Cnemidocoptic Mite Infestations in Wild Birds

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Cnemidocoptic Mite Infestations in Wild Birds

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ABSTRACT

During 1965 many wild birds were examined for the lesions of "scaly leg" disease, caused by mites of the genus *Cnemidocoptes*. Mite infestation was found in redwinged blackbirds (*Agelaius phoenicus*), common grackles (*Quiscalus versicolor*), cowbirds (*Molothrus ater*) and in two new hosts for the mite, a black-capped chickadee (*Parus atricapillus*) and a crested flycatcher (*Myiarchus crinitus*). The mite was identified as closely related to *Cnemidocoptes jamaicensis* (Turk 1950). Mites were transmitted from diseased to healthy red-winged blackbirds by cage contact but nine other wild bird species appeared not to be susceptible during an observation period of six months, even when mites were applied to scarified skin. Attempted transmission to chickens was not successful during an observation period of six months. Male and female mites were observed in copulation. The progress of the disease, pathological findings and the histopathology of "scaly leg" disease in wild birds is described.

INTRODUCTION

"Scaly leg" disease, a burrowing mite infestation in domestic and wild birds, is caused by mites of the genus *Cnemidocoptes* and involves the skin of the feet and legs, or other unfeathered parts of the body.

Robin and Lanquetin (1859) discovered a parasite in fowl affected with a disease that had been known for a long time as a dermatosis, called scabies of fowls. They classified the parasite as *Sarcoptes mutans* and the disease was described by Reynal and Lanquetin (1859). According to Nevin (1935) *Cnemidocoptes viviparous* (Fuerstenberg, 1870), *Dermatoryctes mutans* (Ehlers, 1873) and *Cnemidocoptes mutans* (Canestrini, 1894) are synonyms.

During an investigation of the occurrence of pox virus infection in wild birds from Ontario in 1965, six redwinged blackbirds (*Agelaius phoenicus*) and one common grackle (*Quiscalus versicolor*) were found with warty lesions resembling footpox on their feet and shanks. Histological sections of skin biopsies from the birds were negative for pox virus infection but revealed a heavy infestation with burrowing mites. This disease, affecting the feet and legs of wild birds, appeared similar to the "scaly leg" disease in poultry (Biester and Devries, 1945). An epizootiological investigation was begun to determine the significance of wild birds as reservoir hosts and their role as sources of infection to domestic birds.

MATERIAL AND METHODS

In 1965 thousands of birds of many different species were trapped and banded at several locations in Ontario by members of the Ontario Bird Banding Association (O.B.B.A.). I had the opportunity to work with the banders and to personally examine many of these birds. In cases in which the diagnosis of mite infestation could

not be made by inspection, either the live bird or skin scrapings were taken to the laboratory. In addition, studies were made on bird skins at the Royal Ontario Museum and on carcasses in frozen storage at the Zoology Department, University of Guelph. Further information was obtained by visits to private aviaries and by personal communication from members of the O.B.B.A.

For mite identification, scrapings of skin lesions collected in the field were fixed in buffered 10% formalin, histologically sectioned and stained with haematoxylin-phloxine-saffron, haematoxylin-eosin, or periodic-acid-Schiff. Examination of sections so prepared revealed the mites but did not permit their identification. To release the mites from their skin burrows, pieces of skin were placed in small vials containing 2 ml of 4% sodium hydroxide. The vials were incubated in a waterbath at 100°C for 4 to 5 minutes, after which they were centrifuged at 1500 rpm for 10 minutes. The supernatant was discarded and with a wire loop or a pasteur pipette a few drops of skin debris were applied to a microslide, thoroughly mixed with 2 to 3 drops of Berlese solution* and covered with a cover-glass. The mites absorbed the green dye from the solution and the details of their structure were revealed. To determine the species of mite, measurements were taken and compared with descriptions of the various species of mites causing "scaly leg" disease in domestic and wild birds. Experimental transmission was attempted to chickens and to healthy wild birds. Gauze covered with skin scrapings from diseased redwinged blackbirds was fixed around the scarified shanks of twelve three-week-old chickens. Adhesive tape was applied on the upper and lower edges of the bandages to prevent the mites from crawling out. After two weeks the bandages were removed. Five months later skin biopsies taken from the exposed chickens were examined for mites by the methods described. In another experiment, three redwinged blackbirds and one cowbird were exposed to mites from diseased blackbirds by binding pieces of gauze containing skin scrapings to their scarified shanks. In an attempt to transmit mites to wild birds by contact, several birds of different species, including redwinged blackbirds, tree sparrows (*Spizella arborea*), cowbirds (*Molothrus ater*), juncos (*Junco hyemalis*), robins (*Turdus migratorius*), catbirds (*Dumetella carolinensis*), white-throated sparrows (*Zonotrichia albicollis*), song sparrows (*Melospiza melodia*), starlings (*Sturnus vulgaris*) and European sparrows (*Passer domesticus*), were caged with four mite-infested redwinged blackbirds. These cages were constructed of 1" by 1½" wire mesh and measured 4'x4'x6'. The birds were fed a mixture of bird seeds, insectivorous food, chicken grower concentrate, peanut butter and fruits.

