Note

Parasitology

The common gallinule, *Gallinula galeata* (Aves: Gruiformes: Rallidae), as a new host for *Eimeria paludosa* (Apicomplexa: Eimeriidae) in Mexico

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Running head: *EIMERIA PALUDOSA* INFECTION IN A COMMON GALLINULE.
ABSTRACT

Up to now, four coccidian species have been identified in Rallidae (Aves: Gruiformes): *Eimeria mongolica*, *E. alakuli*, *E. paludosa* and *E. porphyrule*. Here, we described an *Eimeria* species, *E. paludosa*, from a common gallinule (*Gallinula galeata*) in Mexico. Oocysts were ovoid and wall pitted single-layered. A prominent micropyle was present, the oocyst residuum absent and the polar granule was present. On histological examination of tissues, endogenous stages (meronts, microgametocytes and macrogametocytes) were seen in the epithelial cells of the small intestine (upper and lower intestine). In addition to a new locality, this is the first description of *E. paludosa* from *G. galeata* and is the third description of a coccidian infecting Rallidae in the Americas.

Keywords: *Eimeria paludosa*, *Gallinula galeata*, Gruiformes, Mexico, Rallidae.
The common gallinule (*Gallinula galeata*) is a bird species (Aves: Gruiformes: Rallidae) widely distributed in the Americas [5]. In Central Mexico, it is a common gruiform in wetlands, easily recognized by its dark plumage, yellow legs and a red frontal shield [10].

The coccidia are a diverse group of parasitic protozoa. Some species of coccidia are homoxenous and strictly host specific, other species have complex heterogenous life cycles that involve a broad range of different host species [11]. Up to now, four coccidian species have been identified in Rallidae: *Eimeria mongolica*, *Eimeria alakuli*, *Eimeria paludosa* and *Eimeria porphyrala* [6, 8]. The aim of this study was the description of *E. paludosa* from *G. galeata* as a new host.

An adult, common gallinule (*Gallinula galeata*), possibly attacked by a raptor, was submitted to the Centro de Investigación y Estudios Avanzados en Salud Animal (CIESA), Toluca (2,625 m a.s.l.; 19°17'32"N, 99°39'14"W). Fecal samples were taken and microscopy revealed coccidia oocysts. Each fecal sample was placed into a 1.5 ml a plastic vial containing 2.5% potassium dichromate solution (K₂Cr₂O₇) 1:6 (v/v) and observed in a light microscope [4].

At necropsy, a liver injury (parenchymal disruption) was observed and the following organs and tissues were collected from the bird: trachea, lungs, liver, stomach, duodenum and small intestine. These samples were placed in 10% neutral buffered formalin and processed, sectioned, and stained with hematoxylin and eosin for routine histologic examination. The fecal samples were placed in a thin layer (5 ml) of K₂Cr₂O₇ in Petri dishes, incubated at 23-28 °C and monitored daily, until 70% of oocysts were sporulated. Morphological observations, photomicrographs and measurements (n=35), were made as elsewhere reported [2, 4], using a Nikon Eclipse 80i microscope coupled to a digital camera Nikon DS-Fi2.

Initially, the oocysts were non-sporulated, but approximately 70% of the oocysts were sporulated at day seven (under the conditions used in this study).
Oocysts (n = 35) were ovoid, 18.0–23.9 × 13.0–16.5 (20.7 × 14.9); length/width (L/W) ratio 1.2–1.6 (1.3). Wall pitted single-layered, 0.7–0.9 (0.8) thick. Prominent micropyle present, oocyst residuum absent and polar granule present (Fig. 1). Sporocysts 2, elongate-ovoid, 9.6–13.1 × 5.9–6.7 (11.4 × 6.4); L/W ratio 1.5–2.0 (1.7). Stieda body present, nipple-like, 0.5 high × 1.6 wide; sub-Stieda present, rounded irregular, 1.4 high × 0.8 wide; para-Stieda body absent; sporocyst residuum present, consisting of scattered spherules of different sizes (up to 1.0 µm) (Fig. 1). Sporozoites 4, vermiform, with posterior refractile body. Phototypes of the host and photomicrographs of sporulated oocysts are deposited and available in the Repository of iBIRDS (www.ibirds.org), number ESV-30/2019.

