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Eimeria dixoni sp. n. (Apicomplexa: Eimeriidae) from an Introduced Population of Common House Geckos, *Hemidactylus frenatus* (Sauria: Gekkonidae), in Dallas County, Texas

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ABSTRACT: *Eimeria dixoni* sp. n. is described from the feces of 11/16 (68%) common house geckos, *Hemidactylus frenatus,* in Texas. Sporulated oocysts of the new species are spherical or subspherical, 20.8 × 19.7 (17–22 × 17–21) μm, with a smooth, bilayered wall; shape index 1.06 (1.0–1.1). A micropyle, oocyst residuum, and polar granule are absent. Sporocysts are ovoid, 9.3 × 7.8 (8–11 × 7–8) μm; Stieda and substieda bodies are absent. A spherical or ovoid sporocyst residuum is present, composed of a compact mass of similar-sized membrane-bound granules. Sporozoites are vermiform, 9.8 × 2.8 (8–11 × 2.6–3.2) μm in situ, each containing spherical anterior and spherical or subspherical posterior refractile bodies. In addition to the new species, *Eimeria lineri* McAllister, Upton, and Freed, 1988, was found in 14/16 (88%) sympatric Mediterranean geckos, *Hemidactylus turcicus turcicus.* However, neither eimerian was found to be shared among congeneric geckos, suggesting strict host specificity.

KEY WORDS: *Eimeria dixoni* sp. n., *Eimeria lineri,* coccidia, Gekkonidae, common house gecko, *Hemidactylus frenatus,* Mediterranean gecko, *Hemidactylus turcicus,* Texas, prevalence, Apicomplexa, Eimeriidae.

The common house gecko, *Hemidactylus frenatus,* is a medium-sized Old World gekkonid lizard that ranges from southern Africa and Madagascar eastward to tropical southern Asia, the Malay Archipelago, and the western Pacific Islands of the Indian Ocean (Taylor, 1921; Smith, 1935). It has been widely introduced into northern Australia and Hawaii (McCoy and Busack, 1970) and also into the western hemisphere in Mexico (Edgren, 1956; Marcellini, 1971). Like the related Mediterranean gecko, *Hemidactylus turcicus turcicus* (Linnaeus), this gekkonid lizard occasionally enters the United States along shipping routes.

Much is known about the trematode (Killick and Beverley-Burton, 1982; Kennedy et al., 1987a, b), cestode (Kennedy et al., 1982; Jensen et al., 1983), and especially the nematode (Gupta, 1959; Caballero, 1968; Jehan, 1970; Oshmarin and Demshin, 1972; Schmidt and Kuntz, 1972; Jaing and Lin, 1980) parasites of *H. frenatus.* However, compared to other gekkonids, little is available on the coccidian parasites of the species (see Matuschka and Bannert, 1986a, b). Yamamoto (1933) reported 2 unnamed eimerians from *H. frenatus* in Taiwan, and Else and Colley (1975) described *Eimeria cicaki* in a single house gecko from Malaysia. Nothing is known about the coccidia of introduced North American populations of *H. frenatus.*

Between April and June 1989, we had the opportunity to examine select specimens of *H. frenatus* for intestinal protozoans. Fecal samples from some of these geckos contained coccidian oocysts of the genus *Eimeria,* which proved to represent a previously undescribed species. The following is a description of this new eimerian and presents preliminary evidence that supports the notion that this new species, as well as *Eimeria lineri* McAllister, Upton, and Freed, 1988, from *H. turcicus,* may have narrow host specificity.

Materials and Methods

Sixteen adult (7 male and 9 female) *H. frenatus* ($\bar{x}$ ± SEM snout–vent length [SVL] = 54.3 ± 1.5, range = 42–62 mm) were collected by one of us (D.M.B.) as they roamed free within the reptile facility of the Dallas Zoo, Dallas County, Texas. In addition, 16 wild adult (8 male and 8 female, 48.9 ± 1.3, 42–57 mm) *H. t. turcicus* were collected for comparative purposes from within the same building and examined for coccidial parasites. Individual geckos were assigned an accession number and placed in 3.8-L glass jars containing damp toweling and water. Freshly shed fecal pellets were obtained from captive geckos, placed in individual vials containing 2.5% (w/v) aqueous $K_2Cr_2O_7$, and stored at 4°C. Geckos were later toe-clipped following accepted

