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Original Article

Eucoleus contortus (Nematoda: Capillariidae), a parasite of *Cairina moschata domestica* (Anseriformes: Anatidae) on Marajó Island, Pará State, in Brazilian Amazon

Eucoleus contortus (Nematoda: Capillariidae), um parasito de *Cairina moschata domestica* (Anseriformes: Anatidae) na Ilha de Marajó, Estado do Pará, na Amazônia Brasileira

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Abstract

The family Capillariidae is one of the most important in the superfamily Trichinelloidea, with 27 genera and more than 300 species parasitizing vertebrates. This study considers the morphology, morphometry and prevalence of *Eucoleus contortus* parasitizing the Muscovy duck *Cairina moschata domestica* esophagus from Marajó Island, in State of Pará, Brazil. Morphologically the nematodes had a filiform body, with transversely striated cuticle, long esophagus, divided into two parts, one muscular and another consisting of stichocytes, spicule weakly sclerotized, spiny sheath and pseudobursa present in males. Females had a pre-equatorial vulva, barrel-shaped eggs and were bioperculated. In the northern region of Brazil, the Muscovy duck is an abundant bird, and one of the items in the food supply for human communities. The occurrence of *E. contortus* adds data to the biodiversity of parasites described in Anseriform birds of the Brazilian Amazon, especially those used as source of protein by human communities of Marajó.

Keywords: Nematoids, parasites, poultry, Amazon.

Resumo

A família Capillariidae é uma das mais importantes da superfamília Trichinelloidea, com 27 gêneros e mais de 300 espécies parasitando os vertebrados. Este estudo considera a morfologia, morfometria e prevalência de *Eucoleus contortus* parasito do esôfago de pato doméstico na Ilha de Marajó, Estado do Pará, Brasil. Morfologicamente os nematódeos apresentaram corpo filiforme, com cutícula estriada transversalmente, esôfago longo, dividido em duas partes, sendo uma muscular e outra formado por esticócitos, espículo fracamente esclerotizado, bainha espinhosa e pseudobursa presente nos machos. Fêmeas com vulva pré-equatorial, ovos em forma de barril e bioperculado. Na região norte do Brasil, o pato doméstico é uma ave abundante, compondo um dos itens do suprimento de alimentos para muitas pessoas. A ocorrência de *E. contortus* adiciona dados à biodiversidade de parasitos descritos em aves Anseriformes da Amazônia brasileira, em especial as utilizadas como fonte de proteína por comunidades humanas do Marajó.

Palavras-chave: Nematoides, parasitos, aves domésticas, Amazônia.

Introduction

The family Capillariidae Neveu-Lemaire, 1936 is one of the most important in the superfamily Trichinelloidea Ward, 1907 (1879), with more than 300 known species parasitizing all vertebrate classes around the world (ANDERSON, 2000; GIBSON et al., 2014). The classification of capillariids is one of the most complex and unsatisfactory among nematodes, due to the scarcity of good morphological characteristics (SPRATT, 2006). Moreover, there are still problems with the correct identification of these parasites, and at present the classification system is based mainly on the morphology of males (MORAVEC & JUSTINE,

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2010). This fact often results in descriptions of species lacking elucidative morphological data (FREITAS & ALMEIDA, 1935; MORAVEC, 1982; STAPF et al., 2013).

In the Baylis (1928) conception, the morphological classification of capillariid members included all of them in the genus *Capillaria sensus* Zeder, 1800, and is not currently accepted by most helminthologists, but remains in use in the medical literature (MORAVEC, 2001). Because of this classification today, the genus *Capillaria* has a large number of synonymies resulting from different attempts to reorganize the genus taxonomically (BUTTERWORTH & BEVERLEY-BURTON, 1980).

Cairina moschata domestica Linnaeus, 1758 (Muscovy ducks) is an important source of food for several human populations, since they provide meat and eggs (MATTOS et al., 2008). In the northern region of Brazil, the Muscovy duck is an abundant bird, composing one of the items in the food supply for human communities. As part of an ongoing study of the helminths of birds on Marajó Island, Brazil, samples of ducks were collected and necropsied. The objective of this study is to characterize the morphology, morphometry and prevalence of nematode Capillariidae parasites in Muscovy duck collected on Marajó Island, Brazilian Amazon.