* Solution of 50 ml. distilled water, 30 mg. gummi arabicum, 200 gm. chloral hydrate and 20 gm. glycerine. Modified by O. B. Remmler by the addition of a few drops of guinea green.

RESULTS

Prevalence of mite infestation.

Birds were trapped and examined at the following locations of bird banding activity: Long Point (Lake Erie); Dundas Marsh; Royal Botanical Gardens in Hamilton; and in Guelph, at the campus of the Ontario Veterinary College. In addition to these, frozen carcasses were examined from redwinged blackbirds and cowbirds collected during the period 1963 to 1965 from Luther Marsh and Bradley's Marsh (Lake St. Clair), by the staff of the Zoology Department, University of Guelph. Two crested flycatcher specimens were submitted by D. H. Baldwin of the Royal Ontario Museum (R.O.M.). The bird skins examined were from the bird collection of the museum. The rate of mite infestation was found highest in redwinged blackbirds. Mite infestations were common also in grackle skins in the R.O.M. collection. Occasional cases of "scaly leg" disease were found in other wild birds (Table I). The cases in the crested flycatcher and the black-capped chickadee are considered new host records.

TABLE 1. *Prevalence of "Scaly-Leg" Disease in Wild Birds*

SPECIES	Number	LOCATION	YEAR	PERCENTAGE
Redwinged blackbird (*Agelaius phoenicus*)	305	Royal Ont. Museum	—	4.3
	446	Long Point	1965	40.0
	360	Bradley's Marsh	1965	11.6
	240	Bradley's Marsh	1963-64	10.4
	22	Luther Marsh	1965	18.1
	546	Dundas Marsh	1965	4.2
Common grackle (*Quiscalus versicolor*)	363	Royal Ont. Museum	—	2.2
	86	Long Point	1965	6.2
Cowbird (*Molothrus ater*)	235	Long Point	1965	—
	10	Dundas Marsh	1965	—
	152	Luther Marsh	1965	1.3
Black-capped chickadee (*Parus atricapillus*)	29	Hamilton	1965	3.4
Crested flycatcher (*Myiarchus crinitus*)	2	Toronto	1965	50.0

Pathological findings.

Most of the birds had small, yellowish-grey or reddish-brown, wart-like skin proliferations that seemed to begin on the soft parts of the plantar side of the tarsus and to spread along the digits and up the shanks to the hock. In the early stages these lesions did not exceed the size of a matchhead but later they became more confluent. Feathered parts of the legs were not involved, nor were any lesions seen around the base of the beak or on other parts of the body. Some birds showing severe mite infestation had shanks which were five times the normal diameter; in redwinged blackbirds up to 7 mm. No loss of toes was observed but in some cases the toe nails were greatly overgrown (fig. 1-3) and the ability to perch was impaired. The scales were elevated and increased desquamation took place.

Histopathology.

