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COCCIDIAN PARASITES OF PEROMYSCUS ATTWATERI AND P. PECTORALIS IN TEXAS WITH A DESCRIPTION OF A NEW SPECIES FROM P. PECTORALIS LACEIANUS

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In 1988, five Texas mice, *Peromyscus attwateri*, were collected from Hood County, Texas and in 1990, six white-ankled mice, *Peromyscus pectoralis*, were collected from Kimble County, Texas; feces from all hosts were preserved and later examined for coccidia. Ten of 11 mice (91%) were infected with one to three eimerians. All five *P. attwateri* were infected, including three with only *Eimeria langebarteli*, one with only *Eimeria arizonensis*, and one with both species; five of six (83%) *P. pectoralis* had eimerians, including four with *Eimeria langebarteli* and a new eimerian named for Dr. J Knox Jones, and one with both eimerians and *E. arizonensis*. Sporulated oocysts of *E. arizonensis* from *P. attwateri* were abundant and were subspheroidal with a sculptured outer wall and measured 25.3 x 22.2 (24-27 x 20-23) μm with ovoidal sporocysts 13.8 x 8.8 (13-15 x 7.5-10) μm ; a polymorphic oocyst residuum that varied from one large to many smaller globules was 7.0 (5-8) μm ; polar body, sporocyst residuum, and Stieda body all were present. Sporulated oocysts of *E. arizonensis* from *P. pectoralis* were scarce and were not measured. Sporulated oocysts of *E. langebarteli* from *P. attwateri* were ellipsoidal, 21.5 x 13.8 (17-24 x 12-16) μm with elongate-ovoidal sporocysts 10.1 x 5.5 (9-11 x 5-7) μm ; oocyst residuum was absent, but polar body, sporocyst residuum and Stieda body were present; oocysts and sporocysts of *E. langebarteli* from *P. pectoralis* were slightly smaller, measuring 20.6 x 13.4 (18-25 x 12-15) μm and 9.2 x 5.2 (8-11 x 4.5-6) μm , respectively. Sporulated oocysts of the new eimerian were ellipsoidal, 16.5 x 11.9 (14-18 x 11-13) μm with ovoidal sporocysts, 9.1 x 4.7 (8-11 x 4-5); oocyst residuum was absent, but polar body was present as were sporocyst residuum and Stieda body.

The genus *Peromyscus* is a diverse assemblage of rodents containing ap-

proximately 49 (Honacki *et al.*, 1982) to 59 (Hall, 1981) species. It seems to be the mammalian equivalent to leopard frogs (*Rana pipiens*), a ubiquitous group for which no one seems to know the exact number of species (D. Pettus, pers. comm.). Although *Peromyscus* spp. are distributed widely over North America, exhibit great ecological diversity, are easy to trap, and live and reproduce readily in the laboratory, not much attention has been given them in surveys for Coccidia. In 1985, Reduker *et al.* reviewed this circumstance and noted, "The literature reports only five *Peromyscus* spp (8.5%) examined for *Eimeria*, from which nine *Eimeria* have been described. Given the relatively high natural infection rate of *Peromyscus* populations with *Eimeria*..., the potential for discovery of additional *Eimeria* spp. as more *Peromyscus* spp. are examined appears substantial." If we include the data of isosporans found in deer mice (Davis, 1967; McAllister and Upton, 1989) with the above studies, still only seven *Peromyscus* spp. have been surveyed to present from which 13 coccidians (10 eimerians, three isosporans) have been described.

Here we report a new eimerian from one of two additional *Peromyscus* spp. that had not been surveyed previously for coccidians and add new host records for two previously described eimerians.

MATERIALS AND METHODS

All mice were captured alive with Sherman box traps between 1988 and 1990. Fresh feces were collected from them and stored in 2.5% (w/v) aqueous potassium dichromate ($K_2Cr_2O_7$) at ambient temperatures in the field until they could be returned to the lab and processed. Methods to process and store fecal samples and for concentrating, measuring, and photographing oocysts are noted elsewhere (Duszynski *et al.*, 1982; Stout and Duszynski, 1983). Measurements of sporulated oocysts are given in micrometers with size ranges in parentheses following the means.