Materials and Methods

The study used Nematoda Capillariidae obtained from 19 males and 11 females of *C. moschata domestica* aged 4-8 months and acquired from rural properties of the municipality of Soure (00° 43' 00" S; 48° 31' 24" W), in Marajó Island, Brazil. The Muscovy ducks were components of small extensively reared herds with free access to the environment, for the purpose of providing meat and eggs for families or for sale at local markets. These birds were slaughtered stunning with a club, cutting the blood vessels of the neck, exsanguination on the farm and only the organs of the digestive tract were transported to the Laboratório de Histologia e Embriologia Animal, Universidade Federal Rural da Amazônia, Campus Belém (Brazil). In the laboratory, the organs were separated and placed in Petri dishes with saline solution NaCl 0.9% and examined using a stereomicroscope. The recovered nematodes were fixed in a solution of AFA (93 parts 70% ethyl alcohol, 5 parts formaldehyde, and 2 parts glacial acetic acid) and processed using light microscopy and scanning electron microscopy according to method described by Pinheiro et al. (2018). A total of 10 male specimens, 10 female specimens and 50 eggs were used for the morphometric analysis of the nematodes. Measurements are given in micrometers unless otherwise noted and are presented as the range (minimum and maximum values) followed by the mean in parentheses. Taxonomic classification of nematodes was in accordance with Vicente et al. (1995) and Gibbons (2010).

Results

Survey data

A total of 242 *E. contortus* were recovered from the Muscovy duck in the epithelium of the esophageal mucosa, and this species is not present in other organs. Host-parasite data showing prevalence 76.6% (23 infected hosts out of 30 analyzed), mean intensity of 10.52, mean abundance of 8.15 and range of infection of 1 to 52 nematodes per bird. All specimens collected showed characteristics compatible with *E. contortus* (syn *Capillaria contorta*) (Nematoda: Capillariidae). The morphological and morphometric characteristics of the *E. contortus* are presented below:

Nematoda Rudolphi, 1808

Family Capillariidae Neveu-Lemaire, 1936

Eucoleus contortus (syn. *Capillaria contorta*) Creplin, 1839 (Gagarin, 1951)

(Based on light microscopy and scanning electron microscopy examination: Figures 1-3)

Medium-sized nematodes in relation to their congeners, filiform, with finely transversely striated cuticle. Cephalic region in button

