

Helminths Parasitizing *Procellosaurinus erythrocerus*, a Little-known Neotropical Lizard Endemic to Brazilian Semiarid Caatinga Biome

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ABSTRACT: We report the identification of helminths in *Procellosaurinus erythrocerus*, a lizard endemic to Brazilian Caatinga biome. Parasites that we found, such as *Parapharyngodon* sp. and *Oochoristica* sp., have not been reported in this host, which is under threat in its area of occurrence.

Procellosaurinus erythrocerus is a fossorial lizard of diurnal behavior and psammophilous habits, which is endemic to the Caatinga biome in Brazil (Rodrigues 2003). This lizard, which is typical of the paleoquaternary sand dunes of the Middle São Francisco River, occurs in the states of Bahia (Rodrigues 1991), Piauí (Freitas and Veríssimo 2012), and Pernambuco (Souza et al. 2013).

Very few studies about helminths parasitizing Gymnophthalmidae lizards in the Caatinga biome have been published (Ribeiro et al. 2018), and records of helminths in *P. erythrocerus* are nonexistent. We report the occurrence of helminths in *P. erythrocerus* in Brazil.

Lizards were collected from September to November 2011 and from July to December 2016, using pitfall traps, in a fragment of Caatinga vegetation located on the Campus of Agricultural Sciences (9°19'40"S, 40°32'56"W) of the Universidade Federal do Vale do São Francisco (UNIVASF) in the municipality of Petrolina, State of Pernambuco, Brazil. The physiognomy of this area is shrubby, with herbaceous stratum, sandy soil, flat relief, and vegetation consisting mainly of cactus and bromeliads. The lizards were euthanized with a lethal injection of lidocaine (Conselho Nacional de Controle de Exper-

imentação Animal 2015), immediately necropsied, and identified as described by Rodrigues (1991). Voucher specimens were deposited in the herpetology collection of the Museu de Fauna da Caatinga (MFCH 684–689 and MFCH 4886–4891) at the Centro de Conservação e Manejo de Fauna da Caatinga of UNIVASF.

Live helminths were collected, fixed in 4% hot formalin for 15 d and then stored in 70% ethanol. To identify the nematodes, they were cleared in Amann's lactophenol and mounted on temporary slides. The cestodes were stained with Delafield's hematoxylin and mounted on permanent slides with Canada balsam. Nematodes were identified as described by Anderson et al. (2009) and cestodes according to Khalil et al. (1994). Voucher specimens were deposited in the Helminthological Collection of the Oswaldo Cruz Institute (CHIOC) in Rio de Janeiro, Brazil. The prevalence, mean intensity, and mean abundance of helminth were calculated as described by Bush et al. (1997).

Necropsies were performed on eight adult male specimens of *P. erythrocerus* (snout-vent length [SVL]=28.77±1.51 mm) and four adult females (SVL=31.38±1.18 mm), 50% of which contained helminths. The helminth community was composed of *Parapharyngodon* sp. (Nematoda, Pharyngodonidae) and *Oochoristica* sp. (Cestoda, Anoplocephalidae). Despite the low richness of helminth species, this host sample had a high prevalence, mainly due to the infrapopulation of *Oochoristica* (50%; Table 1).

TABLE 1. Helminth species associated with *Procellosaurinus erythrocerus* ($n=12$), in the municipality of Petrolina, state of Pernambuco, Brazil, and their respective ecological data.

Helminth species	Infected hosts	Prevalence (%)	Mean intensity	Mean abundance	Range	Site of infection
Nematoda						
<i>Parapharyngodon</i> sp. ^a	3	25	1	0.25±0.43	1	Intestinal cecum
Cestoda						
<i>Oochoristica</i> sp.	6	50	1.67±1.11	0.83±1.14	1–4	Small intestine

^a Each host infected with this nematode was parasitized by one specimen.

All the *Parapharyngodon* sp. specimens collected (CHIOC 38780) were adult females found in the intestinal cecum. Because the main morphological features that characterize species of this genus are found in males (Burse and Goldberg 1999), we were unable to identify the specimens to the species level.

The *Oochoristica* sp. specimens (CHIOC 40098) were collected from the small intestine of hosts. These specimens present a set of morphological features not previously found in other species of the genus. Therefore, we believe that this could be a new species, and future taxonomic studies will be conducted to confirm this hypothesis.

Prior to this study, two species of *Parapharyngodon* had been reported parasitizing Gymnophthalmidae lizards in the Caatinga biome: *Parapharyngodon largitor* and *Parapharyngodon alvarengai*; as well as an unidentified species of the genus *Oochoristica* (host list in Brito et al. 2014; Ribeiro et al. 2018; Silva Neta and Ávila 2018).

The low richness of helminth species found in *P. erythrocerus* might be attributed to their small body size, because these hosts have a maximum SVL of 31 mm (Rodrigues 1991). According to Ribeiro et al. (2018) and Silva Neta and Ávila (2018), the body size of gymnophthalmid lizards is directly associated with the richness of helminths, where low SVL promote smaller parasitic abundance and diversity than large lizard hosts.

The fossorial and semifossorial habit of Gymnophthalmidae lizards might facilitate infection by monoxenous parasites (Ribeiro et al. 2018). This could explain the parasitism by *Parapharyngodon* sp., because eggs con-

taining the infective larvae (L3) of these nematodes remain in the soil until they are ingested by the host (Anderson 2000).

Species of *Oochoristica*, like all cestode species, have a heteroxenous life cycle (i.e., the intermediate or paratenic host contains the infective stage of the cestode), which is obligatorily transferred to the definitive host through predation or accidental ingestion of the host harboring the infective stage (Mackiewicz 1988). From what little is known about the life cycle of some species of *Oochoristica*, beetles mainly of the family Tenebrionidae act as intermediate hosts, but other groups of insects might also act as intermediate hosts (Conn 1985). *Procellosaurinus erythrocerus*, a species that has no particular preference for food items, feeds mainly on insects and spiders (Rocha and Rodrigues 2005). Therefore, occurrence of *Oochoristica* sp. in this host might be attributed to the ingestion of some prey item of its diet. According to Brito et al. (2014), diet, predation behavior, and the use of microhabitats are determining factors for the composition of the parasite communities in lizards of the Caatinga biome.

It should be noted that the lizard *P. erythrocerus* is currently classified as an endangered species in the state of Pernambuco, Brazil, and as a vulnerable species in the state of Bahia, Brazil. The main threat is the extraction of sand from the dunes that are the habitat of this lizard. Moreover, the sandy soils adjacent to the São Francisco River are widely used in livestock- and fruit-growing activities in these states, and its modification reduces the size of the lizard's habitat and limits its food resources (Secretária de Meio

Ambiente e Sustentabilidade de Pernambuco 2017).

Information about the biology and ecology of this lizard species is still scanty and limited to the studies by Rodrigues (1991, 2003) and Freitas and Veríssimo (2012). Studies about several aspects of its lifestyle, including parasitism and the implications of the host-parasite relationship, are important in order to underpin conservation proposals for this lizard endemic to the Caatinga biome.

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