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Eimeria nycteae sp. n. (Apicomplexa: Eimeriidae), a new parasite species from the snowy owl, *Nyctea scandiaca*

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Abstract. Coprological examinations of three snowy owls, *Nyctea scandiaca* (L.) revealed the presence of a coccidium of the genus *Eimeria* that apparently represents a previously undescribed species. Oocysts of *Eimeria nycteae* sp. n. were spherical to subspherical, 23.6 (23-25) × 22.2 (22-23) μm with a shape index 1.1 (1.0-1.1). The oocyst wall was bilayered, smooth ~ 0.75 μm thick. A polar granule was absent. Sporocysts were ellipsoidal, 18.5 (18-19) × 9.8 (9-10) μm with a shape index 1.9 (1.8-2.1) with Stieda and substieda bodies. A sporocyst residuum was present as small granules scattered among sporozoites. The sequence of the sporulation process of this new species is given and illustrated with photomicrographs. Owls examined did not exhibit any signs of alteration of their health status.

The snowy owl, *Nyctea scandiaca* (L.), is widely distributed throughout circumpolar arctic regions of the Old and New Worlds and also is often kept in captivity. A survey of the coccidian parasites occurring in some snowy owls kept in captivity in the Czech Republic was conducted from September 1997 to August 1998. Some of these animals were infected with a new species of *Eimeria*. Here, we give a description of the sporulated oocyst of this new species, as well as detailed information about its sporulation.

MATERIALS AND METHODS

Faecal samples of 12 captive snowy owls were collected from the ground in their cages and submitted for parasitological examination. To eliminate the possibility of pseudoparasitic origin of the found coccidium, faecal samples from other birds fed on the same diet were collected too. Samples were screened routinely for parasites using flotation in Sheather's sugar solution. Unsporulated coccidian oocysts were consequently allowed to sporulate in Petri dishes in a thin layer of 2.5% (w/v) potassium dichromate ($K_2Cr_2O_7$) solution at laboratory temperature (20-22ºC). Thirty sporulated oocysts were measured using bright-field microscopy (100× objective) equipped with a calibrated ocular micrometer. All measurements are in micrometers (μm), given as the mean followed by the range in parentheses. Isolated oocysts were examined and photographed using Nomarski interference contrast (NIC) microscopy.

To observe the sporulation process, fresh faecal samples were collected on two separate occasions from two captive snowy owls. Faeces were mixed with 2.5% (w/v) $K_2Cr_2O_7$ solution, poured into Petri dishes to a depth of <5 mm, and incubated at 25°C to allow oocysts present to sporulate. The oocysts were examined and photographed prior to incubation and every 8 thereafter for 72 hours.

RESULTS

Repeated coprological examination of three snowy owls from two localities revealed unsporulated coccidian oocysts, which were later found to represent a previously undescribed species of the genus *Eimeria.* No other bird of prey from the same collections was found to excrete coccidian oocysts.

Eimeria nycteae sp. n. Figs. 1-9

Oocysts spherical to subspherical 23.6 (23-25) × 22.2 (22-23), with a shape index 1.1 (1.0-1.1). Oocyst wall bilayered, smooth and colourless, ~0.75 with the outer layer ~2/3 of total thickness. A micropyle, oocyst residuum and polar granule absent. Sporocysts ellipsoidal, 18.5 (18-19) × 9.8 (9-10) with a shape index 1.9 (1.8-2.1). Sporocyst wall single-layered, thin, smooth and colourless. Stieda body flat, 0.3-0.5 high and 1.5 wide. Substieda body lentil-shaped, homogenous, 1.75 (1.5-2.0) high and 2.3 (2.0-2.5) wide. Sporocyst residuum composed of numerous small, dispersed granules, often in a row between sporozoites or irregularly scattered among sporozoites. In fresh sporulated oocysts, sporozoites did not fill sporocysts and the space between the substieda body and sporozoites was seen in 90% of the sporocysts. Sporozoites banana-shaped 13.3 (13-14) long and 4.0 wide (in situ), lying lengthwise in the long axis of the sporocyst. Each sporozoite with two rounded refractile bodies 2.0 and 3.0 in diameter. Faintly-visible nucleus situated in the central part of the sporozoite.