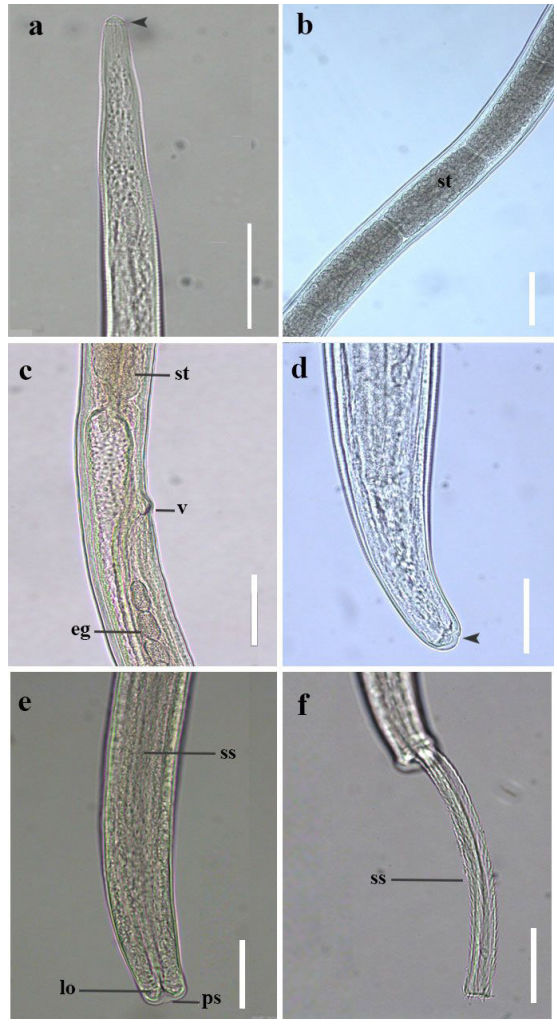

Figure 1. Scanning electron microscopy of eggs of *Eucoleus contortus* parasitizing the esophagus of *Cairina moschata domestica* in Pará State, Brazil. (a) Anterior end in button shape (arrowhead). Bar = 50 µm; (b) well defined stichocytes (st) with large and fragmented nuclei. Bar = 100 µm; (c) Esophageal-intestinal junction of the female, lateral view. End of stichocytes (st), vulva (v) and eggs (eg). Bar = 100 µm; (d) Female posterior extremity, lateral view, subterminal anal opening (arrowhead). Bar = 50 µm; (e) Tail of the male, ventral view, with retracted spiny spinal sheath (ss), caudal lobes (lo) and pseudobursa (ps). Bar = 50 µm; (f) Posterior end of a male, ventrolateral view, sheath extruded from cloaca (ss). Bar = 50 µm.

format (Figures 1a, 2a). Oral aperture circular. Muscular esophagus short, narrow. Nerve ring circulating the muscular esophagus in its initial portion. Stichosome consisting of single row of about 33 elongate stichocytes with distinct transverse annulae (mean of the three initial, middle and final stichocytes); nuclei of stichocytes large and fragmented (Figure 1b). Two wing-like pseudocoelomatic glandular cells present at esophagus-intestinal junction. Two bacillary lateral bands along the body, more numerous in females.

Males (Based on 9 specimens with hem retracted and 1 specimen with sheath exposed): Body length of 14 mm (11–16); and maximum width at the junction between the esophagus and bowel of 48 (37–60). Length of muscular esophagus 276 (223–307) × 15 (12–20), of stichosome 4 mm (3–5), number of stichocytes about 31 (25–44), stichocytes with distinct 13 (8–17) transverse annulae; nuclei of stichocytes large. Length of entire esophagus 5 mm (4–6), representing 34% of body length. Nerve ring situated 69 (52–83) from anterior extremity. Spicule single, weakly sclerotized, measuring 770 (600–980) × 13 (10–21); proximal end of spicule blunt. Spicular sheath spinous; length of part of sheath extruded from cloaca 177, width 14 in only one specimen. Posterior end of body rounded, with two distinct, round dorsolateral lobes10 (10) long, and one pair papillae in each one lobes. Cloacal opening terminal, length of tail 13. Membrane pseudobursa present 13 (10–15) × 24 (23–27) (Figures 1e, 2e).

Females (Based on 10 gravid specimens): Body length of 26 mm (21–29); and maximum width at the junction between the

