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Two new species of coccidia (Apicomplexa: Eimeriidae) from leaf-tailed geckos, *Uroplatus* spp. (Sauria: Gekkonidae) from Madagascar, including a new host of *Eimeria brygooi* Upton and Barnard, 1987

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Abstract

During May and June 2015, four common leaf-tailed geckos, *Uroplatus fimbriatus* (Schneider), five satanic leaf-tailed geckos, *Uroplatus phantasticus* (Boulenger), and four mossy leaf-tailed geckos, *Uroplatus sikorae* Boettger originally collected from Madagascar and housed at the Dallas Zoo, USA, had their faeces examined for coccidian parasites. Eight (62%) geckos were found to be passing oöcysts, including a new eimerian, a new isosporan and a previously described eimerian. Three of four (75%) *U. fimbriatus* (type host) and one of five (20%) *U. phantasticus* were infected with *Eimeria schneideri* n. sp.; oöcysts were subspheroidal to ellipsoidal with a bi-layered wall and measured (length $\times$ width, L $\times$ W) 15.1 $\times$ 13.5 μ m, with a length/width (L/W) ratio of 1.1. A micropyle and oöcyst residuum were absent but 1–many polar granules were present. Sporocysts were ovoidal, 6.9 $\times$ 5.3 μ m, L/W 1.3. Stieda, sub-Stieda and para-Stieda bodies were absent. A globular sporocyst residuum was present as dispersed granules. Four of five (80%) *U. phantasticus* harbored *Isospora boulengeri* n. sp.; oöcysts were subpheroidal to ellipsoidal with a bi-layered wall and measured 17.3 $\times$ 16.0 μ m, L/W 1.1. A micropyle and oöcyst residuum were absent but a polar granule was present. Sporocysts were ellipsoidal, 9.5 $\times$ 6.9 μ m, L/W 1.4. Stieda and sub-Stieda bodies were present but a para-Stieda body was absent. A globular sporocyst residuum was present with dispersed granules. In addition, one of four (25%) *U. sikorae* was infected with an eimerian indistinguishable from *Eimeria brygooi* Upton and Barnard, 1987, previously reported from Madagascar day gecko, *Phelsuma grandis* Gray and golddust day gecko, *Phelsuma laticauda* (Boettger) from Madagascar. These are the first coccidians described from *Uroplatus* spp.

Conflict of Interest The authors declare that they have no conflict of interest.

Compliance with ethical standards All applicable institutional, national and international guidelines for the care and use of animals were followed.

Introduction

The genus *Uroplatus* Duméril currently includes 20 species of leaf or flat-tailed geckos which are endemic to Madagascar and its coastal islands with the exception of the very highest montane regions above 2400 m altitude and the most arid southern spiny forest (Greenbaum et al., 2007; Raxworthy et al., 2008). They are highly-specialized nocturnal arboreal insectivorous lizards that are found exclusively in primary and secondary humid forests at very low densities (Glaw & Vences, 2007). The common leaf-tailed gecko, *Uroplatus fimbriatus* (Schneider) has a fragmented distribution and is restricted to eastern Madagascar in low altitude rainforest; the satanic leaf-tailed gecko, *Uroplatus phantasticus* (Boulenger) also has a fragmented distribution, occurs in eastern rainforest and may be a composite of several species (Glaw & Vences, 2007); and the mossy leaf-tailed gecko, *Uroplatus sikorae* Boettger has a large but fragmented distribution in eastern, northern and western Madagascar (Glaw & Vences, 2007). Unfortunately, habitat deforestation is the primary threat to the future of *Uroplatus* geckos as well as collection for the pet trade (Ratsoavina et al., 2013). Indeed, The [World Wide Fund for Nature](http://www.worldwildlife.org/) (WWF [<http://www.worldwildlife.org/>]) lists all of the *Uroplatus* species on their "Top 10 most wanted species list" of animals threatened by illegal [wildlife trade](#), because of them "being captured and sold at alarming rates for the international pet trade".