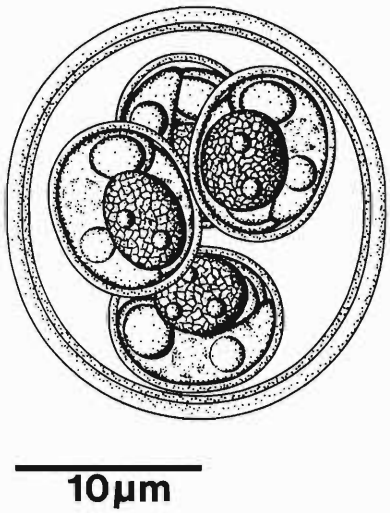


Figure 1. Line drawing of sporulated oocyst of *Eimeria dixoni* sp. n.

guidelines (ASIH–HL–SSAR, 1987) to avoid duplicate sampling and released unharmed where they were originally collected. Fecal samples were screened for coccidia by flotation in modified Sheather's sugar solution (sp. gr. 1.30) and positive samples containing unsporulated oocysts were allowed to sporulate at 22°C in petri dishes containing a thin layer of 2.5% potassium dichromate, then mailed to Kansas State University prior to further examination. Sporulated oocysts were concentrated by centrifugation–flotation (as above) and examined and photographed using Nomarski interference-contrast microscopy. Oocysts were measured using a calibrated ocular micrometer; measurements are reported in micrometers (µm) with the means followed by the ranges in parentheses. Oocysts of the new species were 15–22 days old when examined and photographed.

Results

Twenty-five of 32 (78%) geckos were infected with coccidia, including 11/16 (69%) *H. frenatus,* which harbored a previously undescribed species of *Eimeria,* and 14/16 (88%) *H. t. turcicus* infected with *Eimeria lineri* McAllister, Upton, and Freed, 1988. Neither of these 2 eimerians was found to be shared among geckos. Below is a description of the new species.

Eimeria dixoni sp. n. (Apicomplexa: Eimeriidae) (Figs. 1–4)

DESCRIPTION: Oocysts ($N = 30$) spherical or subspherical, 20.8 × 19.7 (17–22 × 17–21); shape index (length/width) 1.06 (1.0–1.1). Wall smooth and bilayered, ca. 1.2 thick, composed of a thick, colorless outer layer ca. 0.8 and thinner inner layer ca. 0.4. Micropyle, polar granule, and oocyst residuum absent. Sporocysts ($N = 30$) ovoid, 9.3 × 7.8 (8–11 × 7–8), with a smooth, thin wall ca. 0.4 thick; shape index 1.2 (1.1–1.4); Stieda and substieda bodies absent. Spherical or ovoid sporocyst residuum ($N = 9$) present, 5.8 × 4.5 (5–7 × 3–6), composed of a compact mass of similar-sized membrane-bound granules. Sporozoites ($N = 7$) vermiform, tapered anteriorly, 9.8 × 2.8 (8–11 × 2.6–3.2) in situ, and usually arranged head-to-tail within sporocyst. Each sporozoite contains a spherical anterior refractile body ($N = 6$), 1.9 (1.6–2.4), and a spherical or ovoid posterior refractile body ($N = 7$), 3.1 long × 2.5 wide (2.4–3.8 × 2.4–2.6). A nucleus lies between the refractile bodies.

TYPE SPECIMENS: Syntypes (oocysts in 10% formalin) are deposited in the U.S. National Museum, Beltsville, Maryland 20705, as USNM 80757.

TYPE HOST: *Hemidactylus frenatus* Schlegel *in* Duméril and Bibron, 1836 (Sauria: Gekkonidae), common house gecko, adult female, Arkansas State University Museum of Zoology, ASUMZ 13028, 9 May 1989.

TYPE LOCALITY: U.S.A., Texas, Dallas County, Dallas Zoo, 621 East Clarendon Drive.