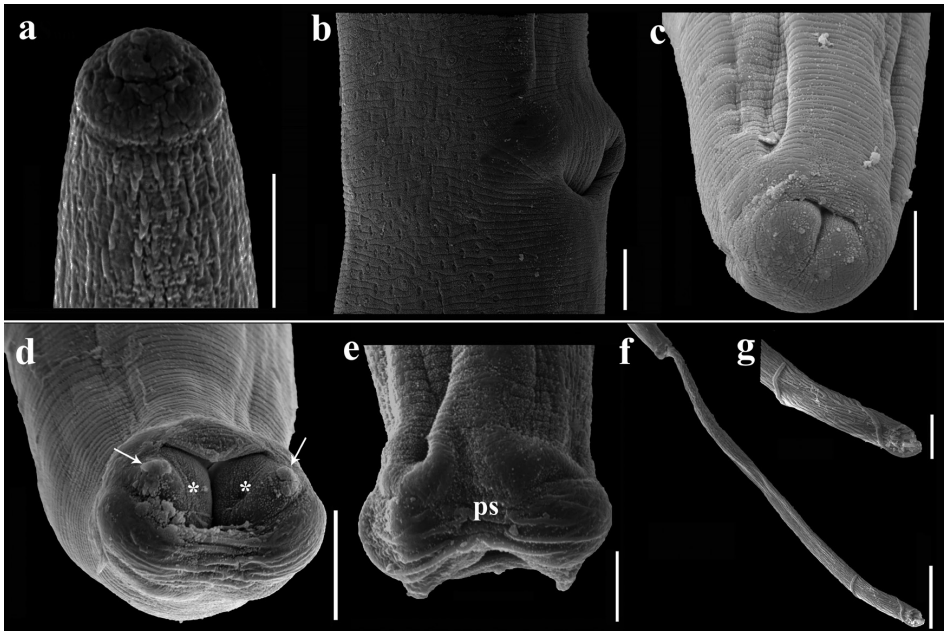

Figure 2. Scanning electron microscopy of *E. contortus*, parasitizing the esophagus of *C. moschata domestica* in Pará State, Brazil. (a) Anterior end in button shape (arrowhead). Bar = 5 µm; (b) Lateral view of the vulvar, showing lateral bacillary bands. Bar = 10 µm; (c) The posterior end of a female, with an anal opening. Bar = 10 µm; (d) Tail of the male in ventrolateral view, with caudal lobes (*), each with papilla (arrow); (e) Tail detail of the male, evidencing membranous pseudobursa (ps). Bar = 10 µm; (f) Tail lateral view of male with spiny sheath extruded. Bar = 50 µm; (g) Detail of the spinal sheath with the spines. Bar = 20 µm

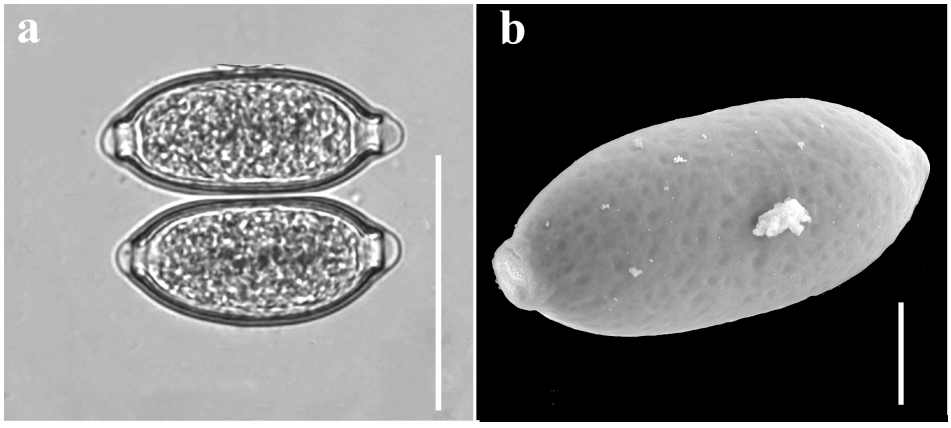

Figure 3. Photomicrographs and scanning electron microscopy of eggs of *E. contortus* parasitizing the esophagus of *C. moschata domestica* in Pará State, Brazil. (a-b) barrel-shaped eggs, with two well-defined asymmetric polar plugs, rough and porous shell surface. Bar a = 50 µm and Bar b = 10 µm.

esophagus and bowel of 67 (43–77). Length of muscular esophagus 379 (287-445) × 15 (7–23), of stichosome 6 mm (5–8), number of stichocytes about 32 (27–39), stichocytes with distinct 14 (8–16) number of transverse annulae; nuclei of stichocytes large. Length of entire esophagus 7 mm (5–8), representing 26% of body length. Nerve ring situated 69 (50–87) from anterior extremity. Vulva located 7 mm (6–8) from anterior end of body, at 27% of body length. The distance from the end of the stichocytes to the vulva 165 (57–330). The upper lip of the vulva is more elevated than the lower lip. Vulvar appendix absent. Eggs arranged in single file in uterus. Eggs barrel shaped 50 (40–90) × 20 (20–40), with protruding polar plugs 6 (3–7) × 9 (5–9) (Fig. 3ab). Egg wall with layer hyaline, outer layer with fine superficial net-like sculpture. Caudal end rounded 8 (7–10), anus subterminal (Fig. 1I).

Taxonomy summary:

Eucoleus contortus (syn *Capillaria contorta*) Creplin, 1839 (Gagarin, 1951)

Host: *Cairina moschata domestica* Linnaeus, 1758 (Anseriformes: Anatidae);

Common name in Brasil: Pato do mato, pato bravo, pato selvagem, asa branca, pato bravo verdadeiro.

Site of infection: Epithelium of the esophageal mucosa.

Biome: Amazon and Environment: Estuarine

Location: Municipality of Soure (Latitud -0.541205; Longitud -48.670139), Microrregião do Arari, Pará, Brazil.