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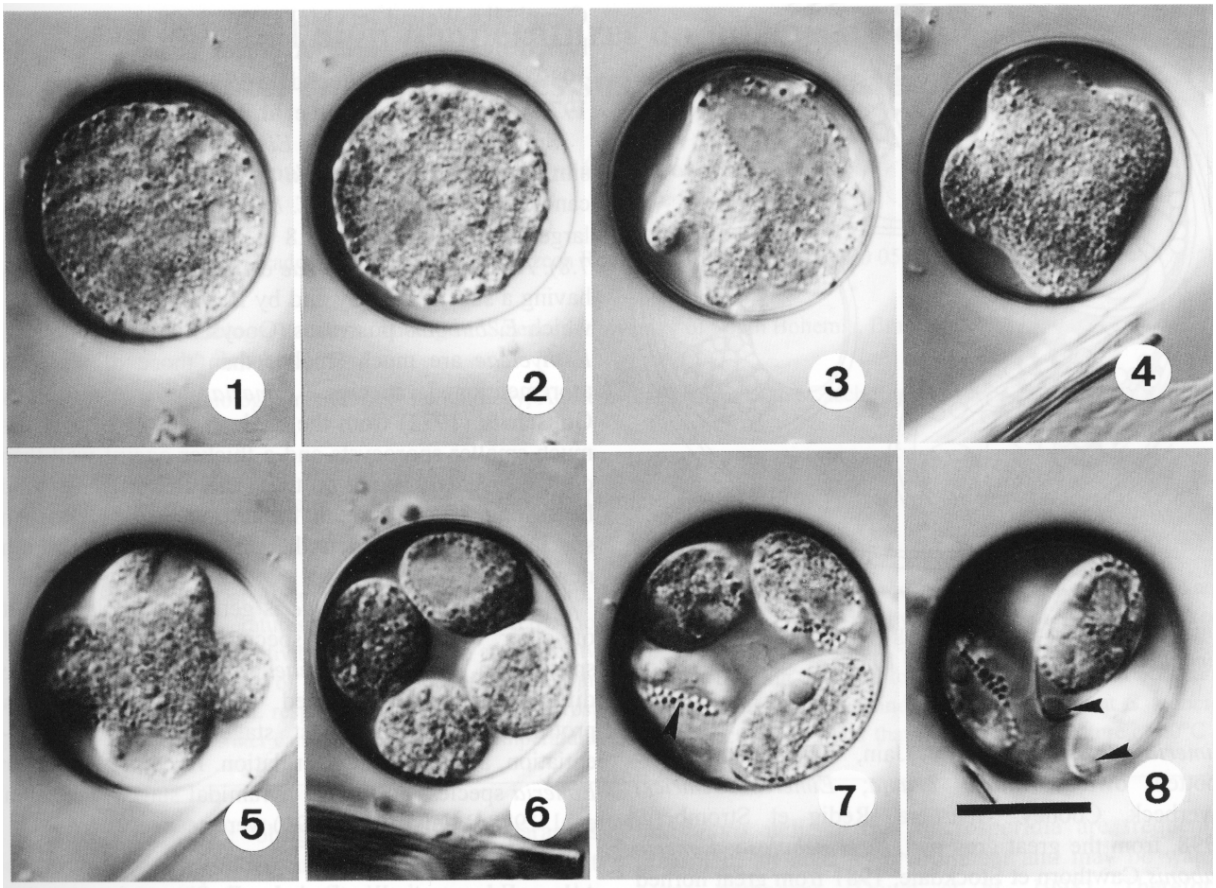

Figs. 1-8. Photomicrographs of the sporulation process in oocysts of *Eimeria nycteae* sp. n. Nomarski interference contrast (NIC). Scale bar = 10 μm. **Fig. 1**. Oocyst freshly passed in faeces. **Fig. 2.** Oocyst with concentrated sporont after 16 hours. **Fig. 3.** Oocyst with protrusions after 32 hours. **Fig. 4.** Oocyst with sporont beginning cleavage after 40 hours. **Fig. 5.** Oocyst with sporont formed sporoblasts after 48 hours. **Fig. 6.** Oocyst with four spherical sporoblasts after 54 hours. **Fig. 7.** Oocyst after 64 hours. Note sporocyst residuum composed of numerous small granules in row between sporozoites (arrowhead). **Fig. 8.** Completely sporulated oocyst after 72 hours. Note substieda bodies (arrowheads).

T y p e h o s t : Snowy owl, *Nyctea scandiaca* Linnaeus, 1758 (Aves: Strigiformes: Strigidae).

T y p e l o c a l i t y : ZOO Hluboká nad Vltavou, Czech Republic.

O t h e r l o c a l i t i e s : ZOO Dvůr Králové nad Labem, Czech Republic.

P r e v a l e n c e : 3 of 13 (23%).

S i t e o f i n f e c t i o n : Unknown. Oocysts recovered from faeces.