Very little is known about the coccidian parasites of *Uroplatus* spp. Brygoo (1963) reported that *U. fimbriatus* was infected with an *Eimeria* sp. Unfortunately, he provided no measurements or line drawings so it is impossible to know what species might have been present in this host. However, he did mention that the form he found was similar to a gall bladder coccidian (*Choleoeimeria*?) known from *Calumma brevicorne* (Günther) (= *Chamaeleo brevicornis*). In addition, Modrý (1998), in an unpublished dissertation, and, in a personal communication with CTM, reported limited information on an isosporan and an eimerian from *U. phantasticus* and two eimerians from *U. sikorae*. He also reported coccidians from Nosy Be flat-tailed gecko, *Uroplatus ebenau* (Boettger) and Henkel's flat-tailed gecko, *Uroplatus henkeli* Böhm & Ibsch presumably originating from Madagascar. More recently, an unidentified eimerian was reported from *Uroplatus* sp. from an unknown locality (Wolf et al. 2014). Herein, we provide a description of an eimerian from *U. fimbriatus* and an isosporan from *U. phantasticus* as well as a new host record for *Eimeria brygooi* from *U. sikorae*.

Materials and methods

Between May and June 2015, four adult *U. fimbriatus*, five *U. phantasticus* and four *U. sikorae* were collected by a commercial dealer from unknown localities in Madagascar. They were purchased by the Dallas Zoo (Dallas County, Texas, USA) and immediately placed in quarantine where fresh faecal samples were collected and placed in individual vials containing 2.5% (w/v) aqueous potassium dichromate (K₂Cr₂O₇); samples were shipped to CTM and examined for coccidian parasites. Samples were examined for coccidia by light microscopy after flotation in Sheather's sugar solution (specific gravity = 1.30). Once they had completely sporulated, samples were sent to RSS when sufficient numbers of oöcysts were present in a single host sample, and measurements were taken on 20 oöcysts using a

calibrated ocular micrometer or Olympus® cellSens 1.7 digital software and reported in micrometres (µm) with means followed by the ranges in parentheses; photographs were taken using Nomarski interference-contrast optics. Oöcysts were *c.*295 days old when measured and photographed. Because these were live hosts housed and displayed in a zoological collection, no tissue samples (small intestine and gall bladder) were available for study. Most hosts were measured for snout-vent length (SVL), weighed (g) and sexed.

Host photovouchers were accessioned into the Arkansas State University Herpetological Collection (ASUMZ), State University, Arkansas, U.S.A. Photosyntypes of sporulated oöcysts were accessioned into the Harold W. Manter Laboratory of Parasitology (HWML), Lincoln, Nebraska, U.S.A. Scientific names of reptiles follow the TIGR Reptile Database (Uetz & Hošek, 2016).

Results

Three of four (75%) *U. fimbriatus* and one of five (20%) *U. phantasticus* were infected with a new eimerian, four of five (80%) *U. phantasticus* harbored a new isosporan, and one of four (25%) *U. sikorae* was infected with *Eimeria brygooi* Upton and Barnard as follows.

Eimeria schneideri n. sp.

Type-host—Common leaf-tailed gecko, *Uroplatus fimbriatus* (Schneider, 1797) (Reptilia: Sauria: Gekkonidae) (adult 88g male 210 mm SVL, symbiotype ASUMZ 33539 collected April/May 2015).

Other host—Satanic leaf-tailed gecko, *Uroplatus phantasticus* (Boulenger, 1888) (Reptilia: Sauria: Gekkonidae) (adult 7.6g female, symbiotype ASUMZ 33540 collected April/May 2015). This gecko possessed only two oöcysts of *E. schneideri* that measured 13.9×12.6 µm with sporocysts measuring 6.9×5.6 µm.

Type-locality—Madagascar (exact locale unknown). However, *U. fimbriatus* has been recorded from lowland sites in the east and from Nosy Mangabe at the northern extent of its range to the south of the island (Glaw & Vences, 2007).

Type-material—Photosyntype deposited in the HWML 102105.

Prevalence—In 3 of 4 (75%) of the type host. In 1 of 5 (20%) *U. phantasticus*.

Sporulation time—Exogenous. All oöcysts were passed unsporulated or partially sporulated and fully sporulated within 5 days at *c.*23°C.

Site of infection—Unknown; oöcysts passed in faeces.