Discussion

The nematodes found inserted in the mucosa of the esophagus of Muscovy ducks raised extensively in the municipality of Soure, Marajó Island, State of Pará (Brazil), have characteristics similar to those of the Capillariidae family. Gibbons (2010) groups this family into 27 genus, of which 10 parasitize birds: *Aonchotheca* López-Neyra 1947; *Baruscapillaria* Moravec 1982; *Brevitominx* Travassos, Freitas & Mendonça, 1964; *Capillaria* Zeder 1800; *Echinocoleus* López-Neyra 1947; *Eucoleus* Dujardin 1845; *Ornithocapillaria* Baruš & Sergeeva 1990; *Pseudocapillaria* Freitas, Mendonça & Guimarães, 1959; *Pterothominx* Freitas, Mendonça & Guimarães, 1959; and *Tridentocapillaria* Barus & Sergeeva 1990, with *Capillaria*, *Eucoleus* and *Pseudocapillaria* recorded as parasitizing ducks (MORAVEC, 1982; MORAVEC et al., 1987; STAPF et al., 2013).

The genus *Eucoleus* is composed of species that parasitize the respiratory tract, mucosa of the esophagus, buccal cavity and stomach of birds and mammals (MORAVEC, 1982; VICENTE et al., 1995; GIBBONS, 2010). Although Anderson (2000) and Anderson et al. (2009), employ *Eucoleus* as a synonym of *Capillaria*, Moravec (1982), Vicente et al. (1995) and Gibbons (2010) accept *Eucoleus* as a valid genus, with morphologically presenting males with thin spicule, moderately sclerotized with a long spinal sheath covered with cuticular spines, caudal lateral alae absent, two small lobes rounded laterally towards the posterior supporting a pseudobursa, and females with vulvae without an appendix.

The nematodes of the present study presented morphological and morphometric characteristics compatible with *E. contortus*. Creplin (1839) proposed *E. contortus* as a parasite of the oral cavity and esophagus of different birds (Anseriformes, Charadriiformes, Galliformes Falconiformes and Passeriformes) in Germany, but later, different authors re-described or added a new geographic distribution for the species, including Diesing (1851) in Falconiformes, Passeriformes and Charadriiformes from Austria; Eberth (1863) in Passeriformes from Germany; Linstow (1877) in Passeriformes, Charadriiformes and Anseriformes from Berlin; Railliet & Lucet (1889) in Anseriformes from Paris; Cram (1936) in Galliformes, Charadriiformes and Anseriformes from United States; Chabaud (1952) in Charadriiformes from Paris and Mettrick (1959) in Galliformes and Anseriformes from England.

Muscovy ducks are extensively reared in most part of Brazil, and on the Marajó Island they are of great importance to the human populations as a source of food, although there are few data on their parasitic fauna. In Brazil, the first record of bird parasitic nematodes was made by Travassos (1915) in Anseriformes, Charadriiformes, Passeriformes, and Falconiformes, followed by Freitas & Almeida (1935) in Passeriformes, Anseriformes, Charadriiformes, Falconiformes, and Galliformes; Freitas et al. (1959) in Galliformes, Piciformes and Psittaciformes, Mattos et al. (2008) in Anseriformes and Stapf et al. (2013) in Anseriformes. Although Brazil is one of the main refuges for resident and visiting birds, in discussions of work related to the parasites of these animals, only Vicente et al. (1995) has reviewed nematodes in birds in Brazil.

The use of scanning electron microscopy, although very common for nematodes, has rarely been applied for members of the Capillariidae family (MORAVEC & BARTON, 2018), especially because of the difficulty in processing the samples. In this study using SEM, we observed details of the cephalic region in button shape, in female vulva with unraised lip, in males tail with pseudobursa, supported by two lobes, each lobe having a papilla, spinal sheath armed with spines, besides the difference in quantity of bacillary bands between males and females. Morphometric comparisons between *Eucoleus contortus* and its other re-descriptions, in addition to the comparison with other species found in Brazil, are presented in Table 1.

