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Author(s): Lance A. Durden and Nixon Wilson

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PARASITIC AND PHORETIC ARTHROPODS OF SYLVATIC AND COMMENSAL WHITE-FOOTED MICE (*PEROMYSCUS LEUCOPUS*) IN CENTRAL TENNESSEE, WITH NOTES ON LYME DISEASE

Lance A. Durden* and Nixon Wilson†
Department of Entomology, Museum Support Center, Smithsonian Institution, Washington, D.C. 20560

ABSTRACT: Sixteen species of parasitic or phoretic arthropods were collected from 56 white-footed mice, *Peromyscus leucopus,* live-trapped in central Tennessee from April through November 1987. Arthropod infestation was compared for mice taken from sylvatic (woodland) versus commensal (household) habitats. Three species were recorded from hosts in both habitats: the sucking louse *Hoplopleura hesperomydis,* the flea *Epitedia wenmanni,* and the laelapid mite *Androlaelaps casalis.* Twelve of the 13 remaining arthropod species were taken only from mice trapped in woodland whereas the phoretic glycyphagid mite *Glycyphagus hypudaei* was collected only from commensal mice. Arthropod faunas on commensal hosts clearly were impoverished. The 12 additional arthropod species recorded from the woodland mice consisted of 1 nidicolous beetle, *Leptinus orientamericanus*; 1 bot, *Cuterebra fontinella*; 3 fleas, *Ctenophthalmus pseudagyrtes, Orchopeas leucopus* and *Peromyscopsylla scotti*; 1 tick, *Dermacentor variabilis*; 2 mesostigmatid mites, *Androlaelaps fahrenholzi* and *Ornithonyssus bacoti*; 3 chiggers, *Comatacarus americanus, Euschoengastia peromysci,* and *Leptotrombidium peromysci*; and 1 undescribed pygmephorid mite of the genus *Pygmephorus.* Two nymphal and 100 larval *D. variabilis* were examined for spirochetes and found to be uninfected.

The white-footed mouse, *Peromyscus leucopus* (Rafinesque), has been implicated as the principal small mammal reservoir of the Lyme disease spirochete *Borrelia burgdorferi* Johnson, Schmid, Hyde, Steigerwalt, and Brenner in the northeastern and north-central United States (Burgdorfer and Keirans, 1983; Piesman, 1987). Similarly, *Ixodes dammini* Spielman, Clifford, Piesman and Corwin has been shown to be the main tick vector of this spirochetosis in these geographical regions. Ectoparasite surveys, particularly with respect to potential tick vectors of Lyme disease, have been fairly numerous within the 2 above-mentioned areas, but similar data for the southeastern United States, including Tennessee, are few. Although Lyme disease is being reported with increasing frequency in the southeastern United States, the sylvatic cycle has not been elucidated in this region. *Peromyscus* spp. (particularly *P. leucopus* and *Peromyscus gossypinus* (Le Conte)) and/or cotton rats (*Sigmodon hispidus* Say and Ord) are the most likely reservoir rodent hosts whereas the tick *Ixodes scapularis* Say is strongly suspected as the principal vector of Lyme disease in such areas (Burgdorfer and Keirans, 1983; Burgdorfer and Gage, 1987; Piesman, 1988; Piesman and Sinksky, 1988; Oliver, 1989).

This study was designed principally to document the ectoparasite fauna associated with *P. leucopus* in central Tennessee. Previously, the ticks *Dermacentor variabilis* (Say) and *Amblyomma americanum* (Linnaeus) (Zimmerman et al., 1987) and the fleas *Ctenophthalmus pseudagyrtes* Baker, *Epitedia wenmanni* (Rothschild), *Orchopeas leucopus* (Baker), *Peromyscopsylla hesperomys* (Baker), *Peromyscopsylla scotti* I. Fox, and *Stenoponia americana* (Baker) have been recorded (Pfitzer, 1950) as ectoparasites of *P. leucopus* in Tennessee.

Peromyscus leucopus often invades buildings and can be more common than house mice, *Mus musculus* Linnaeus, in such habitats. Therefore, the ectoparasite records that follow have been segregated with respect to sylvatic (trapped in woodland) versus commensal (trapped in households) hosts for purposes of comparison.

Simple investigations into spirochete presence or absence for samples of ticks that were removed from *P. leucopus* also are included.

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* Present address: Department of Arboviral Entomology, Virology Division, U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, Frederick, Maryland 21702-5011.

† Department of Biology, University of Northern Iowa, Cedar Falls, Iowa 50614.

MATERIALS AND METHODS

Adult *P. leucopus* were trapped in a deciduous woodland 24 km west of Nashville, Davidson County, Tennessee and in nearby houses from April through November 1987. Mice were collected using Sherman live-traps set once per week and baited with a combination of sunflower seeds, cracked corn, and peanut

butter. Captured mice were anesthetized with ether inside a stoppered jar and arthropods were collected from the jar and from the host by meticulous searching of the pelage aided by a low-power binocular microscope. Arthropods (except ticks examined for spirochetes) were stored in 70% ethanol until they could be cleared (in potassium hydroxide or lactophenol), slide-mounted (in Canada balsam or Hoyer's medium), and identified. Mice that survived anesthesia were ear-tagged for individual recognition and released at their capture sites; recaptured individuals were not processed for ectoparasites.