Etymology—The specific epithet is given in honor of Johann Gottlob Theaenus Schneider (18 January 1750–12 January 1822), a German naturalist who described the type host in 1797.

Description (Figs. 1–5, 12)

Sporulated oöcyst—Oöcyst ($n = 20$) brown in colour, smooth, subspheroidal to ellipsoidal; 15.1×13.5 ($13\text{--}18 \times 12\text{--}15$), length/width (L/W) ratio 1.1 (1.0–1.4). Wall bi-layered, c.1.0 thick, inner c. 0.4, outer c. 0.6. Micropyle and oöcyst residuum absent, 1–many fragmented polar granule(s) present.

Sporocyst—Sporocysts ($n = 20$) 4, colourless, smooth, subspheroidal, 6.9×5.3 ($6\text{--}8 \times 4\text{--}6$); L/W ratio 1.1 (1.0–1.2); wall single-layered c. 0.5 thick, with valves joined by longitudinal sutures. Stieda, sub-Stieda, and para-Stieda bodies absent; sporocyst residuum composed of globule with granules in compact mass between sporozoites.

Sporozoite—Sporozoites 2, sausage-shaped, not measured; single subspheroidal anterior refractile body and subspheroidal posterior refractile body, with nucleus slightly posterior to midpoint.

Remarks—The genus *Eimeria* (Eimeriidae) has consistently been characterized as containing coccidians with sporocysts possessing a Stieda body (Jirk, et al., 2002; Berto et al., 2014). However, in spite of seeing sporocysts in *E. schneideri* without a Stieda body and oöcysts with a L/W ratio ranging from 1.1–1.4 (sensu Paperna and Landsberg, 1989), we believe it prudent at this time to place our new species in the genus *Eimeria* rather than in *Acroeimeria* (sensu Paperna and Landsberg, 1989) for two valid reasons: (1) lack of tissue samples showing endogenous stages invested in a displaced host-cell border on the surface of the intestinal mucosal epithelium and/or (2) distinct DNA sequences that separate *Eimeria* spp. from this genus (Megía-Palma et al., 2015).

This is the smallest (on average) eimerian described to date from lizards of the infraorder Gekkota (see El-Touhky et al., 2013). Indeed, the other infected *U. fimbriatus* possessed even smaller oöcysts ($n = 20$) that measured 14.5×12.9 ($12\text{--}18 \times 11\text{--}16$) μm with sporocysts ($n = 20$) measuring 7.4×5.2 ($6\text{--}9 \times 4\text{--}7$) μm . Of the oöcysts reported previously from other geckos, only those of *Eimeria gekkonis* Tanabe from Schlegel's Japanese gecko, *Gekko japonicus* Schlegel (Gekkonidae) from Japan and *Eimeria tarentolae* Matuschka and Bannert from Moorish gecko, *Tarentola mauritanica* Linnaeus (Phyllodactylidae) from Minorca, Spanish Balearic Island are similar enough in size to be compared to the new species (Tanabe, 1928; Matuschka & Bannert, 1986). The former possesses ovoidal oöcysts that measure $17\text{--}20 \times 13\text{--}15$ μm (L/W 1.3), and latter has ellipsoidal oöcysts, 17.8×13.5 μm (L/W 1.3), without a polar granule, both larger than oöcysts of *E. schneideri* n. sp. Unfortunately, Tanabe (1928) did not provide information on sporocysts of *E. gekkonis* while those of *E. tarentolae* are spheroidal and have a diameter of $6.4\text{--}7.0$ (6.8) μm unlike sporocysts of the new species which are subspheroidal. In addition, none of the previously described eimerians from gekkonids from Madagascar (Table I) are similar to the new species. Based on morphological, zoogeographic and phylogenetic differences, we are therefore confident that our eimerian from *U. fimbriatus* is new to science.

***Isospora boulengeri* n.sp.**

Type-host—Satanic leaf-tailed gecko, *Uroplatus phantasticus* (Boulenger, 1888) (Reptilia: Sauria: Gekkonidae) (adult 7.6g female, symbiotype ASUMZ 33540 collected April/May 2015).