Serial sections vertical to the plane of the skin revealed most of the pouches or burrows of the mites to be in the cornified epithelium. A few mites had invaded the stratum spinosum and the stratum germinativum but mites were not found in deeper layers of the skin. Sections made in the plane of the skin showed the proliferated stratum corneum with the striking honeycomb pattern which had been described as early as 1873 (Ehlers). The sections from the flycatcher contained more than 60 pouches. Most of them were empty, either due to the loss of mites in processing or because the mites

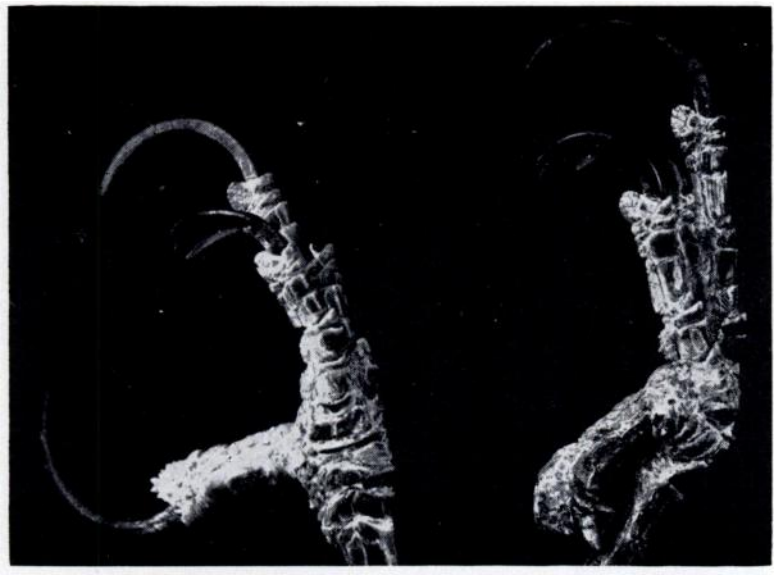

FIGURE 1. *Early lesions of "scaly leg" disease in a redwinged blackbird.*

FIGURE 2. *Severe case of Cnemidocoptes mange in a male adult redwinged blackbird showing remarkable skin proliferation and overgrowth of the toenails.*

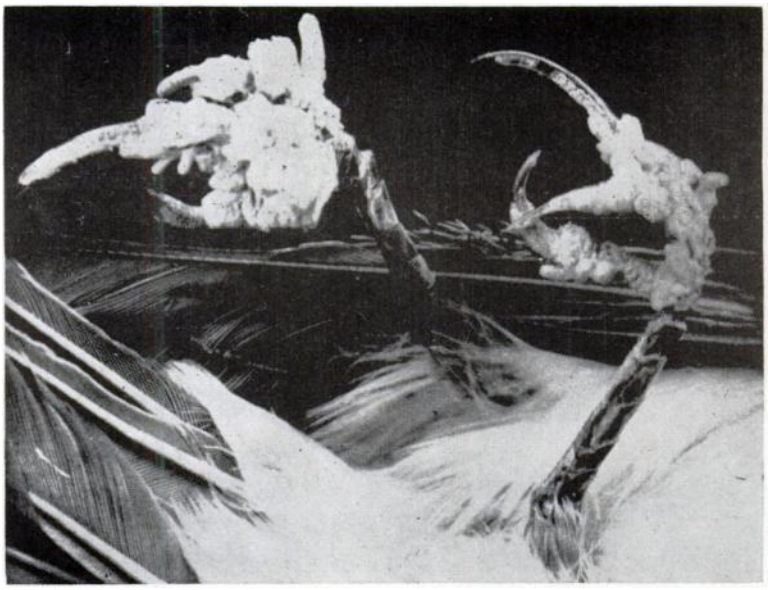

FIGURE 3. *"Scaly leg" in a crested flycatcher. Note absence of lesions on both shanks.*

had penetrated more deeply. In the redwinged blackbird more than 100 pouches were counted in one section measuring 8 x 5 mm. In some sections of the deeper layers of the skin a few congested vessels were seen in the dermis. Inflammatory changes were seen only in cases in which secondary infection with bacteria or fungi had occurred. These changes consisted of focal necrosis and infiltration with leukocytes and histiocytes.

Description of mites.

The mites had the following characteristics which placed them in the *genus Cnemidocoptes* (Acarines: Sarcoptides): they were viviparous. Females had spheroid bodies without distinct spines. The dorsal striae were broken and showed a scale-like pattern. The legs were short and the tarsi were clawlike, without suckers and setae. The body setae were short, except for one long pair on the posterior margin of the mite. The anal aperture was terminal with a dorsal slit, but the genital pore was ventral and situated parallel with the striae. The epimeres were well defined and heavily chitinized. Males had suckers and long setae on all legs. Para-anal suckers were absent. Both sexes had a dorsal shield characteristic for the genus (Baker *et al*, 1956).