RESULTS AND DISCUSSION

Five *P. attwateri* collected from Hood County, Texas in 1988 and six *P. pectoralis* collected from Kimble County, Texas in 1990 were examined for coccidia and 10 of 11 (91 %) were infected with from one to three eimerians; one of these is described below as new and the other two, *E. arizonensis* and *E. langebarteli*, although described previously, have additional structural information or observations noted for each, as seemed necessary.

Eimeria arizonensis Levine, Ivens and Kruidenier, 1957

Description: Recently, Duszynski *et al.*, 1992 documented significant structural variation in *E. arizonensis* sporulated oocysts, especially in the size, shape, and configuration of the large oocyst residuum. Oocysts in the two *Peromyscus* spp. we examined also showed this structural "plasticity" of the oocyst residuum

and measured (N=50) 25.3 x 22.2 (24-27 x 20-23) with L:W ratio 1.14 (1.1-1.3) and sporocysts were 13.8 x 8.8 (13-15 x 7.5-10) with L:W ratio 1.6 (1.4-1.7). These oocyst measurements are slightly smaller and the sporocyst measurements slightly larger than those reported by Duszynski *et al.* (1992), and Levine and Ivens (1990), but all qualitative features are the same as in previous reports. Given that oocysts of *E. arizonensis* seem to exhibit a wide range of structural variation (Duszynski *et al.*, 1992; Upton *et al.*, 1992), the slight size differences from former descriptions may be attributable to host differences. Oocysts were 677 days old when measured.

Hosts: *Peromyscus attwateri* Allen, 1893 and *P. pectoralis laceianus* Bailey, 1906.

Localities: U.S.A., Texas, Hood County (*P. attwateri*) and Kimhle County (*P. pectoralis laceianus*).

Prevalence: Found in two of five (40%) *P. attwateri* and in one of six (17%) *P. pectoralis laceianus*.

Site of infection: Unknown, oocysts recovered from feces.

Remarks

Upton *et al.* (1992), documented that oocysts of *E. arizonensis* could be crosstransmitted between *Peromyscus* and *Reithrodontomys spp.* This species now has been reported in three *Reithrodontomys* and in seven *Peromyscus* host species.

Eimeria langebarteli Ivens, Kruidenier and Levine, 1959

(Figs. 1, 2)

Description: Oocyst ellipsoidal, wall of uniform thickness - 1.1, composed of two layers: outer wall smooth, yellowish, - 3/4 of total thickness; inner layer as a blue/brown line; oocyst residuum absent, but one polar body is usually present; sporulated oocysts (N=50) 21.5 x 13.8 (17-24 x 12-16) with L:W ratio 1.6 (1.3-1.8); sporocysts (N=50) elongate-ovoidal, 10.1 x 5.5 (9-11 x 4.5-7) with L:W ratio 1.8 (1.6-2.3); Stieda body present, but sub- and parastieda bodies absent; sporocyst residuum of one-three small granules, sometimes clumped into small rosette (Fig. 1); sporozoites each with two refractile bodies with posterior one larger than anterior one. Oocysts were 799 days old when measured.

Taxonomic Summary

Hosts: *Peromyscus attwateri* Allen, 1893 and *P. pectoralis laceianus* Bailey, 1906.

Localities: U.S.A., Texas, Hood County (*P. attwateri*) and Kimble County (*P. pectoralis laceianus*).

Prevalence: Found in four of five (80%) *P. attwateri* and in five of six

(83%) *P. pectoralis laceianus*.

Site of infection: Unknown, oocysts recovered from feces.

Remarks

Three of the 10 eimerians described from *Peromyscus* spp. have sporulated oocysts with the same general features: distinctly ellipsoidal (L:W > 1.4), greatest length < 25, without oocyst residuum, with a polar body, and sporocysts with residua and Stieda bodies (Reduker *et al.*, 1985; Levine and Ivens, 1990). These are *E. carolinensis* von Zellen, 1959; *E. delicata* Levine and Ivens, 1960; and *E. langebarteli* Ivens, Kruidenier and Levine, 1959. *Eimeria langebarteli* differs from *E. carolinensis* by having oocysts that are slightly larger, but with a thinner wall, by having longer, ellipsoidal sporocysts vs. shorter, ovoid ones, and by having sporocysts with a distinct residuum (Reduker *et al.*, 1985) vs. a few small granules in some sporocysts (von Zellen, 1959). It differs from *E. delicata* by being significantly larger in oocyst length and width.