On histological examination of tissues, endogenous stages (meronts, microgametocytes and macrogametocytes) were seen in the epithelial cells of the small intestine (upper and lower intestine). Meronts were ovoidal and measured 18.0 × 11.0 µm and were surrounded by a parasitophorous vacuole (Fig. 2).

Up to now, four coccidian species have been identified in Rallidae: *Eimeria mongolica*, *E. alakuli*, *E. paludosa* and *E. porphyrulae* [6, 8]. *Eimeria paludosa* was first described from both *Fulica atra* and *Gallinula chloropus* in France [7]. Furthermore, *E. paludosa* has been identified from related birds: *Porphyrio poliocephalus* in Russia [12], *Porphyrio porphyrio* in India [1], *Fulica americana* in USA [8], *Gallinula tenebrosa* in Australia [13], and *Fulica atra* in Portugal [3]. In addition to a new locality, this is the first description of *E. paludosa* from *G. galeata*.

The sporulated oocysts obtained in this study were compared in detail with coccidian parasites from other birds that belong to the same host family [4]. The morphology and morphometry of the *E. paludosa* oocysts are different from other *Eimeria* species in birds from the same family (Table 1). Two coccidian species from *Fulica atra* in Russia were identified: *E. mongolica*, it does not possess the characteristic micropyle and *E. alakuli*, larger oocysts than those
The main characteristics of *E. porphyroide* from *Porphyrio martinica* in Brazil, is larger oocysts and sporocysts, much smaller micropyle, a sub-micropyle granule, and a much shorter sporulation time of only two days [6]. The sporulated oocysts obtained in this study, are clearly distinct from all other *Eimeria* species reported from gruiform birds (Table 1). To confirm this finding, further genomic studies based on partial mitochondrial cytochrome c oxidase subunit I (COI) and 18S rDNA sequences [9], are needed.

In conclusion, the description of *E. paludosa* from *G. galeata* is the third description of a coccidian infecting Rallidae in the Americas.

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Figure legends

**Fig. 1.** Photomicrographs of a coccidian parasite *Eimeria paludosa* showing a pitted oocyst wall (A), micropyle (arrow) (B), and polar granule (arrow) (C). *Scale-bar*: 10 µm.

**Fig. 2.** Photomicrograph of a small intestine histological section of a coccidian parasite *Eimeria paludosa* from an adult common rail *Gallinula galeta*. Meronts are surrounded by it's parasitophorous vacuole. *Scale-bar*: 10 µm.
| Species | E. paludosa | E. alakuli Rakmatullina-Batshrina & Svanbaev, 1972 | E. mongolica Matschoulsky, 1941 | E. paludosa Léger & Hesse, 1922 | E. porphyrulae Lainson, 1994 |
|---------|-------------|-------------------------------------------------|-----------------------------|-----------------------------|-----------------------------|
| Host    | Gallinula galeata (Lichtenstein) | Fulica atra (Linnaeus) | Fulica atra (Linnaeus) | Fulica americana (Gmelin), Fulica atra (Linnaeus), Gallinula chloropus (Linnaeus), Porphyrio porphyrio (Linnaeus) | Porphyryla martinica (Linnaeus) |
| Locality | Toluca, México | Russia | Russia | France; India; Russia; USA | State of Pará, Brazil |
| Reference | This study | McAllister & Upton (1990) | McAllister & Upton (1990) | McAllister & Upton (1990) | Lainson (1994) |

**Oocyst**
- **Shape**: Ovoid
- **Wall**: One-layer (0.8)
- **Length (L)**: 18–23.9 (20.7)
- **Width (W)**: 13–16.5 (14.9)
- **L/W ratio**: 1.2–1.6 (1.3) aprox. 1.3
- **Polar granules**: One large to several small granules
- **Oocyst residuum**: Absent
- **Micropyle**: Present (5.4)
- **Sporocyst**
  - **Shape**: Elongate-ovoid
  - **Length (L)**: 9.6–13.1 (11.4)
  - **Width (W)**: 5.9–6.7 (6.4)
  - **L/W ratio**: 1.5–2 (1.7)
  - **Stieda body**: Nipple-like (0.5 high × 1.5 wide)
  - **Sub-Stieda body**: Rounded irregular (1.1 high × 2.0 wide)
  - **Residuum**: Scattered sphérules of different sizes (up to 1.0)
  - **Sporozoite**: Vermiform

**Table 1. Comparative morphology of *Eimeria* spp. recorded from species of the Rallidae**