An attempt was made to determine the species by measurements and by studies of the major structural details of the mites:

Female: The average length was 0.355mm. the average breadth 0.285 mm. The dorsal shield was longer than broad and the punctate area covered only 1/3 of the posterior part of the shield. Its anterior part was devoid of stippling. The

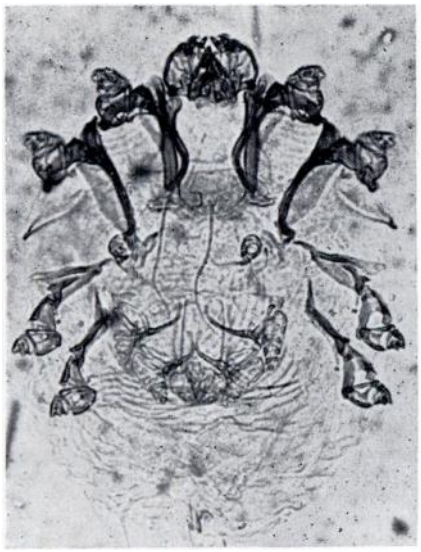

FIGURE 4. *Pregnant female of the cnemidocoptic bird mite from a common grackle, containing a larva and showing the "marginal spine". Ventral view x* 235.

adscutal setae were close together but on separate bases. A distinct arrow-shaped spine-like process, 0.01 mm in length (fig. 4) could be observed protruding from the lateral margin of both sides of the body posterior to the second pair of legs. The anus was terminal with a dorsal slit and to the right of it was located the copulatory opening measuring 0.008 mm. The posterior setae were very short, measuring 0.05 mm. The legs, which were four-segmented, were 0.04 mm long, with tarsi bearing four claws, two of which were small and were not always visible in one plane (fig. 6, 7). The first epimeres on the ventral side were more or less angulated, depending on the fixation of the legs. Coxal spurs were barely visible and sometimes seemed to be split into two parts. The genital pore was in the form of a slit or oval opening between the third and fourth pair of legs. The ventral striae were smooth and not broken into scales, as on the dorsal side. Details of the mouth parts have not been examined.

Male: The average length was 0.170 mm; the average breadth 0.135 mm. The posterior setae were much longer that those of the female, measuring 0.155 mm. The transverse bar of the dorsal shield was not chitinized. The adscutal setae were on separate bases, the outer setae on larger bases and much longer than the medial or inner setae. The legs had five segments; the tarsus bore only one clawlike protuberance. All legs had more than one of the setae longer than the sucker, which was found

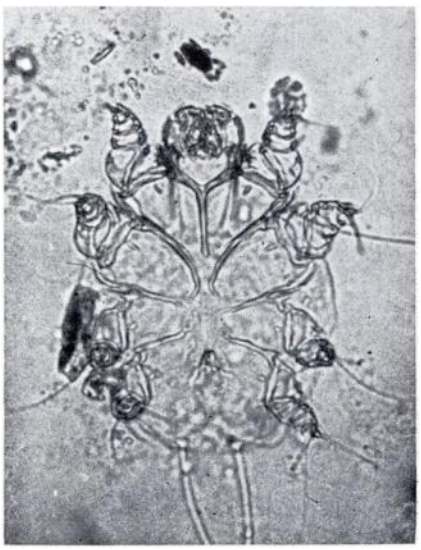

FIGURE 5. *The male of the cnemidocoptic bird mite found in redwinged blackbirds. The ventral view shows the distinct coxal spurs. x* 355.

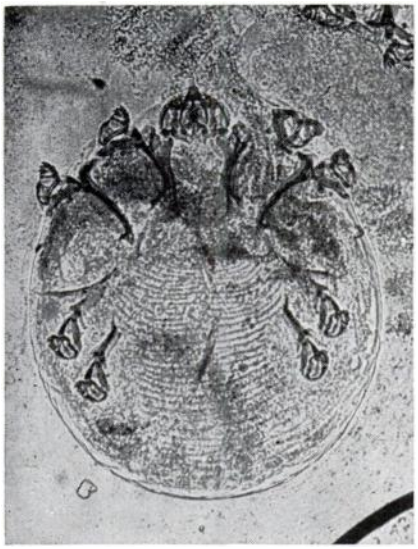

FIGURE 6. *The female of the cnemidocoptic bird mite from a redwinged blackbird. Angulation of the epimeres, "marginal spines" and three claws are visible on the tarsi. Ventral view x* 195.

