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EIMERIA (PROTOZOA: EIMERIIDAE) FROM NORTH AMERICAN SCIURIDS,
GLAUCOMYS SABRINUS AND TAMIAS TOWNSENDII:
WITH A DESCRIPTION OF A NEW SPECIES

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ABSTRACT: From 1990 to 1991, 11 northern flying squirrels, Glaucomys sabrinus, and 30 Townsend's chipmunks, Tamias townsendi, were live-trapped, marked, and released in MacDonald Forest, Benton Co., Oregon and their feces at each capture examined for the presence of coccidian parasites. Two eimerians were found in G. sabrinus: Eimeria dorneyi and a second eimerian that was identified from T. townsendi. Sporulated oocysts of the new eimerian are strongly ellipsoidal, pointed at 1 end, and are 47.2 × 25.0 (41–52 × 22–31) μm with ovoidal sporocysts, 19.0 × 10.5 (17–21 × 9–11) μm. A micropyle and oocyst residuum are absent, but, occasionally, a polar granule is present in the oocyst. In the sporocysts, Stieda and substieda bodies are present, as is a membrane-bound residuum. Sporulated oocysts of E. dorneyi are uniformly ellipsoidal, 23.0 × 14.7 (17–26 × 13–16) μm with elongate ellipsoidal sporocysts, 11.6 × 5.7 (9–13 × 5–7) μm. A micropyle and oocyst residuum are absent, but 1 polar granule is present. A Stieda body is present, but sub- and paraschieda bodies are absent. The sporocyst residuum is composed of granules in a compact mass. Here we provide phototype (hapantotype) specimens archived in a nationally accredited museum and a line drawing (cartoon) to supplement the one provided by Sont and Dorney because their drawing did not show the sporocyst residuum given in the written description.

The Sciuridae (squirrels and their relatives) comprise 50 genera with 273 species (Wilson and Reeder, 1993), but only 16 of these genera have had 1 or more of their species examined as possible hosts for coccidia. The squirrels are divided into 2 tribes of the Sciurinae to determine which are valid species and which are not (P Wilber, unpubl. obs.). We have noted that (1) many “species” do not meet minimal criteria for a species description under the International Code of Zoological Nomenclature (Ride et al., 1985); (2) several “species” have been described several times, but given different names; and (3) many valid species occur in multiple hosts. In this study, we name 1 new species and provide mensural data and type material on a second species to retain the name Eimeria dorneyi Levine and Ivens, 1965.

MATERIALS AND METHODS

Hosts were live-trapped at 1 site in MacDonald Forest at 2–5 wk intervals from 8 July to 14 September 1990 and from 30 March to 6 October 1991. Fecal samples from G. sabrinus were only examined in 1990. Rodents were individually marked and released. Feces were collected from traps to examine for the presence of coccidia. The squirrels were divided into 2 subfamilies, the Pteromyinae (14 genera, 43 spp.) and the Sciurinae (36 genera, 230 spp.). In this study we had the opportunity to examine feces from Glaucomys sabrinus Shaw, 1801 and from Tamias townsendi Bachman, 1839, a member of each subfamily, respectively. In a companion study, in which we are examining all coccidian species described from the Marmotini tribe of the Sciurinae to determine which are valid species and which are not (P Wilber, unpubl. obs.), we have noted that (1) many “species” do not meet minimal criteria for a species description under the International Code of Zoological Nomenclature (Ride et al., 1985); (2) several “species” have been described several times, but given different names; and (3) many valid species occur in multiple hosts. In this study, we name 1 new species and provide mensural data and type material on a second species to retain the name Eimeria dorneyi Levine and Ivens, 1965.