Type-locality—Madagascar (exact locale unknown). However, *U. phantasticus* has been recorded from many localities in the central-east of the island (Glaw & Vences, 2007).

Type-material—Photosyntype deposited in the HWML 102106.

Prevalence—In 4 of 5 (80%) of the type host.

Sporulation time—Exogenous. All oöcysts were passed unsporulated or partially sporulated and fully sporulated within 5 days at *c.*23°C.

Site of infection—Unknown; oöcysts passed in faeces.

Etymology—The specific epithet is given in honor of George Albert Boulenger (19 October 1858–23 November 1937), a Belgian-British zoologist who described the type host in 1888 and provided scientific names to 2,000+ new species of animals, chiefly fishes, reptiles, and amphibians.

Description (Figs. 6–9, 13)

Sporulated oöcyst—Oöcyst (*n* = 20) tan in colour, smooth, subspheroidal to ellipsoidal; 17.3×16.0 (15–18 $\times$ 12–17), length/width (L/W) ratio 1.1 (1.0–1.2). Wall bi-layered, *c.*1.0 thick, inner *c.* 0.4, outer *c.* 0.6. Micropyle and oöcyst residuum absent, 1 polar granule present.

Sporocyst—Sporocysts (*n* = 20) two, colourless, smooth, ovoidal, 9.5×6.9 (7–11 $\times$ 6–8); L/W ratio 1.4 (1.2–1.5); wall single-layered *c.*0.5 thick, with valves joined by longitudinal sutures. Button-like Stieda body present with sub-Stieda body, para-Stieda body absent; sporocyst residuum composed of globule with granules in compact mass between sporozoites.

Sporozoite—Sporozoites 4, sausage-shaped, not measured; single subspheroidal anterior refractile body and subspheroidal posterior refractile body, with nucleus slightly posterior to midpoint.

Remarks—When the new isosporan is compared to other species described from members of the Gekkonidae, it is most similar in size to *Isospora bors* Abdel-Baki, Al-Quaraishy, Al Otaibi, & Duszynski from Baiuch rock gecko, *Bunopus tuberculatus* Blanford, from Saudi Arabia, *Isospora schlegeli* Upton, Hanley, Case, & McAllister from common house gecko, *Hemidactylus frenatus* Duméril & Bibron and mourning gecko *Lepidodactylus lugubris* Duméril & Bibron from Guam, the Mariana Islands, the Philippines, and Mauritius, and *Isospora hemidactyli* (Carini) from house gecko, *Hemidactylus mabouia* (Moreau de Jonnès)

from Brazil (Carini, 1936; Upton et al., 1991; Lainson & Paperna, 1999; Leinwand et al. 2005; Berto et al., 2008; Abdel-Baki et al., 2013). Oöcysts and sporocysts of *I. bors* measure $18 \times 16 \mu\text{m}$ (L/W 1.1) and $10 \times 7 \mu\text{m}$ (L/W 1.3), respectively, but lack a sub-Stieda body and polar granule; oöcysts and sporocysts of *I. schlegeli* measure $17.8 \times 15.8 \mu\text{m}$ (L/W 1.1) and $10.0 \times 8.5 \mu\text{m}$ (L/W 1.3), respectively. Although the new species is similar in size and shares some other morphological features with *I. schlegeli*, the Stieda and sub-Stieda bodies differ significantly between the two (see Fig. 1 composite line drawing of Upton et al., 1991). Finally, oöcysts and sporocysts of *I. hemidactyli* are larger than those of *I. boulengeri* as follows: $20.0\text{--}25 \mu\text{m}$ (in diameter) (L/W 1.0) and $12.0 \times 9.0 \mu\text{m}$ (L/W 1.3) (Carini, 1936); $21.0 \times 19.2 \mu\text{m}$ (L/W 1.1) and $11.0 \times 8.8 \mu\text{m}$ (L/W 1.2) (Lainson & Paperna, 1999); $24.4 \times 22.3 \mu\text{m}$ (L/W 1.1) and $11.8 \times 9.8 \mu\text{m}$ (L/W 1.2) (Berto et al., 2008). In addition, all of the hosts reported for *I. boulengeri* have originated far from Madagascar in Brazil (Carini, 1936; Lainson & Paperna, 1999; Berto et al., 2008), and based on differences in zoogeography, the new species would be expected to be different.