Eggs of *E. contortus* morphologically have a barrel shape, with polar plugs and a rough surface; morphometrically the eggs presented similarity in size with that already described in the literature for the species (see Table 1). Campbell & Little (1991) states in his study that eggs of *E. boehmi* are characterized by having a barrel shape and polar plugs with small morphological differences. Macchioni et al. (2013), when analyzing dog feces in Italy with a prevalence of 7.4% of capillary parasites (*E. aerophilus* and *E. boehmi*) affirm that the use of molecular biology should be fundamental for the specific identification of family Capillariidae.

In this study, 76.6% of the analyzed ducks were parasitized by *E. contortus* in the esophageal mucosa. Different authors report parasitism and a high prevalence of *E. contortus* parasitizing the esophagus in different birds: Betlejewska et al. (2002) reported by 52.3% of parasitism in *Anas platyrhynchos* in the Northwest of Poland. Mattos et al. (2008) described the occurrence of *E. carinae* with prevalence of 6.6% in Muscovy ducks raised extensively in the State of Rio de Janeiro. Stapf et al. (2013) reported 24% of prevalence in *A. platyrhynchos* and 40% of prevalence in

Table 1. Comparison of morphological and morphometric characteristics of *Eucoleus contortus* with other species of the genus *Eucoleus* in bird species.

Caracteres	*Eucoleus contortus*		*Eucoleus contorta*		*Eucoleus contorta*		*Eucoleus carinae*		*Eucoleus annulatus*	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Order	Anseriformes		Anseriformes		Anseriformes		Anseriformes		Galliformes	
Family	Anatidae		Anatidae		Anatidae		Anatidae		Phasianidae	
Hosts	*Cairina moschata domestica*		*Anas crecca* [d]		*Anas boschas domestica* [e]		*Cairina moschata domestica* [h]		*Phasianus colchichus* [j]	
Type locality	Soure, Pará (Brazil)		(Brazil)		(North America) [f]		Rio de Janeiro (Brazil) [i]		Cosmopolitan	
Length[a]	11–16	21–29	8–15	15–30	8–16	13–30	14.3	36.5–39.9	15.41	22.50–22.56
Width	37–53	43–77	600–700	120–150	20–140	30–150	32–88	40–160	40–86	32–130
Nervous ring	52–83	50–87	–	–	64–83	83–92	37	81–86	70–75	86–97
Muscular esophagus[L, b]	223–307	287–445	–	–	232–264	232–264	108	336–344	320	570
Muscular esophagus[W, b]	12–20	7–23	–	–	–	–	–	–	–	–
Entire oesophagus [a]	4–6	5–8	3	3	3.28–3.64	3.28–3.64	3.93	6.23–7.23	3.07	4.6–5.0
Vulva [a]	–	6–8 [c]	–	–	–	0.040 [g]	–	0.12 [g]	–	–
Eggs [L, W, b]	40–50 × 20–40		49–56 × 24–28		49–58 × 24–29		43–51 × 21–29		54 × 64	
Spicule [L, b]	650–980	–	800	–	800–1200	–	–	–	–	–
Spicule [W, b]	10–21	–	–	–	–	–	–	–	–	–
Spicular sheath spines	Present	–	Present	–	Present	–	–	–	–	–
Numbers of specimens	10	10	–	–	–	–	–	–	–	–
References	In this study		Travassos (1915)		Freitas & Almeida (1935)		Freitas & Almeida (1935), Vicente et al. (1995)		Freitas & Almeida (1935)	