FIGURE 7. *Leg from the female mite of a redwinged blackbird showing three claws on the tarsus. The fourth claw is not visible in the plane of the photograph. x* 1000.

on all legs. Very distinct triangular coxal spurs, which sometimes seemed disconnected from the coxae, were found in the first and second pairs of legs, whereas they were less distinct in the third and fourth pairs of legs (fig. 5).

Larvae: Measured 0.17 mm in length and 0.125 mm. in breadth. They had six five-segmented legs with suckers and several spurs or hooklets on the tarsi. The first epimeres were almost fused in the middle (fig. 5). The second epimeres were hooked. The posterior setae were body length or even longer and were sometimes found bent anteriorly over the body. Coxal spurs were quite distinct.

Nymph: Distinguished from the female only by size: 0.185 mm in length and 0.152 mm in breadth and by the fact that the coxal spurs were more obvious than in the female.

Males and females have been observed in copulation.

Measurements of the mites found in redwinged blackbirds, common grackles, cowbirds and in the crested flycatcher were compared but no differences were found (Table II).

Comparison with other Cnemidocoptes

Comparisons were made with other mites of the genus *Cnemidocoptes* (Table III). The major distinguishing characteristics were as follows:

Cnemidocoptes mutans were larger. Posterior setae were longer (0.09 mm). The genital pore was situated between the second and third pair of legs. The epimeres of the first pair of legs were gradually curved, while the epimeres of the second pair were straight. The tarsi bore only two long, slim scissor-like claws of unequal length.

Coxal spurs were not described, but in a picture of *C. glaberrimus Sicher* (Baker *et al*, 1956) they appeared not to be connected with the coxae on all four pairs of legs. The legs were five-segmented (Nevin, 1935. Megnin, 1879, Neumann, 1905).

Cnemidocoptes laevis, var, columbae was smaller than *C. mutans*. The female measured from 0.270 to 0.310 mm in length and from 0.230 to 0.270 mm in breadth. It had no dorsal scales but very fine parallel, transverse striae. The epimeres of the first pair of legs were united by a transverse piece in the form of a circumflex accent. The male had two copulatory suckers as in *Sarcoptes* and the epimeres of the first pair of legs were joined in the shape of a Y (Neumann, 1905).

Cnemidocoptes laevis, var. gallinae. The female was from 0.310 to 0.350 mm long and from 0.270 to 0.300 mm broad. The dorsal side had fine transversal striae. The epimeres of the first pair of legs remained free. Marginal spines were not seen. The tarsi had two claws. The male was from 0.170 to 0.180 mm long and from 0.120 to 0.130 mm broad, and had two co-

TABLE 2. *Comparison of Wild Bird Mites from different Bird Species**

	R. Blackbird	Grackle	Cowbird	Flycatcher
FEMALES				
length	0.335 - 0.415	0.260 - 0.335	0.270 - 0.320	0.285 - 0.300
breadth	0.270 - 0.355	0.220 - 0.285	0.215 - 0.230	0.220 - 0.245
legs	0.044	0.04	0.042	0.045
dorsal shield:				
length	0.085 - .090	0.080 - 0.090	0.090	0.075 - 0.085
breadth	0.06 - 0.07	0.06	0.057	0.06
punctate area	0.04	0.030 - 0.035	0.04	0.04
eggs	0.032 x 0.021			
posterior hairs	0.05 - 0.06	0.055 - 0.07	0.047	0.03 - 0.04
MALES				
length	0.175 - 0.190	0.180 - 0.195	0.183 - 0.188	0.180 - 0.190
breadth	0.125 - 0.150	0.135 - 0.150	0.125 - 0.130	0.120 - 0.125
legs	0.045 - 0.052	0.04 - 0.05	0.05	0.047 - 0.055
sucker	0.020 - 0.025	0.025 - 0.028	0.018 - 0.026	0.023
posterior hairs	0.110 - 0.155	0.105 - 0.170	0.152	0.152 - 0.165
LARVAE				
length	0.16 - 0.18	0.16	0.18	0.16
breadth	0.115	0.12 - 0.13	0.13	0.14
posterior hairs	0.155 - 0.160	0.17	0.16	0.155
legs	0.0395	0.037 - 0.041	0.039 - 0.05	0.034
NYMPHS				
length		0.185		
breadth		0.152		
posterior hairs		0.035		
legs		0.038		

* All measurements are in MM.