***Eimeria brygooi* Upton and Barnard, 1987**

Host—Mossy leaf-tailed gecko, *Uroplatus sikorae* (Boettger, 1913) (Reptilia: Sauria: Gekkonidae) (adult 32.0 g, SVL = 115 mm, symbiotype ASUMZ 33540 collected April/May 2015).

Other hosts—Madagascar day gecko, *Phelsuma grandis* Gray (Upton & Barnard, 1987; Daszak & Ball, 1991), gold dust day gecko, *Phelsuma laticauda* (Boettger) (Upton & Barnard, 1987).

Locality—Madagascar (exact locale unknown).

Material—Photovoucher deposited in the HWML 102107.

Prevalence—In 1 of 4 (25%).

Sporulation time—Exogenous. All oöcysts were passed unsporulated or partially sporulated and fully sporulated within 5 days at $c.23^{\circ}\text{C}$.

Site of infection—Unknown; oöcysts passed in faeces.

Description (Figs. 10–11)

Sporulated oöcyst—Oöcyst ($n = 20$) brown in colour, smooth, spheroidal to subspheroidal; 24.4×21.6 ($21\text{--}29 \times 20\text{--}24$), length/width (L/W) ratio 1.1 (1.0–1.4). Wall bi-layered, $c.1.4$ thick, inner $c. 0.4$, outer $c. 0.6$. Micropyle absent, oöcyst residuum absent, 1 distinct polar granule present as well as numerous small granules.

Sporocyst—Sporocysts ($n = 20$) four, colourless, smooth, ovoidal, 9.4×8.0 ($8\text{--}11 \times 7\text{--}9$); L/W ratio 1.2 (1.1–1.5); wall single-layered $c.0.5$ thick, with valves joined by longitudinal sutures. Stieda, sub-Stieda and para-Stieda bodies absent; sporocyst residuum composed of globule with granules in compact mass between sporozoites.

Sporozoite—Sporozoites 2, banana-shaped, 16.6×3.5 ($n = 1$); single spheroidal to subspheroidal anterior refractile body and ovoidal posterior refractile body, with nucleus slightly posterior to midpoint.

Remarks—When oöcysts of *E. brygooi* from *U. phantasticus* are compared to the description by Upton & Barnard (1987) of *E. brygooi* from *P. grandis* from Madagascar no major differences were found except that average oöcyst length in our isolate was slightly larger (24.4 [22–29 $\times$ 20–23] vs. 23.0 [18.8–25.2] μm) and range in oöcyst shape index was greater (1.0–1.4 vs. 1.0–1.2) as well as the possession of a single polar granule, a structure not noted in their original description. However, Upton & Barnard (1987) did mention the presence of “numerous small granules up to 1.0 μm in diameter usually scattered within oöcyst”. We are confident our isolate is conspecific and therefore add a new host for *E. brygooi*.

Discussion

Madagascar is the largest oceanic and fourth largest island and, although it contains only 1% of the world’s terrestrial habitat, it is considered a major global biological hotspot for biodiversity; there is no other place on Earth with such consistent high levels of endemism (particularly among reptiles) across many taxa (Myers et al., 2000; Scantelbury, 2013). Unfortunately, Madagascan reptiles are under increasing pressure from rampant degradation and fragmentation of forests and other wildlife habitat (Steininger et al., 2003; Alnutt et al., 2004) as well as overcollecting and exportation.

With nearly 300 species of lizards (Uetz & Hošek, 2016), many of which are endemic, and given the long term geographic isolation of Madagascar, this would be an ideal region to study coccidia-reptile host co-evolution as well. However, to date, few reptiles have been surveyed and only eight species of saurians (four chameleons and four geckos) have been reported to be infected with 15 coccidians (Table 1). In addition, four snakes from Madagascar have been reported to harbor five coccidians, *Caryospora* spp. (Upton et al., 1990). Therefore, many more reptiles remain to be surveyed and we expect new host and distributional records for their coccidians as well as discovery of additional new species.