The sporulated oocysts we saw were similar in all features to the oocysts described by Ivens *et al.* (1959), except that we presumed to see a thin, inner oocyst wall not recorded in the original description.

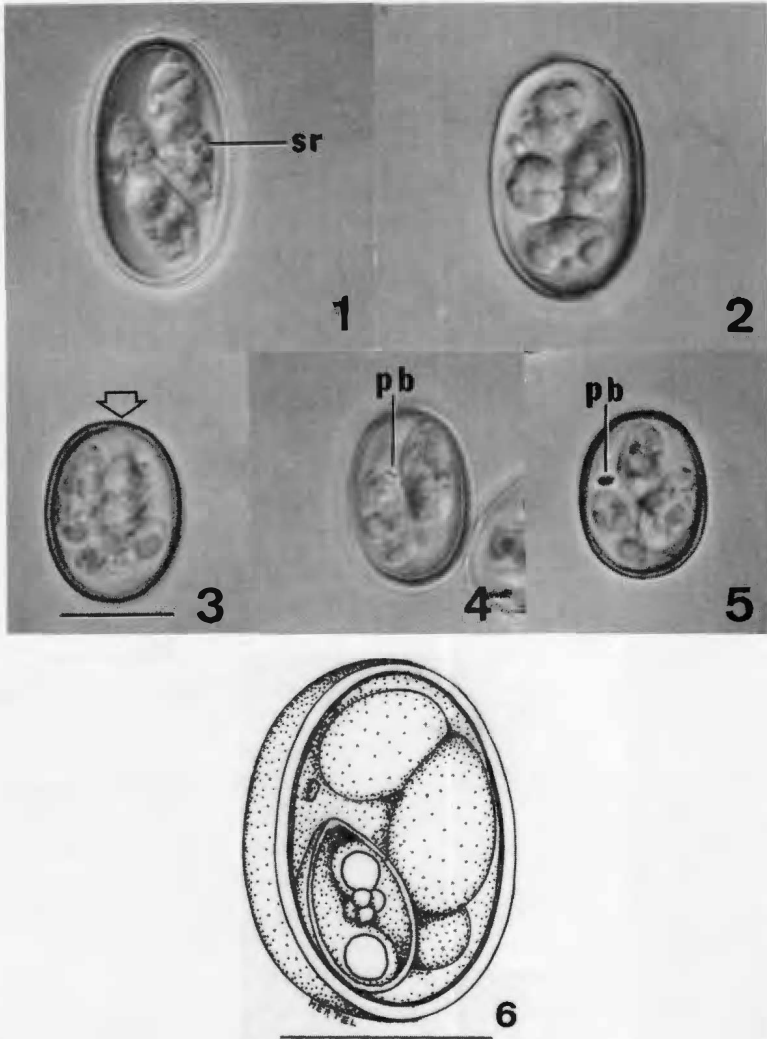
Oocysts in *P. pectoralis laceianus* (Fig. 1) were slightly smaller than those in *P. attwateri* (Fig. 2) and measured 20.6 x 13.4 (18-25 x 12-15) with sporocysts 9.5 x 5.2 (8-11 x 4.5-6); L/W ratios and other structural features were the same. *Eimeria langebarteli* has now been recorded in six *Peromyscus* and *Reithrodontomys* spp. (Duszynski *et al.*, 1992).

In the five *P. attwateri* we studied, three were infected only with *E. langebarteli*, one with only *E. arizonensis*, and one with both eimerians.

Eimeria knoxjonesi n. sp.

(Figs 3-6)

Description: Oocyst ellipsoidal, wall -0.8-1.0, composed of two layers that appear thinner at one end (Fig. 3): outer wall smooth, yellow, -2/3 of total thickness; inner layer green; oocyst residuum absent, but a refractile polar body is present in most of the oocysts (Figs. 4, 5); sporulated oocysts (N=41) 16.5 x 11.9 (14-18 x 11-13) with L:W ratio 1.4 (1.3-1.6); sporocysts (N=41) ellipsoidal, pointed at one end, 9.1 x 4.7 (8-11 x 4-5) with L:W ratio 1.9 (1.7-2.2); small, button-like Stieda body at pointed end (Figs. 3-5), but sub- and parastieda bodies absent; sporocyst residuum usually a small rosette of three-four granules (Fig. 4), but sometimes these are dispersed; sporozoites with one refractile body at blunt end and sometimes a second, smaller body at pointed end (Figs. 3, 5). Oocysts were 97 and 730 days old when measured.