TABLE 3. *Differences in the Species of the Genus Cnemidocoptes*

	C. mutans*	C. fossor**	C. pilae*	C. jamaicensis***	C. Sp. of wild birds*
FEMALES					
length	0.309 - 0.471	0.250	0.29 - 0.38	0.30 - 0.36	0.335 - 0.415
breadth	0.25 - 0.39	0.22	0.27 - 0.35	0.245 - 0.280	0.270 - 0.355
legs	0.055 - 0.07	0.0323	0.045 - 0.055		0.044
eggs		0.108 - 0.118	0.06 - 0.13		0.0320
posterior hairs	0.09		0.058		0.05 - 0.06
dorsal shield:					
length	0.075 - 0.09		0.07 - 0.075		0.085 - 0.09
breadth	0.070		0.062 - 0.07		0.06 - 0.07
punctate area	0.045		0.03 - 0.04		0.04
MALES					
length	0.25	0.162	0.155 - 0.195		0.175 - 0.19
breadth	0.15	0.118	0.125 - 0.145		0.125 - 0.150
legs	0.04	0.0378	0.05		0.045 - 0.053
sucker	0.0185	0.016	0.018		0.020 - 0.025
posterior hairs	0.195		0.215		0.110 - 0.155
LARVAE					
length	0.165 - 0.17	0.13	0.135 - 0.185	0.14 - 0.15	0.16 - 0.18
breadth	0.09 - 0.10		0.11 - 0.15	0.11 - 0.115	0.115
legs	0.048	0.0324	0.04 - 0.045		0.0395
posterior hairs	0.165		0.185	0.140 - 0.150	0.155 - 0.16
NYMPHS					
length			0.14 - 0.16		0.185
breadth			0.13 - 0.14		0.152
legs			0.032		0.038
posterior hairs			0.025		0.035

Reference: * personal observations
** Ehlers, 1873
*** Turk, 1950
Note: All measurements are in millimeters.

pulatory suckers (Neumann, 1905, Hirst, 1922).

Cnemidocoptes fossor was much smaller. The female was 0.25 mm long and 0.22 mm broad. The posterior setae were described as almost as long as the body. The genital pore was located between the second pair of legs. The tarsi bore four claws. The male was 0.162 mm long, 0.118 mm broad and had only one of the setae longer than the sucker on the fourth pair of legs (Ehlers, 1873).

Cnemidocoptes pilae was smaller. The dorsal shield was heavily chitinized and the punctate area was completely covered with dots. The adscutal setae arose from a common base, the outer hair being markedly longer than the inner hair. On the first tarsus there was

no hair longer than the sucker and on the second tarsus there was only one hair longer than the sucker. The integument was relatively smooth (Lavoipierre and Griffiths, 1951, 1953).

Cnemidocoptes jamaicensis was of the same size. The genital pore was set far back between the fourth pair of legs. A comparatively large and well-marked spine was seen at the lateral margins which had a secondary smaller process on its posterior edge. The posterior hairs were very short. The tarsus of the legs bore four claws with three upper ones and a larger lower one. The male had not been described. The larva had posterior hairs of body length and the first and second tarsi had three claws and one sucker in the place of the fourth claw of the female (Turk, 1950).

Besides mites of the genus *Cnemidocoptes,* a single unidentified mite of another genus was isolated from skin lesions of a common grackle.

Transmission Studies

Contact or natural transmission occurred between infested and healthy redwinged blackbirds. After 48 days of exposure in the same cage, one of the healthy redwinged blackbirds developed a small, dry, raised skin proliferation on the soft part of the right tarsus. Very slow progress of the disease was observed over a period of several months. It was found, however, that the irritation caused by scraping skin from the diseased birds for other transmission studies caused more rapid extension of the lesions. The birds of other species kept in the same cages with the redwinged blackbirds showed no evidence of mite infestation after a period of more than six months.