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Figs. 1–11.

Nomarski interference-contrast photomicrographs of sporulated coccidian oocysts from *Uroplatus* spp. from Madagascar. 1–3, *Eimeria schneideri* n. sp. from *Uroplatus fimbriatus*. 4–5, *E. schneideri* n. sp. from *Uroplatus phantasticus*. 6–9, *Isospora boulengeri* n. sp. from *Uroplatus phantasticus*. 10–11, *Eimeria brygooi* from *Uroplatus sikorae*. Abbreviations: oocyst wall (OW), polar granule (PG), refractile body (RB), Stieda body (SB), sporocyst (SP), sub-Stieda body (SSB), suture line (SU), sporozoite (SZ). Scale bars: all figs, 10 μ m.

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Fig. 12.

Composite line drawing of oocyst of *Eimeria schneideri* n. sp. Scale bar: 5 μ m.

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Fig. 13.
Composite line drawing of oöcyst of *Isospora boulegeri* n. sp. Scale bar: 5 μ m.

Table I

Comparison of the sporulated oöcysts of four *Choleoeimeria* species, seven *Eimeria* species and four *Isospora* species reported from saurian hosts from Madagascar.

<i>Choleoeimeria</i> , <i>Eimeria</i> *, <i>Isospora</i>	Type host and family	Oöcyst shape, size, features	Sporocyst shape, size, features	References
<i>C. brookesiae</i>	<i>Brookesia decaryi</i> Angel (Chamaeleonidae)	Cylindroidal 25.6 × 15.0 (L/W 1.7) 23–27 × 13–16 M, OR, PG: all – OW: 2 layers, smooth, 0.8 thick	Ellipsoidal 10.1 × 6.9 (L/W 1.5) 9–11 × 6–7 SB, SSB, PSB: all – SR: +, large granules	Modrý et al. (2001)
<i>C. fischeri</i>	<i>Furcifer oustaleti</i> (Mocquard) (Chamaeleonidae)	Cylindroidal 30.3 × 16.8 (L/W 1.8) 28–34 × 15–18 M, OR: both – PG: + OW: 2 layers, smooth, 1.0 thick	Ellipsoidal 9.6 × 8.0 (L/W 1.2) 9–10 × 7–9 SB, SSB, PSB: all – SR: +, large globules	McAllister (2012)
<i>C. phelsumae</i>	<i>Phelsuma grandis</i> Gray (Gekkonidae)	Cylindroidal 32.0 × 15.0 (L/W 2.1) 30–33 × 14–17 M, OR, PG: all – OW: 1 layer, smooth, 0.5 thick	Ellipsoidal 9.8 × 7.0 (L/W 1.4) 8–12 × 7–9 SB, SSB, PSB: all – SR: +, granular	Daszak & Ball (1991)
<i>Choleoeimeria</i> sp.*	<i>Calumma brevicorne</i> (Günther) (Chamaeleonidae)	Cylindroidal 22 × 11 (L/W 2.0) M, OR, PG: all – OW: 1 layer, smooth, 1.0 thick	Subspheroidal 8 × 6 (1.3) SB, SSB, PSB: all – SR+: granular	Brygoo (1963)
<i>E. brygooi</i>	<i>P. grandis</i> (Gekkonidae)	Spheroidal/subspheroidal 23.0 × 21.3 (L/W 1.1) 19–25 × 16–23 M, OR, PG: all – OW: 2 layers, smooth, 1.4 thick	Ovoidal 9.2 × 7.9 (L/W 1.2) 8–10 × 7–9 SB, SSB, PSB: all – SR +, granular	Upton & Barnard (1987)
<i>E. furmani</i>	<i>Hemidactylus frenatus</i> Duméril & Bibron (Gekkonidae)	Ellipsoidal 20.5 × 16.9 (L/W 1.4) 18–24 × 14–19 M, OR: both – PG: + OW: 2 layers, smooth, 1.4 thick	Ellipsoidal 9.6 × 7.2 (L/W 1.3) 9–10 × 6–8 SB, SSB, PSB: all – SR +, spheroidal/ellipsoidal	Upton et al. (1990)
<i>E. glawi</i> **	<i>Furcifer pardalis</i> (Cuvier) (Chamaeleonidae)	Cylindroidal/ellipsoidal 27.7 × 18.4 (L/W 1.5) 26–30 × 17–19 M, OR, PG: all – OW: 2 layers, smooth, 1.0 thick	Ellipsoidal 7.3 × 5.2 (L/W 1.4) 7–8 × 5–6 SB, SSB, PSB: all – SR: +, globular/granular	Modrý et al. (2001)
<i>E. schneideri</i>	<i>Uroplatus fimbriatus</i> (Schneider) (Gekkonidae)	Subspheroidal/ellipsoidal 15.1 × 13.5 (L/W 1.1) 13–18 × 12–15 M, OR: both – PG: + OW: 2 layers, smooth, 1.0 thick	Subspheroidal 6.9 × 5.3 (L/W 1.1) 6–8 × 4–6 SB, SSB, PSB: all – SR: +, globular/granular	This report
<i>E. vencesi</i>	<i>F. pardalis</i> (Chamaeleonidae)	Spheroidal/subspheroidal 14.3 × 13.0 (L/W 1.1) 13–16 × 12–13 M, OR, PG: all + OW: 1 layer, smooth, <1.0 thick	Ellipsoidal 7.3 × 5.2 (L/W 1.4) 7–8 × 5–6 SB, SSB, PSB: all – SR: +, globular/granular	Modrý et al. (2001)
<i>E. sp.</i> *	<i>C. brevicorne</i> (Chamaeleonidae)	Spheroidal 19 (L/W 1.0) M, OR, PG: all – OW: 1 layer, smooth, 1.0 thick	Spheroidal 10 (L/W 1.0) SB, SSB, PSB: all – SR: +, granular	Brygoo (1963)
<i>E. worthi</i>	<i>F. oustaleti</i> (Chamaeleonidae)	Spheroidal/subspheroidal 17.9 × 15.0 (L/W 1.2) 18–19 × 15–16 M, OR, PG: all – OW: 1 layer, smooth, 0.8 thick	Spheroidal/sub spheroidal 7.9 × 7.4 (L/W 1.1) 7–10 × 5–7 SB, SSB, PSB: all –	Modrý et al. (2001)