Guts were dissected from a sample of 100 larval (57 unengorged, 24 partially engorged, and 19 fully engorged individuals) and 2 nymphal (1 unengorged, 1 partially engorged) *D. variabilis*. These dissections were made in a drop of phosphate-buffered saline on alcohol-cleaned microscope slides. Wet mounts were examined microscopically for spirochetes under high-power dark-field illumination. An immunofluorescent antibody test was available for further testing of spirochete-positive gut dissections.

Voucher arthropods from this study are deposited as unstained slide mounts as follows: lice, fleas, and *Pygmephorus* sp. mite in the National Museum of Natural History (NMNH), Washington, D.C. (lice accessioned as ENT-A-3305 and fleas as ENT-A-3373); ticks in the U.S. National Tick Collection, % Institute of Arthropodology and Parasitology, Georgia Southern University, Statesboro (accessioned as RML 119,029 and RML 119,030); most other mites in the Florida State Collection of Arthropods, Gainesville.

RESULTS AND DISCUSSION

Table I lists the results for the 16 species of parasitic or phoretic arthropods that were collected from 56 *P. leucopus* processed during this survey.

Data on seasonal occurrence of the ectoparasites are sparse except for the tick *D. variabilis*. Ticks were present only in April and May (9 infested animals, mean intensity = 5.0) and again in August and September (8 infested animals, mean intensity = 21.5). The bot *Cuterebra fontinella* Clark was collected only in November and the chigger *Euschoengastia peromysci* (Ewing) was collected only in April and November; data for other arthropod species did not suggest clear phenologies.

Immature *D. variabilis* were the only ticks retrieved from *P. leucopus* in this study and none of those examined was positive visually for spirochetes; further testing with immunofluorescent antibodies was considered unnecessary. This result was anticipated because, although *B. burgdorferi* has been isolated from *D. variabilis* previously, this tick does not play a significant role in transmission of Lyme disease and probably is a poor vector (Oliver, 1989). In a tick survey of 37 *P. leucopus* in central Alabama, 13 larval *A. americanum* and 6 larvae and 1 nymph of the suspected Lyme disease vector *I. scapularis* were collected (Piesman and Sinksky, 1988). However, many previous studies have implicated *D. variabilis* as the principal tick ectoparasite of *P. leucopus*. This *P. leucopus–D. variabilis* association does little to clarify the Lyme disease picture for the southeastern United States and suggests that other hosts and ticks could be involved in the cycle.

In 2 previous studies of ticks associated with *P. leucopus* at Land Between the Lakes, Tennessee and Kentucky, contrasting results were obtained. Cooney and Burgdorfer (1974) did not find any ticks on 45 *P. leucopus* examined whereas Zimmerman et al. (1987) removed 172 immature *D. variabilis* and 1 immature *A. americanum* from 164 mice. On *P. leucopus* trapped in wooded habitats, Zimmerman et al. (1987) noted a prevalence of 36.5% for *D. variabilis*, which is somewhat lower than the 56.7% recorded for our study. Zimmerman et al. (1987) also recorded a lower mean intensity of *D. variabilis* than in this survey and noted a unimodal (March and April) *D. variabilis* larval infestation peak, in contrast to the clearly bimodal (April and May and August and September) trend apparent in this work. Seasonal bimodality for *D. variabilis* immatures on *P. leucopus* has been noted, however, in other surveys, e.g., Sonenshine et al. (1965) for Virginia, Jackson and DeFoliart (1975b) for Wisconsin, Smart and Caccamise (1988) for New Jersey, and Carroll et al. (1989) for Maryland. Nevertheless, the high infestation intensities reported here for the second annual (August and September) population peak of immature *D. variabilis* do not appear to have been recorded previously.

The sucking louse *Hoplopleura hesperomydis* (Osborn) was 1 of only 3 species of arthropods taken from *P. leucopus* in both woodland and household habitats. This louse is a well known ectoparasite of some species of *Peromyscus* (Whitaker, 1968) but has not previously been documented from Tennessee. *Leptinus orient-americanus* Peck is a nidicolous and phoretic beetle usually associated with shrews and moles; it has been recorded previously from eastern Tennessee, but the only other documented collections to date from *P. leucopus* or their nests are from the District of Columbia and Indiana (Peck, 1982). A bot was removed from the inguinal region of 2 male *P. leucopus*. These large

TABLE I. Parasitic and phoretic arthropods of 56 white-footed mice (*Peromyscus leucopus*) from woodland and household habitats in central Tennessee, 1987.

