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Redescription and New Host Record of *Eimeria serbica* from the Caucasian Tree Squirrel, *Sciurus anomalus*, from Turkey

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REDESCRIPTION AND NEW HOST RECORD OF *EIMERIA SERBICA* FROM THE CAUCASIAN TREE SQUIRREL, *SCIURUS ANOMALUS*, FROM TURKEY

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ABSTRACT: Fecal samples from 20 Caucasian tree squirrels, *Sciurus anomalus* (Gmelin, 1778) Güldenstaedt, 1785, were collected in Turkey during February and March, 2004, and all 20 were infected with a single species of coccidia, *Eimeria serbica*. Sporulated oocysts are ellipsoidal, 27.5 × 17.5 (21–34 × 15–20) with a length:width ratio (L/W) of 1.6 (1.4–1.8); they lack a micropyle and oocyst residuum, but 0–2 polar granules may be present. Sporocysts are ellipsoidal, 11.9 × 6.9 (10.5–14 × 6–7.5) with a L/W of 1.7 (1.5–2.1); a Stieda body and sporocyst residuum are present.

The order Rodentia has more described species than any other mammalian order. In one family alone, the Sciuridae, there are 50 genera with 260 species that are found in a wide variety of habitats throughout most of the New World and Eurasia (Walker, 1991; Wilson and Reeder, 1993). To date, >450 species of coccidia have been described from various rodent genera (Duszynski and Upton, 2001), but none has been described from the Caucasian tree squirrel *Sciurus anomalus*. Here, we report new host and geographic records for *Eimeria serbica* Pop-Cenitch & Bordjochki, 1957, thus adding to our continually growing knowledge of the parasite fauna of rodents.

MATERIALS AND METHODS

Between February and March, 2004, 20 fecal samples were collected from Caucasian tree squirrels in Turkey; 16 were live-trapped and feces collected upon defecation. The other 4 were killed and feces collected directly from their intestines. Fecal material was placed in vials of 2% (w/v) aqueous potassium dichromate ($K_2Cr_2O_7$) solution, mixed thoroughly, and temporarily refrigerated at 4 C before being shipped to the United States. Upon receipt at the University of New Mexico, the samples were stored at ambient temperature for ~2–3 mo until they could be processed and screened for coccidia as detailed by Duszynski and Wilber (1997). Oocysts were measured and photographed using both bright-field and Nomarski differential interference contrast (DIC) microscopy. Because only line drawings of the oocysts have been published (Pop-Cenitch and Bordjochki, 1957; Ryšavý and Èerná, 1979), we have included photomicrographs with this manuscript and submitted 2 photosyntypes to the U.S. National Parasite Collection in Beltsville, Maryland. Standardized abbreviations for oocyst and sporocyst structures generally follow those of Wilber et al. (1998): *oocyst characters*: length (L) and width (W) with their ranges, and ratios (L/W), micropyle (M), residuum (OR), polar granules (PG); *sporocyst characters*: L, W, ranges, and L/W, Stieda body (SB), substieda body (SSB), parastieda body (PSB), residuum (SR), sporozoites (SZ), refractile bodies (RB), and nucleus (N) in SZ. All measurements are in micrometers (μm) with ranges in parentheses after the means.

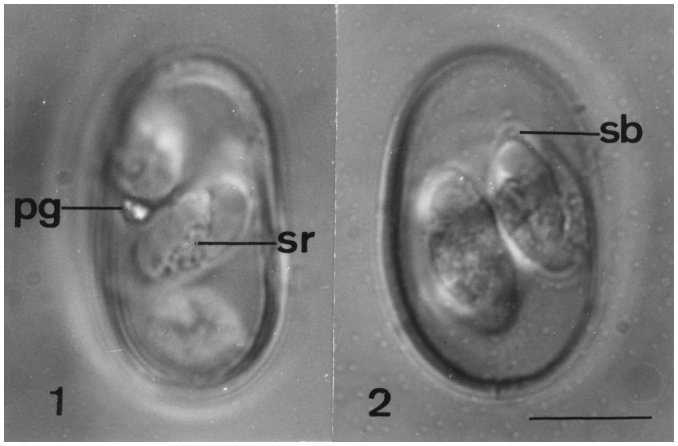
DESCRIPTION

Eimeria serbica Pop-Cenitch & Bordjochki, 1957

(Figs. 1–2)

Description of sporulated oocyst: Oocyst shape: ellipsoidal; number of walls: 1; wall thickness: 1.5; wall characteristics: smooth; L × W (n =50): 27.5 by 17.5 (21–34 by 15–20); L/W: 1.6 (1.4–1.8); M: absent; OR: absent; PGs: 0–2. Distinctive features of oocyst: ellipsoidal shape with smooth, thick outer wall.