S p o r u l a t i o n : Exogenous. All oocysts were passed unsporulated in the faeces. The granular sporont filled freshly passed oocysts (Fig. 1). By 16 hours after leaving the host, the sporont shrank to 16-18 μm in diameter. The protoplasmic mass of the sporont contained large granules around the periphery with smaller granules in the interior (Fig. 2). After 32 hours, most oocysts contained a sporont with protrusions pointed towards the periphery of oocyst (Fig. 3). After this stage, the protrusions gradually increased in size, became spherical and finally separated from each other to form subspherical or oval sporoblasts (Figs. 4-6). After 64 hours, the sporoblasts elongated, and began to form the sporocyst membrane, sporocyst residuum and Stieda body. About the same time the Stieda body was formed; one of refractile bodies appeared in the sporozoites (Fig. 7). At 72 hours, the substieda body became visible and the sporozoites were completely formed; they also contained an additional refractile body (Fig. 8). Oocysts were fully sporulated within 72 hours at 25°C.

T y p e m a t e r i a l : Photosyntypes are deposited at the Institute of Parasitology, Academy of Sciences of the Czech Republic, České Budějovice (No. Hl 2/98).

E t y m o l o g y : The specific epithet reflects the generic name of the host.

DISCUSSION

No species of *Eimeria* have been previously described from the snowy owl, *Nyctea scandiaca*. To date, there are seven species of *Eimeria* described and named from owls (Strigiformes: Tytonidae, Strigidae):

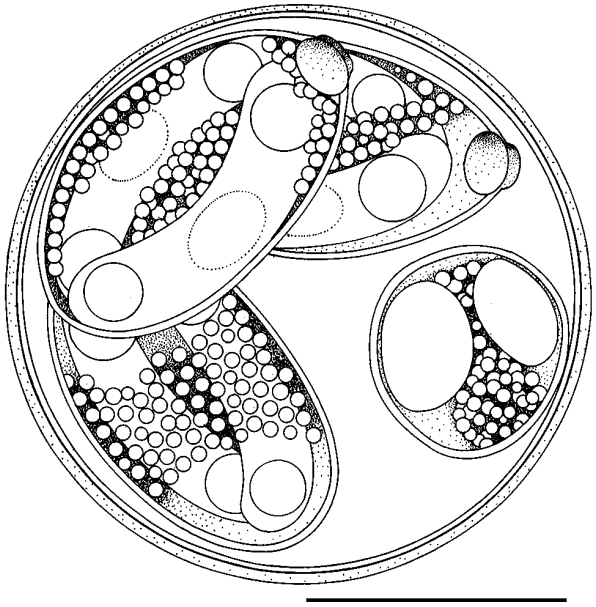

Fig. 9. Composite line drawing of sporulated oocyst of *Eimeria nycteae* sp. n. Scale bar = 10 μm.

Eimeria atheni Chauhan et Jain, 1979 infecting the spotted owlet, *Athene brama*; *Eimeria bemricki* Averbeck, Cooney, Guarnera, Redig et Stromberg, 1998, from the great grey owl, *Strix nebulosa*; *Eimeria bubonis* Cawthorn et Stockdale, 1981 from great horned owl, *Bubo virginianus*; *Eimeria megabubonis* Upton, Campbell, Weigel et McKown, 1990, from the great horned owl, *Bubo virginianus*; *Eimeria speotytoi* Carini, 1939, described from the burrowing owl, *Speotyto cunicularia*; *Eimeria strigis* Kutzer, 1963 from the tawny owl, *Strix aluco*; and *Eimeria varia* Upton, Campbell, Weigel et McKown, 1990, infecting the barred owl, *Strix varia* (Averbeck et al. 1998, Carini 1939, Cawthorn and Stockdale 1981, Chauhan and Jain 1979, Kutzer 1963, Upton et al. 1990).

Sporulated oocysts of *Eimeria nycteae* are most similar in size to *E. bemricki* and *E. bubonis*. *E. nycteae* can be distinguished from *E. bemricki* and *E. bubonis* by larger sporocysts (18.5 × 9.8 vs. 10.0 × 6.5 resp. 12.7 × 7.8). Additionally, *E. nycteae* differs from *E. bubonis* by having a substieda body and by lacking a polar granule, which *E. bubonis* possesses. Oocysts and sporocysts of *E. nycteae* are much smaller than those of all other aforementioned species. *Eimeria* sp. reported by Gottschalk (1972) from the eagle owl, *Bubo bubo,* has much smaller sporocysts and a thicker oocyst wall than does *E. nycteae.* Based on these facts, *E. nycteae* could be distinguished from all hitherto described eimerian species from owls and is therefore considered to be a new species.

Sporulation of *E. nycteae* is generally similar to that of other avian *Eimeria* species. In the course of sporulation of *E. nycteae,* five stages can be differentiated: the rounded sporont, sporont with protrusions, four-sporoblast stage, sporozoite differentiation, and complete sporulation. In contrast to other *Eimeria* species, no typical pyramidal stages (Ferguson et al. 1978, Mielke et al. 1991) were seen.

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