[a]Measurements in millimeters; [b]Abbreviations: L = length; W = width; [c]Calculated from anterior extremity; [d]Other hosts cited by Travassos (1915): *Anas crecca* (Linnaeus, 1758) (Syn. *Nettion crecca* (Linnaeus, 1758) (Anseriformes: Anatidae), *Alle alle* (Linnaeus, 1758) (Charadriiformes: Alcidae), *Chroicocephalus ridibundus* (Linnaeus, 1766) (Syn. *Larus ridibundus* Linnaeus, 1766) (Charadriiformes: Laridae), *Larus delawarensis* Ord, 1815 (Syn. *Larus canus* Linnaeus, 1758) (Charadriiformes: Laridae), *Charadrius hiaticula* Linnaeus, 1758 (Syn. *Aegialitis hiaticola* Linnaeus, 1758) (Charadriiformes: Charadriidae), *Recurvirostra americana* (Gmelin, 1789) (Syn. *Recurvirostra avoceta* Linnaeus, 1758) (Charadriiformes: Recurvirostridae), *Calidris pugnax* Linnaeus, 1758 (Syn. *Pavoncella pugnax, Philomachus pugnax, Tringa pugnax* Linnaeus, 1758) (Charidriiformes: Scolopacidae), *Corvus corone corone* (Linnaeus, 1758) (Passeriforme: Corvidae), *Coloeus monedula* (Linnaeus, 1758) (Passeriforme: Corvidae). *Corvus dauuricus* Pallas, 1776 (Syn. *Trypanocorax frugilegus* Linnaeus, 1758) (Passeriforme: Corvidae), *Sturnus unicolor* Temminck, 1820 (Syn. *Sturnus vulgaris* Linaeus, 1758) (Passeriforme: Corvidae), *Erithacus rubecula* (Linnaeus, 1758) (Passeriforme: Muscicapidae), *Buteo brachyurus* Vieillot, 1816, (Syn. *Buteo vulgaris* Linnaeus, 1758) (Accipitriformes: Acipritridae), *Accipiter haplochrous* P. L. Sclater, 1859 (Syn. *Accipiter nisus* Linnaeus, 1758) (Accipitriformes: Acipritridae), *Vanellus miles* Boddaert, 1783 (Syn. *Vanellus vanellus* Linnaeus, 1758) (Charadriiforme: Charadriidae), *Thalasseus elegans* Gambel, 1849 (Syn. *Sterna maxima* Boddaert, 1783) (Charadriiforme: Laridae); [c]Other hosts cited by Freitas & Almeida (1935): *Alle alle* (Linnaeus, 1758), *Chroicocephalus ridibundus* (Linnaeus, 1766), *Larus delawarensis* (Ord, 1815), *Charadrius hiaticula* (Linnaeus, 1758), *Recurvirostra americana* (Gmelin, 1789), *Calidris pugnax* (Linnaeus, 1758), *Corvus corone corone* (Linnaeus, 1758). *Corvus corone americana* (Linnaeus, 1758) (Passeriforme: Corvidae), *Corvus corone cornix* (Linnaeus, 1758) (Passeriforme: Corvidae), *Coloeus monedula* (Linnaeus, 1758), *Corvus dauuricus* (Pallas,1776) (Passeriforme: Corvidae), *Sturnus unicolor* (Temminck, 1820), *Erithacus rubecula* (Linnaeus, 1758), *Accipiter haplochrous* (P. L. Sclater, 1859), *Buteo brachyurus* (Vieillot, 1816), *Vanellus miles* (Boddaert, 1783), *Thalasseus elegans* (Gambel, 1849), *Meleagris gallopavo* (Linnaeus, 1758) (Galliforme: Phasianidae), *Callipepla californica achrustera* (Peters, 1923) (Syn. *Lophortix californica decolorata* Rossem, 1946) (Galliformes: Odontophoridae), *Anser domesticus* Linnaeus, 1758 (Syn. *Anser ferus domestica* Linnaeus, 1758) (Anseriformes: Anatidae); *Anas platyrhynchos* Linnaeus, 1758 (Anseriformes: Anatidae), *Anas bochas domestica* (Linnaeus, 1758) (Anseriformes: Anatidae); [f]North America. Europe. Asia. South America; [g]Calculated from entire esophagus end; [h]Other hosts cited by Freitas & Almeida (1935); Vicente et al. (1995): *Bonasa umbellus* Linnaeus, 1766 (Syn. *Bonasa bonasia* Linnaeus, 1758) (Galliformes:Phasianidae), *Chrysolophus pictus* Linnaeus, 1758 (Galliforme: Phasianidae), *Colinus virginianus* Linnaeus, 1758 (Syn. *Tetrao virginianus* Linnaeus, 1758) (Galliformes: Odontophoridae), *Gallus gallus* Linnaeus, 1758 (Galliformes: Phasianidae), *Lyrurus tetrix* Linnaeus, 1758 (Galliformes: Phasianidae), *Meleagris gallopavo* (Linnaeus, 1758) (Galliforme: Phasianidae), *Numida meleagris* Linnaeus, 1758 (Syn. *Phasianus meleagris* Linnaeus, 1758) (Galliformes: Numididae), *Perdix perdix* Linnaeus, 1758 (Syn. *Tetrao perdix* Linnaeus, 1758) (Galliformes: Phasianidae), *Phasianus colchicus* Linnaeus, 1758 (Galliformes: Phasianidae), *Syrmaticus reevesi* (Gray, 1829), *Tetrao urogallu* Linnaeus, 1758 (Galliformes: Phasianidae); [i]Paraná; [j]Other hosts cited by Freitas & Almeida (1935): *Alle alle* (Linnaeus, 1758), *Chroicocephalus ridibundus* (Linnaeus, 1766), *Larus delawarensis* (Ord, 1815), *Charadrius hiaticula* (Linnaeus, 1758), *Recurvirostra americana* (Gmelin, 1789), *Calidris pugnax* (Linnaeus, 1758), *Corvus corone corone* (Linnaeus, 1758). *Corvus corone americana* (Linnaeus, 1758) (Passeriforme: Corvidae), *Corvus corone cornix* (Linnaeus, 1758) (Passeriforme: Corvidae), *Coloeus monedula* (Linnaeus, 1758), *Corvus dauuricus* (Pallas,1776) (Passeriforme: Corvidae), *Sturnus unicolor* (Temminck, 1820), *Erithacus rubecula* (Linnaeus, 1758), *Accipiter haplochrous* (P. L. Sclater, 1859), *Buteo brachyurus* (Vieillot, 1816), *Vanellus miles* (Boddaert, 1783), *Thalasseus elegans* (Gambel, 1849), *Meleagris gallopavo* (Linnaeus, 1758) (Galliforme: Phasianidae), *Callipepla californica achrustera* (Peters, 1923) (Syn. *Lophortix californica decolorata* Rossem, 1946) (Galliformes: Odontophoridae), *Anser domesticus* Linnaeus, 1758 (Syn. *Anser ferus domestica* Linnaeus, 1758) (Anseriformes: Anatidae); *Anas platyrhynchos* Linnaeus, 1758 (Anseriformes: Anatidae), *Anas bochas domestica* (Linnaeus, 1758) (Anseriformes: Anatidae).