The attempted transmission by application of mites was not successful, possibly because the birds had removed their bandages by pecking only a few days after application. In this experiment chickens have been observed for more than six months. Some of them showed desquamation and slight localized elevation of scales, as described for stages I and II in the classification of "scaly leg" mite infestation by Griffiths and O'Rourke (1950). Mites have not been demonstrated.

DISCUSSION AND CONCLUSIONS

Wild birds in nature or in captivity are commonly infested with burrowing mites of the genus *Cnemidocoptes.* Four different species of mites: *Cnemidocoptes mutans, Cnemidocoptes fossor, Cnemidocoptes jamaicensis* and *Cnemidocoptes pilae* may be responsible for a disease similar to one known as "scaly leg" in domestic birds.

C. fossor was reported in a maja finch (*Munia maja*) in 1873 but has not been encountered since. Experimental transmission was not successful (Ehlers, 1873).

C. pilae, found in budgerigars and parakeets (Oldham and Beresford-Jones, 1954,, Yunker, 1955) has not been found in any other wild or captive bird species, though it was suggested that the mite found in canaries in South Africa (Kaschula, 1950) might have been *C. pilae* (Lavoipierre

and Griffiths, 1951). This suggests that *C. pilae* may be host specific for parakeets, budgerigars and other psittacine birds.

C. mutans has been reported to be the cause of "scaly leg" disease in a number of species of wild birds. Pillers (1921) mentions it in partridges and some cage birds. A male redwinged blackbird infested with *C. mutans* was reported first by Olive and Schultz (1952). MacDonald (1962) described *C. mutans* in a chaffinch (*Fringilla coelebs*), in which the first lesions appeared proximal to the feathered parts of the leg (in contrast to my own observations). This was also the pattern of development of lesions observed by Poulsen (1964) who found "scaly leg" disease in the chaffinch (*Fringilla coelebs*), brambling (*Fringilla montifringilla*), bullfinch (*Pyrrhula pyrrhula*), European siskin (*Carduelis spinus*), redpoll (*Carduelis flammea*), twite (*Carduelis flaviros tris*), linnet (*Carduelis cannabina*), and skylark (*Alauda arvensis*). He did not see the disease in the yellowhammer (*Emberiza citrinella*), snow bunting (*Plectrophenax nivalis*), greenfinch (*Chloris chloris*) and goldfinch (*Carduelis carduelis*), though all were housed in the same aviary.

Herman, Locke and Clark (1962) investigated foot abnormalities in wild birds. They found "scaly leg" disease caused by a mite "indistinguishable" from *C. mutans* in redwinged blackbirds and common grackles. All white-winged doves (*Zenaida asiatica*) trapped and examined were free of mite infestation but Rosen (1959) reported the disease in these birds in California. An investigation of abnormalities in cowbirds trapped in Alabama showed evidence that 44 birds (0.6%) had "scaly leg" mite infestation. The mite was identified as *C. mutans* (Stewart, 1963).

A new host record for mite infestation was recently recorded in a whitebreasted nuthatch (*Sitta carolinensis umbrosa*), a museum specimen. The mite was identified as *C. mutans* (Hardy, 1965). Three hundred and seventy-nine whitebreasted nuthatch skins which I examined in the collection of the Royal Ontario Museum had no evidence of mite infestation.

In 1964, Keymer and Blackmore described the most common diseases of the skin and soft parts of wild birds in Britain. They found "scaly leg" disease not uncommon in cage birds and backyard poultry and reported the disease in a rook (*Corrus frugilegus*), due to *C. mutans*. They did not find any bird infested with *C. pilae*.

C. jamaicensis was obtained from the legs of a golden thrush (*Turdus aurantiacus*), which was the only infested specimen of 200 thrushes from the bird skin collection of the Science Museum of Jamaica (Turk, 1950). The mite, which was studied in detail, resembled the one found by Ehlers but was considered to be a new species because of the location of the female genitale pore, the large and well marked spine on the borders of the body between the second and third pairs of legs, the shorter length of the posterior setae and other minor differences. This new species has not since been reported in the literature.