Description of sporocyst and sporozoites: Sporocyst shape: ellipsoidal; L × W: 11.9 by 6.9 (10.5–14 by 6–7.5); L/W: 1.7 (1.5–2.1); SB: present; SSB: absent; PSB: absent; SR: present; SR characteristics: small to medium-sized granules dispersed between SZ; SP: lie head to tail, with 1 distinct posterior RB; N not visible.



FIGURES 1-2. Photomicrographs of sporulated oocysts of *Eimeria serbica* Pop-Cenitch and Bordjochki, 1957 from *Sciurus anomalus* from Turkey. Scale bar = 10 μm. Note the ellipsoidal shape, distinct polar granule, and presence of a Stieda body and sporocyst residuum. Abbreviations: **pg,** polar granule; **sb,** Stieda body; **sr,** sporocyst residuum.

Taxonomic summary

Type host: Presumably *Sciurus vulgaris* Linnaeus, 1758, Eurasian red squirrel, but this was not stated in the original description.

Other hosts (this study): Sciurus anomalus (Gmelin, 1778) Güldenstaedt, 1785, Caucasian tree squirrel.

Type locality: EUROPE: Yugoslavia: Serbia, Belgrade Zoo.

Geographic distribution: EUROPE: Yugoslavia, Czech Republic; ASIA: Turkey: Aydin, Elaziğ, Konya.

Prevalence: 20/20 (100%) *S. anomalus* (this study); 1/4 (25%) *S. vulgaris* in Yugoslavia (Pop-Cenitch and Bordjochki, 1957); 4/4 (?)

TABLE I. Caucasian tree squirrels (*Sciurus anomalus*) collected from 5 localities in Turkey and examined for coccidia. All were infected with a single species of *Eimeria* (*E. serbica*).

Squirrel no.	Date collected	Locality
1, 2, 3, 4 (all killed)	14 February 2004	Bozkir, Kenya
5, 6, 7	21 February 2004	Karasalkim Village, Palu, Elaziğ
8, 9, 10, 11, 12	25 February 2004	Kayadibi Village, Hatunsaray, Konya
13, 14, 15, 16	28 February 2004	Kizilca Village, Köşk, Aydin
17, 18, 19, 20	6 March 2004	Fakilar Village, Hadim, Konya

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(100%) *S. vulgaris* in the Czech Republic (Jírovec, 1942; Ryšavý, 1954; Ryšavý and Černá, 1979).

Sporulation: At least 12 days at 25 C (Pop-Cenitch and Bordjochki, 1957) or 96 hr at 16–18 C. (Ryšavý and Černá, 1979).

Prepatent and patent periods: Unknown.

Site of infection: ''Intestine,'' see Jírovec (1942) and Ryšavý and Černá (1979).

Material deposited: Photosyntypes of sporulated oocysts deposited in the U.S. National Parasite Collection (USNPC), Beltsville, Maryland, No. 95336.

Remarks

Ryšavý and Černá (1979) speculated that this species was first described in the Czech Republic by Jírovec (1942) who misidentified it as *Eimeria sciurorum* Galli-Valerio, 1922; however, the form described by Jírovec (1942) had oocysts that were 30–50 by 15–35, much too large to be *E. serbica*. Ryšavý (1954) ''described evidently the same species from the same host [species],'' but also called it *E. sciurorum* (Ryšavý and Černá, 1979). Three years later, Pop-Cenitch and Bordjochki (1957) described and named *E. serbica* from *S. vulgaris* in Yugoslovia. Sporulated oocysts of *E. serbica* that we measured from *S. anomalus* are almost identical in shape (ellipsoidal) and size (21–34 by 15–20, mean 27.5 by 17.5) to those first described from the Eurasian red squirrel *S. vulgaris* from Yugoslavia (21–35 by 12–24, in Pop-Cenitch and Bordjochki, 1957). Additionally, sporocyst size and characteristics from the original description of *E. serbica* (7–8 by 12–13; SB and SR of ''conspicuous dense dark small granules'') were similar to the sporocysts we found in *S. anomalus* (6–7.5 by 10.5–14, mean 6.9 by 11.9). This is the first record of an eimerian infecting the Caucasian tree squirrel.

DISCUSSION

Sciurus vulgaris (subgenus *Sciurus* L., 1758) is found throughout Europe and northern Asia, whereas *S. anomalus* (subgenus *Tenes* Thomas, 1909) is geographically isolated as the only sciurid species in areas of Caucasus, Asia Minor, Syria, Palestine, and western Iran (Walker, 1991). Thus, the 2 species of squirrels are not known to overlap in their geographical localities, and the fact that they both harbor the same species of eimeriid coccidia is interesting, but perplexing. However, it is not uncommon for eimerians that infect 1 species of rodent to be able to infect another congeneric species (e.g., Hnida and Duszynski, 1999). Thus, it seemed the prudent choice at this time to assume that the form we saw in *S. anomalus* was actually *E. serbica*, rather than to create a new species for a form discharging such similar oocysts.

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