DESCRIPTION

Eimeria dorneyi Levine and Ivens, 1965
(Figs. 1–3, 7)

Oocysts uniformly ellipsoidal (Figs. 1, 2) with 2 wall layers, ~1.0–1.3, of equal thickness, outer layer smooth, not sculptured; micropyle and oocyst residuum are absent, but 1 highly refractile polar granule present, which varies in shape, ~1.5 long (Fig. 3); sporulated oocysts (N = 16) 17–21 × 13–16 (23.0 × 14.7) with L/W ratio 1.6 (1.4–1.7); sporocysts (N = 16) elongate-ellipsoidal (Fig. 1), 9–13 × 5–7 (11.6 × 5.7) with L/W ratio 1.8–2.1 (2.0); Stieda body present, prominent, but sub- and paraschieda bodies are absent; sporocyst residuum of compact granules, ~3 × 4, and may be membrane bound; sporozoites with highly granular cytoplasm and 1 large, posterior refractile body.

TAXONOMIC SUMMARY

Type host: Glaucomys sabrinus macrotis, northern flying squirrel (Dorney, 1962).
Type locality: U.S.A., Wisconsin, Vilas County near Trout Lake (Dorney, 1962).
Other localities: Canada, Ontario, University of Waterloo campus (Soen and Dorney, 1969); U.S.A., Oregon, Benton County, MacDonald Forest (this study).

Prevalence: Found in 1/1 G. sabrinus in Wisconsin, 2/2 G. sabrinus in Ontario, and 1/11 (9%) G. sabrinus in Oregon (this study); it was subsequently found in 2 other Oregon G. sabrinus recaptured at a later date.

Sporulation time: Within 1 wk at room temperature (20 C), this study.

Material deposited: Phototype (see Bandoni and Duszynski, 1988) of sporulated oocysts in the U.S. National Parasite Collection (USNPC), Beltsville, Maryland, no. 86934. Symbiotype (see Frey et al., 1992) of this host was not collected as all hosts were marked and released after capture.

Remarks

Dorney (1962) caught 1 G. sabrinus macrotus and found it was discharging oocysts that he thought fit the description of Eimeria sciurorum Galli-Valerio, 1932; however, the original description of E. sciurorum from Sciurus vulgaris (Galli-Valerio, 1932) was so incomplete that it depended upon your interpretation of these definitions in the International Code of Zoological Nomenclature; Ride et al., 1985). Because of this and the assumption that sciurids in different subfamilies can not share eimerians, Levine and Ivens (1965) named the species first described by Dorney (1962) as E. dorneyi. Later, Soen and Dorney (1969) added additional mensural data for E. dorneyi oocysts they found in the same host species in Ontario, Canada. However, neither they nor Levine and Dorney located the specimen(s) of E. sciurorum they claimed as the type material; therefore, their name is not based on a type specimen and is therefore a nomen dubium in the sense of the International Code of Zoological Nomenclature; Ride et al., 1985).
FIGURES 1–6. Photomicrographs of sporulated oocysts of coccidians recovered from the feces of Glaucomys sabrinus captured in the MacDonald Forest, Benton County, OR. 1–3. Eimeria dorneyi. 4–6. Eimeria bentoniensis n. sp. Scale bar = 10 μm for all figures. Abbreviations: pg, polar granule; sb, Stieda body; sr, sporocyst residuum; ssb, substieda body; *, sporozoite refractile body.

Ivens (1965) submitted a photomicrograph (=hapantotype) for reference into an accredited museum, a procedure not consistent with the intent of the International Code of Zoological Nomenclature (Ride et al., 1985) that explicitly recommends the designation of type specimens for new species (see Bandoni and Duszynski [1988] for a complete discussion). Here, we provide structural information to supplement that given by Soon and Dorney (1969) and provide phototypes/hapantotypes (deposited in an accredited museum) of sporulated oocysts (see Article 72 (3) (iv), p. 143–144 in Ride et al. [1985]). We also provide a line drawing to supplement/replace the one in Soon and Dorney (1969) because their recorded mensural data note the presence of a sporocyst residuum that did not appear in their drawing.

