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Patterns of *Knemidokoptes jamaicensis* (Acari: Knemidokoptidae) Infestations Among Eight New Avian Hosts in the Dominican Republic

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J. Med. Entomol. 38(3): 437–440 (2001)

ABSTRACT The ectoparasitic mite *Knemidokoptes jamaicensis* Turk burrows into the cornified epithelium of the legs and feet of Passeriform birds and has been reported from 12 species of North American birds. Here we establish new host and distribution records for *K. jamaicensis* from eight species of birds from three habitats in the Dominican Republic. These species include Hispaniolan pewee (*Contopus hispaniolensis* Bryant), northern mockingbird (*Mimus polyglottos* L.), Cape May warbler (*Dendoica tigrina* Gmelin), prairie warbler (*Dendroica discolor* Vieillot), palm warbler (*Dendroica palmarum* Gmelin), green-tailed warbler (*Microligea palustris* Cory), black-crowned palm tanager (*Phaenicophilus palmarum* L.), and Greater Antillean bullfinch (*Loxigilla violacea* L.). Rates of infestation were as great as 18.2% but varied between species and habitats. Mites were far more common in the dry desert thorn scrub than they were in higher elevation and more moist habitats, despite the fact that many of the affected species had distributions that spanned multiple habitat types. Results suggest that the abundance of scaley-leg mites is controlled by the abundance of suitable host species and by specific ecological conditions that promote transmission.

KEY WORDS *Knemidokoptes jamaicensis*, scaley-leg mites, avian hosts, Passeriform birds, Dominican Republic

Knemidokoptes jamaicensis Turk (1950) is an ectoparasitic mite of Passeriform birds, living and reproducing by burrowing into the cornified epithelium beneath the skin of the legs and feet or occasionally other unfeathered parts of the body (Kirmse 1966). Rarely does *K. jamaicensis* penetrate into deeper layers of the skin. The tissue of infected birds responds to the presence of the mites by growing warty lesions and ribbon-like proliferations of the skin, as well as through overgrowth of the toenails, thus sometimes affecting the birds' ability to perch. This pathological condition is referred to as *scaley-leg*. This mite spends its entire life cycle on its host, and although direct physical contact may not be required for transmission of the parasite from one host to another (Poulson 1964, Kirmse 1966), close contact is likely to promote transmission (Wichmann and Vincent 1958).

The incidence of *K. jamaicensis* was first summarized by Fain and Elsen (1967) who included a list of 10 species of birds from several families that were parasitized by this mite in the Western Hemisphere. These included the great-crested flycatcher (*Myiarchis crinitus* L.), black-capped chickadee (*Poecile atricapillus* L.), white-breasted nuthatch (*Sitta carolinensis* Latham), bare-eyed robin (*Turdus nudigenis* Lafresnaye), white-chinned thrush (*Turdus aurantius* Gmelin), gray catbird (*Dumetella carolinensis* L.), red-winged blackbird (*Agelaius phoeniceus* L.), Brewer's blackbird (*Euphagus cyanocephalus* Wagler), common grackle (*Quiscalus quiscula* L.), and brown-headed cowbird (*Molothrus ater* Boddaert). Since then, additional reports of this mite have been made for the eastern towhee (*Pipilo erythrophthalmus* L.; Pence 1970) and American crow (*Corvus brachyrhynchos* Brehm; Pence 1972) in North America. Arendt (1992) also reported a "scaley-leg" condition from the Ovenbird (*Seiurus aurocapillus* L.) in Puerto Rico but no mites were collected for verification.

Here we establish new host and distribution records for *K. jamaicensis* from eight species of birds from the Dominican Republic. We present data on variation in infestation rates between species and habitats, and summarize ecological patterns of mite infestations to suggest that the incidence of infestations is effected by host abundance and specific ecological conditions that promote the tranmission of the mite between hosts.

Materials and Methods

Birds inspected for evidence of mite infestations were mist-netted at nine study sites in three habitats as part of a larger study of Nearctic–Neotropical migratory birds along an altitudinal gradient (Latta 2000). Three study sites of 12–15 ha each were established in each of three habitats: low elevation desert thorn scrub (20–50 m elevation), mid-elevation subtropical dry forest (300–750 m elevation), and high elevation pine forest (1,100–1,475 m elevation) near Cabo Rojo and the Sierra de Bahoruco, Pedernales Province, Dominican Republic (18° 0′ N, 71° 38′ W). Each habitat is briefly characterized below based on

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previous work by Fisher-Meerow and Judd (1989), Latta and Sondreal (1999), and Latta and Brown (2000).