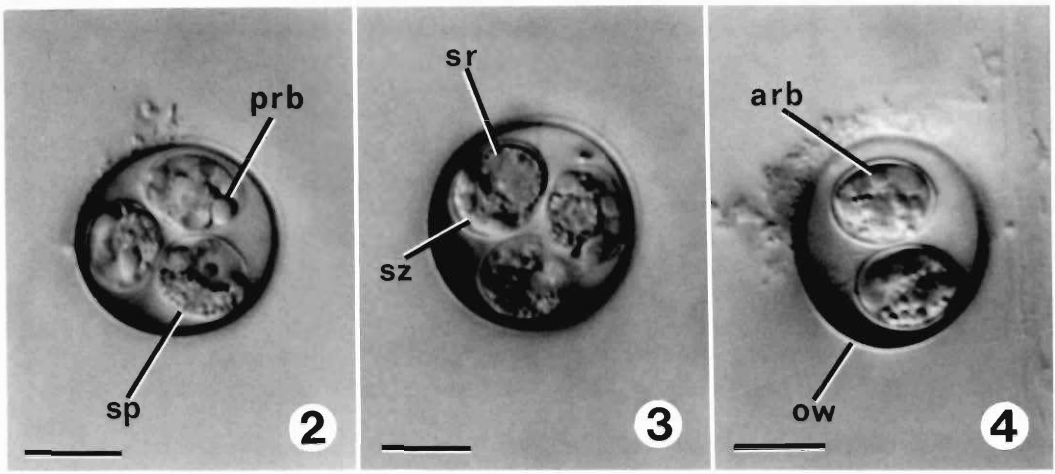
SITE OF INFECTION: Unknown. Oocysts removed from feces.

SPORULATION: Exogenous. Oocysts were passed unsporulated or partially sporulated and became fully sporulated within 48 hr at 22°C in 2.5% $K_2Cr_2O_7$.

PREVALENCE: 11/16 (69%) of *H. frenatus* examined.

ETYMOLOGY: Named in honor of James R. Dixon, Professor of Wildlife and Fisheries Sciences, Texas A&M University, for his contributions to gekkonid biology and neotropical herpetology.

REMARKS: *Eimeria dixoni* sp. n. resembles the following eimerians from gekkonid lizards: *Eimeria* sp. from *H. frenatus* in Taiwan (Yamamoto, 1933); *Eimeria boveroi* (Carini and Pinto, 1926) from the house gecko, *Hemidactylus mabouia* (Moreau de Jonnes, 1818) in Brazil and Mexico (Carini and Pinto, 1926; McAllister and Upton, 1989); *E. cicaki* Else and Colley, 1975, from the stump-toed gecko, *Gehyra mutilata* (Wiegmann, 1835) and *H. frenatus* in Malaysia (Else and Colley, 1975); and *Eimeria brygooi* Upton and Barnard, 1987, from the Madagascar day gecko, *Phelsuma madagascarensis grandis* (Gray, 1870), and golddust day



Figures 2–4. Nomarski interference-contrast photomicrographs of sporulated oocysts of *Eimeria dixoni* sp. n.: arb (anterior refractile body), ow (oocyst wall), prb (posterior refractile body), sp (sporocyst), sr (sporocyst residuum), sz (sporozoite). Scale bars = 10 μm.

gecko, *Phelsuma laticauda* (Boettger, 1880), in Madagascar (Upton and Barnard, 1987). The new species differs from Yamamoto's unnamed eimerian is being less elongate and not having a micropyle, from *E. boveroi* by possessing considerably larger sporocysts and by lacking a polar granule, and from *E. cicaki* and *E. brygooi* by having smaller oocysts and sporocysts and by lacking the 3–7 polar granules characteristic of *E. cicaki*.

Discussion

Hemidactylus frenatus and *H. turcicus* are native to the Old World. The population of *H. frenatus* at the Dallas Zoo was initially started during the 1970's for pest (i.e., insect) control. On the other hand, the *H. turcicus* were accidentally introduced into the zoo in the late 1970's, probably in hay bedding and shipping pallets transported from south Texas. Both geckos typically deposit fecal pellets on walls, sinks, floors, and even in other reptile cages within the reptile facility at the zoo. Because both geckos primarily utilize the same microhabitat within the building, they must come into contact with freshly deposited feces of either species, and the possibility for cross-transmission or autoinfection of coccidia exists. However, as stated previously, neither *E. dixoni* nor *E. lineri* was found to infect geckos other than the type host species.

In conclusion, although *E. turcicus* Upton, McAllister, and Freed, 1988, has been found commonly to infect *H. t. turcicus* at 2 sites in southern Texas and 1 locale in Louisiana (McAllister et al., 1988; Upton et al., 1988), it was not found in the population of Mediterranean geckos at the Dallas Zoo. This suggests that *H. t. turcicus* and *H. frenatus* may not share the same coccidian parasites and that at least some species of lizard coccidia may be species specific. However, caution must be exercised in the final interpretation of our preliminary data. It is known that even when 2 or more hosts have overlapping ranges in natural situations they may not share coccidians, even though both host species are equally susceptible and capable of being infected in the laboratory (see Doran, 1953).

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