<i>Choleoeimeria</i> <i>Eimeria</i> *, <i>Isospora</i>	Type host and family	Oöcyst shape, size, features	Sporocyst shape, size, features	References
<i>I. boulengeri</i>	<i>Uroplatus phantasticus</i> (Boulenger) (Gekkonidae)	Subspheroidal/ellipsoidal 17.3 × 16.0 (L/W 1.1) 20–24 × 18–23 M, OR: both – PG: + OW: 2 layers, smooth, 1.0 thick	SR: +, globular Ovoidal 9.5 × 6.9 (L/W 1.4) 7–11 × 6–8 SB, SSB: both + PSB: – SR: +, globular/granular	This report
<i>I. brygooi</i>	<i>F. pardalis</i> (Chamaeleonidae)	Spheroidal/subspheroidal 20.7 × 19.3 (L/W 1.1) 17–25 × 16–23 M, OR: both – PG: + OW: 2 layers, outer slightly pitted, 1.5 thick	Ellipsoidal 12.2 × 8.1 (L/W 1.5) 12–13 × 8–9 SB, SSB: both + PSB: – SR: +, granular	Modrý et al. (2001)
<i>I. frenatus</i>	<i>H. frenatus</i> (Gekkonidae)	Subspheroidal/ellipsoidal 31.9 × 26.4 (L/W 1.2) 29–36 × 25–30 M, OR, PG: all – OW: 2 layers, smooth, 2.0 thick	Ovoidal 12.2 × 9.4 (L/W 1.4) 11–13 × 8–10 SB, SSB: both + PSB: – SR: +, granular	Upton et al. (1990)

* Inferred from line drawing (Brygoo, 1963).

** Could be *Choleoeimeria*; for discussion, see Megía-Palma et al. (2015), who suggests those oöcysts possessing an oöcyst shape index (OSI = L/W ratio) >1.4 and undergoing endogenous development in the gall bladder are *Choleoeimeria* spp.