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SHORT COMMUNICATION

SEASONAL VARIATION IN PARASITISM BY *LEPTUS* MITES (ACARI, ERYTHRAEIDAE) UPON THE HARVESTMAN, *LEIOBUNUM FORMOSUM* (OPILIONES, SCLEROSOMATIDAE)

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ABSTRACT. We recorded the number of ectoparasitic erythraeid mite larvae (*Leptus* sp. Latreille 1796) that were attached to 1241 *Leiobunum formosum* Wood 1870 from a population in southeastern Virginia. The prevalence of infestation (percent of individuals parasitized) exhibited significant annual and seasonal variation, ranging from 0.5% to 20.3%. The mean intensity of infestation (number of mites per parasitized individual) varied from 1.0 to 1.3, with a maximum observed intensity of 3 mites/individual. This study provides the first description of annual and seasonal variation in mite infestation of harvestmen.

Keywords: Harvestmen, ectoparasites, mites, eryrthraeids, variation

The larvae of erythraeid mites of the genus *Leptus* are common ectoparasites of a variety of arthropods, including harvestmen (Southcott 1992; Cokendolpher 1993; Mitov 2000). Although these mites are assumed to feed upon hemolymph (Åbro 1988), researchers know little about the impact of mites upon the survival, locomotion, or reproductive capacity of their opilionid hosts (Guffey 1998). Prior studies of the interactions of erythraeid mites and harvestmen have focused on the mode of attachment by mites (Åbro 1988), preferences of mites for specific attachment sites (McAloon & Durden 2000; Mitov 2000), and the ecological significance of variation in mite infestation rates between syntopic species (Guffey 1998). Reported values for the prevalence of mite parasitism (fraction of individuals infested) vary from 11% for *Leiobunum vittatum* in Louisiana (Guffey 1998) to 61% for *L. formosum* in Tennessee (McAloon & Durden 2000). Similarly, the intensity of mite infestation (mean number of mites per infested individual) ranges from 2.3 for *L. formosum* (McAloon & Durden 2000) to nearly 4 for *L. nigripes* (Guffey 1998). Reported maximal intensities of infestation have ranged from 14 mites for *L. formosum* (McAloon & Durden 2000) to 32 mites for *Zachaeus crista* (Mitov 2000).

Relatively few studies have examined seasonal variation in parasitism upon harvestmen. In Japan, infestation by gregarines has been observed to vary between seasons for *Leiobunum manubriatum* and between populations for *L. manubriatum* and *L. globosum* (Tsurusaki 1986). In an effort to assess seasonal variation in the prevalence and intensity of larval mite infestations amongst harvestmen, we studied a population of *L. formosum* Wood (1868), which occurs on the campus of Virginia Wesleyan College (VWC) over a period of 14 months (9 October 2003–11 November 2004). In southeastern Virginia, *L. formosum* is one of the most commonly encountered species of harvestman and inhabits pine and mixed mesic hardwood forests (personal observation). This species occurs throughout the southeastern U.S.A., and has a geographic range that extends from Florida north to Ontario and west to Colorado (Cokendolpher & Lee 1993). In contrast to other eastern species of harvestmen, *L. formosum* exhibits an atypical life history in which adults do not perish in the autumn (following mating) but instead overwinter (Comstock 1948). Thus, late spring and early summer populations frequently consist of both juveniles and adults.

Leiobunum formosum is an ideal species for a comparative study of mite parasitism because data regarding the prevalence and intensity of mite infestation for a Tennessee population of this species has already been published (McAloon & Durden 2000). In addition, Cokendolpher (1993) noted a record of infection for *L. formosum* by the mite, *Leptus indianensis*, in nearby Wakefield, VA (approximately 76 km west of our study site). The southeastern Virginia population of *L. formosum* that we examined in this study, thus, may be infested by the larvae of the same species of *Leptus* as the Tennessee population of McAloon & Durden (2000).

In 2003, we captured and released 241 adult *L. formosum* 9 October–22 November. Each individual

Table 1.—Frequency distribution of *L. formosum* hosts with different numbers of larval erythraeid mites attached.

