 km SE of Reno, and 10 km NW of Virginia City, Nevada.

The Geiger Grade area consists of a pinyon-juniper woodland dominated by single-leaf pinyon (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*). Between the trees and in the larger open areas a total of 15–20 species of shrubs are found. The most common of these include low sagebrush (*Artemisia arbuscula*), snakeweed (*Gutierrezia sarothrae*), Mormon tea (*Ephedra viridis*), bitterbrush (*Purshia tridentata*), and big sagebrush (*Artemisia tridentata*). Numerous boulder piles and talus rock slides, in which *P. truei* are abundant, occur throughout the area (for a complete description of the area see Llewellyn 1977).

From 25 April 1975 to 21 October 1976, the study plot was sampled for three successive nights on a biweekly basis, using 140 Sherman live traps situated at 10 m intervals. Four additional nights of trapping were completed during a rainy period in August 1975; only one three-night sequence was completed in May 1976; and the last sequence in October 1976 consisted of four trap periods. In November and December of 1976, a five-night sequence was completed during the middle of each month. During the 21-month period, there was a

[1]Department of Biology, University of Nevada, Reno, Nevada 89557.

total of 129 trap periods and 18,060 trap nights.

The traps were baited with dry, rolled oats, provided with cotton for insulation during the colder months, and checked for captures in the early morning. All individuals captured were sexed, weighed, checked for reproductive condition, marked by toe-clipping, and released at the point of capture. Traps in which a capture was made were thoroughly washed and cleaned before being used again, and all traps were checked for proper working condition as they were being placed at the trap stations.

Because of the nature of the long-term study (Llewellyn 1977), no adult parasites were collected. Consequently, the species of *Cuterebra* was not identified.

## RESULTS

Totals of 152 *P. maniculatus* (73 females and 79 males) and 45 *P. truei* (17 females and 28 males) were captured during the 21-month period, and of these, 12 *P. maniculatus* (7.9 percent) and one *P. truei* (2.2 percent) were parasitized (Table 1). The in-

TABLE 1. Incidence of parasitism by *Cuterebra* larvae in *Peromyscus maniculatus* and *Peromyscus truei* from April 1975 through December 1976.*

| Months | Number of P. maniculatus captured | Number of P. truei captured |
|---|---|---|
| April 1975 | 25 (0) | 0 (0) |
| May | 42 (1) | 0 (0) |
| June | 24 (0) | 6 (0) |
| July | 27 (0) | 6 (0) |
| August | 19 (0) | 7 (0) |
| September | 12 (0) | 6 (0) |
| October | 15 (1) | 7 (0) |
| November | 8 (1) | 7 (0) |
| December | 5 (1) | 8 (0) |
| January 1976 | 6 (1) | 5 (0) |
| February | 13 (2) | 6 (0) |
| March | 9 (0) | 4 (0) |
| April | 5 (1) | 4 (0) |
| May | 4 (2) | 5 (1) |
| June | 5 (1) | 5 (1) |
| July | 6 (0) | 14 (0) |
| August | 3 (0) | 10 (0) |
| September | 9 (0) | 12 (0) |
| October | 5 (1) | 4 (0) |
| November | 3 (0) | 3 (0) |
| December | 7 (1) | 1 (0) |

*Numbers in parentheses represent parasitized individuals.

fected *P. truei* in May and June of 1976 represents the same individual (a male), and in both instances one larva was located on the lower left side of the back. The infected *P. maniculatus* in October and November of 1975 also represents the same individual. Of the 12 parasitized *P. maniculatus*, 8 were females and 4 were males, 9 individuals contained one larva, 2 contained 2 larvae, and one individual contained 3 larvae. Only one *P. maniculatus* was parasitized on more than one occasion.

Most workers have found the principal site of infestation in the inguinal or scrotal region (Whitaker 1968), although Seaman and Nash (1976) reported that 79.5 percent of the infestations in 87 *P. maniculatus* occurred in the rump region. In this study, all of the larvae were located on the back or on the sides. Most workers have also found that the most important period of infection was during the fall (Whitaker 1968), although Brown (1965) found a spring and a fall period in *P. boylii* (brush mouse), and Wecker (1962) and Hunter et al. (1972) found the highest percentages from July through October in *P. leucopus* (white-footed mouse) and *P. maniculatus*. In this study, parasitized individuals were generally found throughout the year, except from July through September of both years (Table 1).