Desert Thorn Scrub Sites. Low elevation desert thorn scrub is characteristic of dogtooth limestone substrate (Howard and Briggs 1953) with very little exposed soil. Vegetation consists of widely scattered, partially deciduous, broadleaf trees and shrubs, and various cacti. Common broadleaf tree species include *Capparis cynophallophora* L., *C. ferruginea* L., *Guaiacum officinale* L., *Haitiella ekmanii* (Burret) Bailey, *Metopium brownei* Urban, and *Phyllostylon brasiliensei* Capanema. Common shrubs include *Croton origanifolius* Lamarck, *C. discolor* Willdenow, and *Lippia alba* Miller. Desert thorn scrub sites have a low, open canopy with a sparse understory dominated by broadleaf shrubs. Forbs, cacti, and succulents are uncommon on the rocky floor, but occasionally extend into the canopy. Mean annual temperatures are 25.0°C in January and 28.5°C in August. Mean annual rainfall is <500 mm (Fisher-Meerow and Judd 1989) with two pronounced dry seasons. Typically, December to March is exceedingly dry compared with the July–August dry season.

Subtropical dry forest sites. Similar dry forest has been studied by Fisher-Meerow and Judd (1989) at a 245-m elevation site <2 km from our study site. At that site, common trees include *Capparis ferruginea* L., *Zizyphus rignoni* Delponte, *Bursera sinaruba* (L.) Sargent, *Cameraria angustifolia* L., *Cordia buchii* Urban, and *Plumeria obtusa* L. Broadleaf trees at these sites are partially deciduous. Dry forest sites have a moderately closed, high canopy, as well as a developed intermediate canopy layer and shrub layer. Mean temperatures are ≈25.0°C in January and 28.5°C in August. Annual rainfall is estimated at 750–1,000 mm with two pronounced dry seasons similar to the desert thorn scrub habitat.

Pine Sites. Pine forests in the Sierra de Bahoruco are dominated by Hispaniolan Pine (*Pinus occidentalis* Swartz); the only other common tree is the palm *Coccothrinax scoparia* Beccari. A well-developed shrub layer is present and common broadleaf species include *Cestrum brevifolium* Urban, *Chamaecrista glandulosa* variety *picardae* (Urban) Irwin & Barneby, *Coreopsis buchii* Blake, *Hypericum hypericoides* (L.) Crantz, *Lyonia truncata* Urban, *L. microcarpa* Urban & Ekman, *Myrica picardae* Krug & Urban, and *Senecio picardae* Krug & Urban. The ground is covered by a thick layer of grasses. Pine forests have a fairly open canopy, a sparse intermediate layer of pine, and a dense mixed-broadleaf and pine understory. Mean annual temperature is 15°C and mean rainfall is ≈1,700 mm per year.

Bird Sampling. We studied winter resident migratory birds and permanent residents from 1 October–1 April 1996–1997 and 1997–1998. Birds were captured with mist-nets (12 m by 3 m by 30 mm mesh) in November, January, and March each year. All mist-netted birds were identified to species, age, and sex by plumage characteristics (Pyle et al. 1987) when possible, and banded with both a numbered metal band and color bands for individual identification. Each bird was inspected for mite infestations indicated by the typical warty lesions and ribbon-like proliferations caused by the scaley-leg mites. Samples of mites were collected by gently scraping the affected areas with a sharp knife and depositing the scrapings into vials of ethyl alcohol. In the laboratory, mites were cleared in lactophenol and mounted in Hoyer's medium. Voucher specimens of mites are deposited in the University of Michigan Museum of Zoology.

Statistical Analyses. The software package SYSTAT version 5.2.1 (Wilkinson 1992) was used to perform statistical tests described by Sokal and Rohlf (1995). A probability of type I error of 0.05 or less was accepted as significant. A row × column test of independence with a *G*-statistic was used to compare the frequency of infestation between bird species and between habitats.

Results

Mites were recovered from leg lesions on eight species of landbirds in the Dominican Republic. These hosts included the Hispaniolan pewee (*Contopus hispaniolensis*), northern mockingbird (*Mimus polyglottos*), Cape May warbler (*Dendoica tigrina*), prairie warbler (*Dendroica discolor*), palm warbler (*Dendroica palmarum*), green-tailed warbler (*Microligea palustris*), black-crowned palm tanager (*Phaenicophilus palmarum*), and Greater Antillean bullfinch (*Loxigilla violacea*). All mites were identified as *K. jamaicensis;* all stages agreed with the redescription of this species in Fain and Elsen (1967).

Infestation rates varied significantly between species ($G = 59.64$, df = 7, $P < 0.001$) and habitats ($G = 49.83$, df = 2, $P < 0.001$; Table 1). The Hispaniolan pewee, northern mockingbird, and palm warbler were the most heavily infested. Several host species were represented by only a single infected individual. Most mite infestations occurred in the desert thorn scrub habitat. No mites were recorded from birds in the pine forest.

Discussion

Observations presented here establish new host and distribution records for *K. jamaicensis* and nearly double the number of host species from which this mite has been recorded. Previous records involve host species which are permanent residents or short distance migrants within North America. Here we report the first host records of three species of long-distance Nearctic–Neotropical migratory birds on their wintering grounds. We also expand the geographic distribution of the mite to include the Caribbean island of Hispaniola. Two other reports exist of *K. jamaicensis* from the Caribbean (Fain and Elsen 1967): one record from Jamaica and another from Trinidad both involve resident thrushes.