Though most of the authors have attributed cnemidocoptiasis in wild birds to *C. mutans,* careful study might reveal a common identity with the bird mites found in the present study. The close resemblance of these mites to *C. jamaicensis,* i.e., the location of the genital pore, the marginal spine, the relatively short posterior setae, and the fact that all mites from five different species of birds were alike, (including the chickadee, in which only female mites were found and which was omitted from table II) may be taken to suggest that either we were dealing with *C. jamaicensis* in all cases, or that we had found a new species closely related to *C. jamaicensis.* A more intensified study of *Cnemidocoptes* mite infestations in wild birds and a reorganization of the nomenclature of the different species of the genus is needed.

In 1963, MacDonald found a blue tit (*Parus caeruleus*) with scaly, white, thickened areas and denuded skin at the base of the beak, around the eyes and on the vent. Though the site of infestation might suggest *C. pilae* the mites isolated were identified as undescribed species of *Myialges* (Epidermoptidae). This is interesting because in the present study a related species (*Parus atricapillus*) was found with mites of the genus *Cnemidocoptes.* Observations like these, where mites, other than *Cnemidocoptes* seemed to cause lesions similar to "scaly leg" disease, suggest a need for further investigations to determine whether other genera of mites may be involved in this disease. They may be merely opportunists, using the prefabricated burrows to lay their eggs. In this respect one must also consider other factors that may produce the picture of "scaly leg" disease such as pox virus infection, epithelial tumours, staphylococcus infection, arthritis, pollen contamination or fungus infections.

In my experience this disease, studied in individual birds over a period of more than six months, was characterized by very slow development of lesions and host specificity. It may be that certain mite species become adapted to the habits and environment of one bird species, so that healthy birds of that species are more susceptible to the mite infestation than other birds. This was shown in our transmission experiments and in the study by Poulsen (1964). The disease was increased in severity experimentally, by mechanical irritation of the diseased legs. It is probable that natural injuries result in more rapid development of the lesions. A warm environment may facilitate transmission of the mites, not only in fowl where it is seen more often in small indoor pens (Neuman, 1905). but also in indoor aviaries where the disease spreads more rapidly.

After Ehlers, who first described the honeycomb pattern in histological sections, no histopathologic studies were made until the discovery of *C. pilae.* Yunker and Ishak (1957) noted that no inflammatory reactions, except during the initial phase of the mite invasions, were observed in "scaly leg" disease. In contrast to my own observations and those of Yunker

and Ishak, inflammation did occur in *C. pilae* infestation of a parakeet (Ivens, Myers, Levine and Pilchard, 1957). Chronic focal changes were noted in the dermis, characterized by infiltration with histiocytes and plasma cells. Whether or not this reaction was caused by secondary infection was not determined.

Thirty-two budgerigars infested with *C. pilae* were found during an investigation in California. The disease appeared to spread slowly but experimental transmission by contact was unsuccessful. As the primary mode of transmission, direct contact from parent to offspring during the nesting period while feeding was suggested (Wichmann and Vincent, 1958).

The role of wild birds as a source of infection to domestic birds or as reservoir hosts of the mites is still unknown. It was demonstrated in the present study that mite infestation in nature was most common in gregarious species of wild birds. Attempts to transmit mites from wild birds to domestic birds have been unsuccessful up to the present. If infection can spread from wild to domestic birds, one may postulate that wild birds such as the seed-eaters (icterides and passerines) which are often found associated with domestic birds on feeding grounds, would be ideal sources of infection. Further transmission experiments are indicated to determine whether *C. mutans* is transmissible to wild birds and whether the wild bird mites of the genus *Cnemidocoptes* are capable of infecting fowl.

APPENDIX

After this paper was completed a male budgerigar (*Melopsittacus undulatus*) from Toronto was found to be infected with *Cnemidocoptes pilae*. Results of study on this case are included in table III.

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NOTICE. Word has just been received that WDA President J. J. Christian has appointed Dr. R. L. Beaudoin as Program Chairman for the 1967 Annual WDA Meeting scheduled to be held in June, 1967 in Urbanna, Illinois. Members interested in making oral presentations at this meeting should contact Dr. Beaudoin, Naval Med. Res. Inst., NNMC, Bethesda, Md. 20014.