## DISCUSSION

Blair (1941, 1942) found that rodents inhabiting forest environments were parasitized by *Cuterebra*, while rodents inhabiting grasslands or more open areas were not parasitized, and he suggested there possibly was a correlation between the habitat and parasitism of a species. In northern Michigan, Blair (1941, 1942) found that *P. maniculatus gracilis*, *Tamias striatus* (eastern chipmunk), and *Napaeozapus insignis* (woodland jumping mouse), all woodland species, were infested, but in southern Michigan *P. maniculatus bairdi*, a field form, was not infested, while *P. leucopus*, a woodland species, was heavily infested. Goertz (1966) also reports differential parasitism by *Cuterebra* in conjunction with differential habitat selection. Goertz (1966)

found that *P. leucopus* and *Neotoma flori-dana* (eastern woodrat), both associated with woodlands, had a high incidence of infestation, but plains and grassland rodents had exceptionally few parasites. Whitaker (1968) also reports differential parasitism of woodland *P. leucopus* and grassland *P. maniculatus bairdi*.

In this study, parasitized *P. maniculatus* and *P. truei* and nonparasitized *P. maniculatus* selected different habitats in the study plot. The mean distance to the nearest tree for the 140 trap stations was 1.51 m (some of the stations were located beneath trees, while others were up to and beyond 5 m). During the 21-month period *P. maniculatus* was captured at 122 stations, with a mean tree distance of 1.44 m, and avoided 18 stations with a mean tree distance of 1.99 m, while *P. truei* was captured at 82 stations with a mean tree distance of 0.86 m, and avoided 58 stations with a mean tree distance of 2.39 m. The mean tree distance for parasitized and nonparasitized *P. maniculatus* was 0.66 m and 1.53 m respectively ($p < 0.10$, Mann-Whitney and Student's T-Tests), while the mean tree distance of parasitized *P. maniculatus* and *P. truei* was not significantly different.

If differential habitat selection is a cause of differential parasitism by *Cuterebra*, then such factors as moisture, soil temperature, or vegetation may possibly be responsible. *Cuterebra* apparently lay their eggs on vegetation and not directly on the host (Baird 1974); after the larvae leave the host they burrow into the soil and pupate (Sillman and Smith 1959); and Layne (1963) found little or no infestation in *P. floridanus* (Florida mouse) in drier habitats.

Differential parasitism could also be caused by host specificity of *Cuterebra*. In a field study Seaman and Nash (1976) found that 87/633 *P. maniculatus* (13.7 percent) and 1/170 *P. difficilis* (0.6 percent) were infested with *Cuterebra* larvae. These findings are noteworthy because *P. difficilis* (rock mouse) and *P. truei* are classified in the same *Peromyscus* group (Hall and Kelson 1959), and the two species generally select the same type of habitats (Baker 1968). In a laboratory study Penner and Pocius (1956)

introduced larvae of *C. fontinella* (tentative identification) into 10 species of mammals, and development occurred in *Mus musculus* (house mouse), *Rattus rattus* (Black rat), *R. norvegicus* (Norway rat), and *P. leucopus*, but not in kittens, guinea pigs, wild and domestic rabbits, *Microtus pennsylvanicus* (meadow vole), *Sigmodon hispidus* (hispid cotton rat), and *P. maniculatus*. In another laboratory experiment Catts (1965) introduced larvae of *C. approximata* into *Cricetus auratus* (hamster), *Neotoma fuscipes* (dusky-footed woodrat), and the natural host *P. maniculatus*. *Neotoma fuscipes* proved to be refractory; 6.2 percent of the separate exposures in the hamsters resulted in positive infection; and 44 percent of the separate exposures in *P. maniculatus* resulted in positive infection. In a second experiment Catts (1965) introduced larvae of *C. latifrons* into nine species of rodents and one rabbit, and infection occurred in *Cr. auratus*, *R. rattus*, *M. musculus*, and the natural host *N. fuscipes*. However, only in *N. fuscipes* was the net production of fully developed larvae high (67 percent), as compared with 25 percent in *Cr. auratus*, 7 percent in *R. rattus*, and 0 percent in *M. musculus*, and Catts (1965) concluded that susceptibility to infection by *Cr. auratus*, *R. rattus*, and *M. musculus* does not necessarily confirm their suitability as a host. *Peromyscus maniculatus* was also infected with larvae of *C. latrifrons* in the same experiment, but appeared refractory.

I conclude that differential parasitism of *P. maniculatus* and *P. truei* was possibly caused by host specificity of *Cuterebra*, whereas differential parasitism of *P. maniculatus* may have been due to habitat selection. Apparently, *P. truei* and parasitized *P. maniculatus* were in the right place under the proper conditions to be infected, but only *P. maniculatus* was infected because of structural, physiological, or behavioral differences. Nonparasitized *P. maniculatus* evidently were not in the proper place.

This hypothesis is offered only as a tentative one, since more experimental evidence is needed before definite conclusions can be made.

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