**Eimeria bentoniensis n. sp.**
(Figs. 4–6, 8)

Oocysts ellipsoidal, pointed at 1 end, with 2 walls, ~1.5, of equal thickness, outer layer smooth (Fig. 4), but often has adherent debris attached (Figs. 5, 6); micropyle and oocyst residuum absent; polar granule absent/present, 0–2, usually 1; sporulated oocysts (N = 28) 41–52 x 22–31 (47.2 x 25.0) with L:W ratio 1.6–2.2 (1.9); sporocysts (N = 26) ovoidal, pointed at Stieda body, 17–21 x 9–11 (19.0 x 10.5) with L:W ratio 1.5–2.2 (1.8); Stieda body pointed and substieda body present, ~2× wider than Stieda body, but parastieda body absent; sporocyst residuum of coarse granules and appears membrane bound, ~1~1.5 in length; 1 large refractile body present, ~1/2 the length of the sporozoite.

**Taxonomic summary**

**Type host:** Glaucomys sabrinus Shaw 1801, northern flying squirrel.

**Type locality:** U.S.A., Oregon, Benton Co., MacDonald Forest, 44°37.63’N, 123°18.28’W.

**Prevalence:** Found in 1/11 (9%) G. sabrinus captured for the first time and subsequently found in 2 animals recaptured at a later date.

**Sporulation time:** Within 1 wk at room temperature (20 C).

**Material deposited:** Phototypes of sporulated oocysts in the USNPC, Beltsville, Maryland, no. 86933. Symbiotypes were not collected.

**Etymology:** The nomen trivale is derived from the type locality (county) and -iensis (L., belonging to).

**Remarks**

Only *Eimeria petauristae* from the Himalayan flying squirrel, *Petaurista petaurista*, in India (Ray and Singh, 1950) approaches the size of our new species, but its sporulated oocyst has a distinctive flask shape with a short neck, a dome-shaped "pseudomicropyle" with a transparent outer cap, and a rugged deep brown outer wall layer, all of which the new species lacks. Also, the sporocysts of our species have both Stieda and substieda bodies, which the sporocysts of *E. petauristae* lack. The 3 flying squirrels infected with *E. bentoniensis* were also infected with *E. dorneyi*. 
The prevalence of *E. vilasi* was higher in male than in female chipmunks in both years of this study. Female mammals may be less susceptible to disease than males because androgens suppress immunity (Schuurs and Verheul, 1990; McGruden and Stimson, 1991). In addition, males may be exposed to parasites more frequently than females because of behavioral or micro-habitat differences (Alexander and Stimson, 1988; Bundy, 1988). It is unclear which of these factors is important in determining the prevalence of *E. vilasi* in *T. townsendii*, or whether both may be working in concert.

The subfamily Pteromyinae contains 14 genera of flying squirrels (*G. sabrinus* and *G. volans*). Only 7 species of *Eimeria* have been described previously in the Pteromyinae: *Eimeria glaucomydis* Roudabush, 1937 from *Glaucomys volans* in Iowa, U.S.A. (Roudabush, 1937); *E. petauristae* Ray and Singh, 1950 from *P. petaurista* in India (Ray and Singh, 1950); *Eimeria parasciurorum* Bond and Bovee, 1958 from *G. volans* in Florida, U.S.A. (Bond and Bovee, 1958); *Eimeria dorneyi* Levine and Ivens, 1965 in *G. volans* from Wisconsin, U.S.A. (Dorney, 1962; Levine and Ivens, 1965); *Eimeria aeromysis* Colley and Mullin, 1971 in *Aeromys tephromelas* from Johore, Malaysia (Colley and Mullin, 1971); *Eimeria hylopetis* Colley and Mullin, 1971 in *Hylopetes spadicus* from Kuala Lumpur, Malaysia (Colley and Mullin, 1971); and *Eimeria malayensis* Colley and Mullin, 1971 in *Petaurista elegans* (type host) and in *P. petaurista* from Kuala Lumpur, Malaysia (Colley and Mullin, 1971). Thus, *E. bentonensis* and *E. dorneyi* are the first eimerians reported from *G. sabrinus*.

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LITERATURE CITED


host specimens (symbiotypes) for new parasite species. Journal of Parasitology 78: 930–932.