Number of Mites Present	Number of *L. formosum* Autumn 2003	Number of *L. formosum* Summer 2004	Number of *L. formosum* Autumn 2004
0	192	656	393
1	39	3	10
2	6	0	0
3	4	0	0

was carefully examined and the number of larval mites on each harvestman was recorded. In 2004, we collected 291 juvenile and 368 adults from the trunks of pine trees (*Pinus taeda*) and hardwoods, including hickory (*Carya* sp.), red maple (*Acer rubrum*), American beech (*Fagus grandifolia*), white oak (*Quercus alba*), and dogwood (*Cornus florida*). These individuals were preserved in 70% ethanol immediately following capture. In January 2005, each of these harvestmen was carefully examined with a stereomicroscope and the number of mites infecting each individual was recorded (this procedure follows that of McAloon & Durden 2000). In addition, from 21 September–11 November 2004, we captured, sexed, and released 290 adults. We also captured and preserved an additional 103 adults from the trunks of nearby pine and hardwood trees from 5 October–4 November 2004. The prevalence and intensity of mite infection for these individuals was determined in February 2005.

The results of our study (Table 1) indicated that the prevalence of larval mite infestation varied dramatically between our three sampling periods (χ^2 = 160.0, df = 2, $P < 0.001$). Mite infestation was significantly more prevalent for Autumn 2003 than for either Summer (χ^2 = 128.1, df = 1, $P < 0.001$) or Autumn 2004 (χ^2 = 59.5, df = 1, $P < 0.001$). Our results also indicated that mite infestation was significantly more prevalent in Autumn than in Summer 2004 (χ^2 = 8.2, df = 1, P = 0.004). In Autumn 2003, the VWC campus population of *L. formosum* exhibited an infestation rate of 20.3%. In contrast, the overall parasitism rates for Summer and Autumn 2004 were only 0.5% and 2.5%, respectively. The intensity of infestation (mean number of mites per parasitized individual) also varied between samples (Table 1). In 2003, the intensity was 1.3, with four observations of hosts infested with 3 mites (the most intense infestations that were observed). During 2004, the intensity for both summer and autumn samples was only 1.0 (no individual was found with more than 1 mite). Unfortunately, we do not have data with regards to the sex of the harvestmen for 2003, but for Summer 2004 only 2 females (out of 173) had a mite and no males (out of 195) were infected. For Autumn 2004, there was no difference in the prevalence of mites between males (243: 0 mites, 5: 1 mite) and females (150: 0 mites, 5: 1 mite). In addition, there was no measurable difference in mite infestation between adults (2 females had 1 mite) and juveniles (1 individual had 1 mite) for the summer sample.

In comparison to the studies of Guffey (1998) and McAloon & Durden (2000), our investigation revealed a considerably lower prevalence and intensity of mite infestation. The ecological significance of this variation is difficult to assess because no adverse effects of ectoparasitic mites upon harvestmen physiology or reproductive success have yet been empirically demonstrated (Guffey 1998). For dipterans, Polak & Markow (1995) found that ectoparasitic mites can severely impair the reproductive activities of individual flies, particularly males, and thus, high intensity mite infections can have serious consequences for individual fitness. However, other studies of ectoparasitic mites have revealed no measurable adverse effects upon the reproduction or survival of host species (Pacejka et al. 1998; Reardon & Norbury 2004). Therefore, further research on the physiological consequences of mite infestation upon harvestmen is required.

Our findings of variation (in comparison to the population of *L. formosum* examined by McAloon & Durden 2000) in the prevalence and intensity of mite infestation may reflect differences in local population densities of either harvestmen or parasitic mites. Similarly, variation in habitat use and activity patterns (Edgar & Yuan 1968; Edgar 1971) could produce differences in the risk of exposure to larval erythraeid mites and consequently generate intra- and interspecific variation in the prevalence or intensity of infestation. Most adult harvestmen at our study site were collected from above ground habitats. Occupation of these areas may minimize contact with the leaf litter, thereby reducing contact with larval mites, and thus contributing to the overall low prevalence and intensity of mite infection that we observed.

Seasonal or annual variation in mite infestation has been observed in other hosts (Morlan 1952; Howell et al. 1957; Shah 2001; Harris et al. 2003), but its significance is not completely understood.

Dramatic seasonal changes in both temperature and humidity have been identified as major contributors to variation in the sizes of mite populations (Boyne & Hayne 1983; Shah 2001). Differences in the prevalence or intensity of mite infestation may also reflect variation in the life history of the parasite. In erythraeid mites, the larvae (but not the adults) are parasitic (Southcott 1992; Cokendolpher 1993). Hence, seasonal variation in infestation may simply reflect periods in the year when larval mites are particularly common or relatively rare. Additional field and laboratory studies of the life history and ecology of parasite and host species are required before the significance of geographical, seasonal, and annual variation can be fully understood.

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