Several ecological patterns are seen in these data. First, this species of mite may be encountered on avian species from a variety of Passeriform families. Fain and

Table 1. Total number of birds examined and the proportion of those which were found to be infested with *Knemidokoptes jamaicensis* in three habitats of Pedernales Province, Dominican Republic

Species	Status	Desert		Dry Forest		Pine Forest		Total	
		n	%	*n*	%	*n*	%	*n*	%
Hispaniolan pewee	R	0	0.0	11	18.2	15	0.0	26	7.7
Northern mockingbird	R	60	6.7	2	0.0	0	0.0	62	6.5
Cape May warbler	M	83	3.6	58	0.0	41	0.0	182	1.7
Prairie warbler	M	300	5.3	4	0.0	48	0.0	352	4.5
Palm warbler	M	479	10.0	1	0.0	176	0.0	656	7.3
Green-tailed warbler	R	77	0.0	50	2.0	3	0.0	130	0.8
Black-crowned palm tanager	R	133	1.5	84	0.0	37	0.0	254	0.8
Greater Antillean bullfinch	R	159	0.0	231	0.4	0	0.0	390	0.3
Total		1,291	5.7	441	0.9	320	0.0	2052	3.7

See text for Latin names. R, permanent resident; M, migratory, winter resident.

Elsen (1967) and Pence (1970 1972) recorded mites from the Tyrannidae, Corvidae, Paridae, Sittidae, Turdidae, Mimidae, Emberizidae, and Icteridae. Here we add the Parulidae and Thraupidae to the list of host families.

Second, our data clearly show a relationship between habitat type and the prevalence of mite infestations. Mites were far more common in the dry desert thorn scrub than they were in higher elevation and more moist habitats, despite the fact that many of the infested species had distributions that spanned multiple habitat types. Only the Hispaniolan pewee was found infested more often in dry forest than in other habitat types, but this species also does not occur in low elevation desert thorn scrub. We are unable to determine how prevalent this pattern is for *K. jamaicensis*, as previous published records of mite infestations do not mention habitat type of hosts, and without banded individuals there is no way of ascertaining whether an infected individual is a local resident or a transient.

Finally, results presented here suggest that infestations by *K. jamaicensis* can be locally common and affect relatively large proportions of some bird populations. For example, our infestation rates of 18.2% for Hispaniolan pewee in dry forest, and 10.0% for palm warbler and 6.7% for northern mockingbird in desert thorn scrub, are relatively high compared with those recorded for other species. Kirmse (1966) presented data on the prevalence of a scaley-leg mite (probably *K. jamaicensis*) from Ontario, Canada, showing rates of infestation of 1.3–11.6% for several blackbird species with large sample sizes, and one population of redwinged blackbirds with an infestation rate of 40.0%.

The observed differences in infestation rates between species and habitats may be related to environmental and host behavioral factors. Latta (2000) showed that rates of infestation of the palm warbler by scaley-leg mites were marginally significantly associated with rainfall, with higher levels of infestation associated with lower rainfall. Low rainfall and dry habitat may promote high infestation rates by creating an environment which is conducive to mite survival and reproduction, because the parasite may require a well-defined microclimate (Van Riper 1991). Alternatively, rainfall may affect mite infestation rates through the physiological stress a dry environment may exert on avian hosts (Esch et al. 1975), resulting in the transmission of the parasite to a weakened individual (Deerenberg et al. 1997, Saino et al. 1997), or in the external manifestation of parasites previously contracted elsewhere (Weatherhead and Bennett 1991). Finally, the effect of rainfall on vegetation structure and the opening of the canopy during the dry season may affect the behavior of resident birds. High mite infestation rates in desert habitats may be due to birds roosting communally in open-canopied desert habitats but not in denser pine forest sites (Latta 2000). Thus, these results suggest that the abundance of scaley-leg mites is controlled not only by the abundance of suitable host species but also by specific ecological conditions that promote horizontal transmission. More data are needed, however, on the biology and habitat preferences of these mites to assess these hypotheses.

Acknowledgments

Fine field assistance was provided by Christopher Brown, Bolívar Cabrera, Fabrice deLacour, Heather Gamper, Brian Gibbons, Jeanne Hammond, Maimonides Herédia, Danilo Mejía, Vinicio Mejía, Randy Moore, Marriah Sondreal, James Tietz, Eduardo Vasquez, Hira Walker, and Kate Wallace. Gary Krause (University of Missouri) provided statistical advice and Kim McCue (Missouri Botanical Garden) helped with botanical taxonomies. The manuscript benefited from comments by John Faaborg and two anonymous reviewers. Funding or equipment was provided by the University of Missouri Research Board, National Fish and Wildlife Foundation, Wildlife Conservation Society, Association of Avian Veterinarians, and USDA Forest Service North-Central Forest Experiment Station. S.C.L. was also supported by a STAR Graduate Fellowship from the U.S. Enviromental Protection Agency. Permission to work in the Sierra de Bahoruco was provided by the Dirección Nacional de Parques and the Departamento de Vida Silvestre.

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Received for publication 28 August 2000; accepted 18 January 2001.