LEGEND TO FIGURES

Figures 1-5. Photomicrographs of sporulated oocysts of eimerians from *Peromyscus* spp. 1. *Eimeria langebarteli* from *P. pectoralis*. 2. *Eimeria langebarteli* from *P. attwateri*. 3-5. *Eimeria knoxjonesi* n. sp. from *P. pectoralis laceianus*. Abbreviations: pb, polar body; sr, sporocyst residuum. Scale bar = 10 μ m.

Figure 6. Line drawing of sporulated oocyst of *Eimeria knoxjonesi* n. sp. Scale bar = 10 μ m.

Taxonomic Summary

Type host: *Peromyscus pectoralis laceianus* Bailey, 1906, juvenile male, C.T. McAllister No. 321, 17 Feb., 1990, alcoholic specimen (=syntype, see Frey et al., 1992) in Arkansas State University Museum of Zoology (ASUMZ) No. 26517.

Type locality: U.S.A., Texas, Kimble County, 6.4 km SE Junction of I-10, vicinity of Segovia (30° 25'N, 99° 45'W).

Material deposited: Phototypes of sporulated oocysts in the USNMPC No. 82824

Prevalence: Found in five of six (83%) *P. pectoralis laceianus*.

Site of infection: Unknown, oocysts recovered from feces.

Etymology: This species is named in honor of Dr. J Knox Jones, Jr. (deceased), Professor of Biology and Museum Science, Texas Tech University, in recognition of his many contributions to our understanding of Texas mammals.

Remarks

Sporulated oocysts of *E. knoxjonesi* most closely resemble those of *E. carolinensis* and *E. delicata*, which themselves are very similar, as noted above. It differs from *E. carolinensis* by having a thinner oocyst wall (1.0 vs. 1.5) that does not have "an inner dark brown layer 0.5 thick," by having smaller sporocysts, and by having a distinct sporocyst residuum, whereas in *E. carolinensis*, "typically no sporocyst residuum is present although small granules were present in several sporocysts" (von Zellen, 1959). It differs from *E. delicata* by having larger oocysts with a thicker (1.0 vs. 0.6), bilayered wall and definite sporocyst residual granules vs. "some sporocyst residual granules ordinarily present, although they may sometimes be absent" (Levine and Ivens, 1960). Also, neither of the two similar species are noted to have the distinct refractile bodies in their sporozoites, structures that are clearly present in *E. knoxjonesi* (Figs. 3-5).

Of the five infected *P. pectoralis* we studied, all were infected with both *E. knoxjonesi* and *E. langebarteli* and one of these was also infected with *Eimeria arizonensis*. It is interesting to note that this eimerian was not present in *P. attwateri*, whereas the other two eimerians found in *P. attwateri* were also found in *P. pectoralis*. It also is curious that all of the *P. pectoralis* examined were infected with two-three species simultaneously, whereas the vast majority of individuals in the other seven *Peromyscus* spp. (including *P. attwateri*, above) examined to date for coccidians are usually found to harbor only one coccidian at a time (e.g., Levine and Ivens, 1960; von Zellen, 1959, 1961; Davis, 1967; Reduker et al., 1985; McAllister and Upton, 1989; McAllister et al., 1993). Perhaps there is something unique about the genetic makeup of *P. pectoralis* or the rocky environment in which this host is found that results in each indi-

vidual being such a good host for eimerians.

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PUBLICATIONS OF THE MUSEUM OF TEXAS TECH UNIVERSITY

It was through the efforts of Horn Professor J Knox Jones, as Director of Academic Publications, that Texas Tech University initiated several publications series including the *Occasional Papers of the Museum*. This and future editions in the series are a memorial to his dedication to excellence in academic publications. Professor Jones enjoyed editing scientific publications and served the scientific community as an editor for the *Journal of Mammalogy*, *Evolution*, *The Texas Journal of Science*, *Occasional Papers of the Museum*, and *Special Publications of the Museum*. It is with special fondness that we remember Dr. J Knox Jones.

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