Arthropod species	Sylvatic hosts (15M, 15F*)	Commensal hosts (14M, 12F)
Anoplura		
Hoplopleura hesperomydis (5M, 12F, 5N*)	2.6 ± 1.8, 23.3%†	1.3 ± 0.5, 11.5%
Coleoptera		
Leptinus orientamericanus (1F)	1.0, 3.3%	–
Diptera		
Cuterebra fontinella (2L*)	1.0, 6.7%	–
Siphonaptera		
Ctenophthalmus pseudagyrtes (1F)	1.0, 3.3%	–
Epitedia wenmanni (2M, 3F)	1.0, 13.3%	1.0, 3.8%
Orchopeas leucopus (1M, 2F)	1.0, 10.0%	–
Peromyscopsylla scotti (1F)	1.0, 3.3%	–
Acari		
Dermacentor variabilis (213L, 4N)	12.8 ± 30.2, 56.7%	–
Androlaelaps casalis (3M, 27F, 4N)	2.2 ± 2.5, 33.3%	1.8 ± 1.2, 23.1%
Androlaelaps fahrenholzi (4F, 1N)	1.0, 16.7%	–
Ornithonyssus bacoti (1F, 2N)	1.0, 10.0%	–
Comatacarus americanus (1L)	1.0, 3.3%	–
Euschoengastia peromysci (49L)	16.3 ± 10.9, 10.0%	–
Leptotrombidium peromysci (155L)	12.9 ± 14.6, 40.0%	–
Glycyphagus hypudaei (4N)	–	1.0, 15.4%
Pygmephorus sp. (1F)	1.0, 3.3%	–

* M, males; F, females; N, nymphs; L, larvae.

† Mean intensity (±standard deviation, for species where variable numbers of specimens were recorded from different host individuals) and prevalence, respectively, following Margolis et al. (1982).

subdermal parasites are well known associates of *P. leucopus,* with numerous records from this host throughout the United States including Tennessee (Sabrosky, 1986).

All 4 species of fleas collected in this survey as well as an additional 2 species have been reported previously from *P. leucopus* in Tennessee (Pfitzer, 1950). Flea prevalences and intensities were unexpectedly low during this study. However, 1 species, *E. wenmanni,* was recorded from mice trapped in both woodland and household habitats. *Epitedia wenmanni, O. leucopus,* and *P. scotti* are characteristic parasites of *P. leucopus* whereas *C. pseudagyrtes* is a general rodent and insectivore flea with little apparent host specificity (Benton and Cerwonka, 1960; Holland and Benton, 1968; Whitaker, 1982).

Three species of mesostigmatid mites were retrieved from *P. leucopus. Androlaelaps casalis* (Berlese) has not previously been reported from *P. leucopus* (Whitaker, 1968, 1982; Whitaker and Wilson, 1974), although it was taken frequently in this survey and was collected from both woodland and household mice. The congeneric *Androlaelaps fahrenholzi* (Berlese) was less common in this study but has been collected previously from *P. leucopus* on numerous occasions (Drummond, 1957; Whitaker, 1968, 1982; Whitaker and Wilson, 1974; Jackson and DeFoliart, 1975a). *Ornithonyssus bacoti* (Hirst), the tropical rat mite, was an infrequent ectoparasite in this survey and was not recorded from mice trapped in households This may be important because *O. bacoti* readily bites humans if available and can cause tropical rat mite dermatitis. It is capable also of transmitting numerous pathogens under experimental conditions (Yunker, 1973).

All 3 species of chiggers reported here from *P. leucopus* were collected only from woodland mice. *Euschoengastia peromysci* and *Leptotrombidium peromysci* Vercammen-Grandjean and Langston are characteristic parasites of *P leucopus,* although the latter species has not been recorded from this host in some surveys (Drummond, 1957; Basolo and Funk, 1974; Whitaker, 1982). The single specimen of *Comatacarus americanus* Ewing represents the first record of this chigger from *P. leucopus* and from Tennessee.

The phoretic deutonymphs (hypopi) of the glycyphagid mite *Glycyphagus hypudaei* (Koch) were taken only from mice trapped in households. *Glycyphagus hypudaei* has been documented from a variety of North American mammals (mainly

rodents and shrews), with *P. leucopus* being 1 of its main hosts (Whitaker and Wilson, 1974). The present records are the first from Tennessee. The undescribed *Pygmephorus* sp. mite listed in Table I is the first record of this mite genus from *P. leucopus*.

The vast differences evident in Table I for the arthropod species recorded from *P. leucopus* trapped in woodland versus household habitats partly were anticipated. *Hoplopleura hesperomydis, E. wenmanni,* and *A. casalis* were the only 3 arthropod species recorded from mice in both habitats. The absence of ticks and chiggers from commensal mice is explained easily because these ectoparasites typically search for hosts from vegetation or soil. A similar situation holds for bot fly larvae because adult female flies normally attach their eggs to vegetation or directly onto the host (Sabrosky, 1986). Three species of fleas and 2 species of mesostigmatid mites were removed only from woodland hosts. It is speculated that this may be a consequence of drier conditions in commensal habitats. Many fleas (especially immature stages) and mites typically are more abundant in the host nest, so desiccation in commensal nidicolous habitats may have a profound influence on these arthropod populations (Furman, 1968; Stark and Kinney, 1969).

Because ticks are absent from commensal *P. leucopus* (with the possible exception of hosts that have recently entered buildings from outside), there should be little danger of tick-borne pathogen transmission in such locations.

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