Table 1. Continued...

Caracteres	*Eucoleus contortus*		*Eucoleus dubius*		*Eucoleus penidoi*		*Eucoleus perforans*		–	
	Male	Female	Male	Female	Male	Female	Male	Female	–	–
Order	Anseriformes		Passeriformes		Tinamiformes		Galliformes		–	–
Family	Anatidae		Tyrannidae		Tinamidae		Phasianidae		–	–
Hosts	*Cairina moschata domestica*		*Attila cinereus*		*Nothura maculosa*		*Phasianas colchichus*		–	–
Type locality	Soure, Pará, Brazil		Rio de Janeiro, Brazil		São Paulo, Brazil		São Paulo, Brazil		–	–
Length[a]	11–16	21–29	11.28–11.67	14.83–14.85	–	15.14	22.45	27.87	–	–
Width	37–53	43–77	32–96	32	24–96	52–140	70	130	–	–
Nervous ring	52–83	50–87	64	72	92–100	92–100	139	217	–	–
Muscular esophagus[L, b]	223–307	287–445	240	280–320	310–380	310–380	395	470	–	–
Muscular esophagus[W, b]	12–20	7–23	–	–	–	–	–	–	–	–
Entire esophagus	4–6	5–8	3.26–3.60	3.63–4.0	3.39 –4.18	3.39–4.18	5.15	6.53	–	–
Vulva[a]	–	6–8 [c]	–	0.024 [g]	–	0.14 [g]	–	0.084 [g]	–	–
Eggs [L, W, b]	40–50 × 20–40		54–56 × 32–40		44–60 × 20–28		55–59 × 22–23		–	–
Spicule [L, b]	650–980	–	–	–	–	–	11.300	–	–	–
Spicule [W, b]	10–21	–	–	–	–	–	21	–	–	–
Spicular sheath spines	Present	–	–	–	–	–	–	–	–	–
Numbers of specimens	10	10	–	–	–	–	1	1	–	–
Reference	In this study		Freitas & Almeida (1935)		Freitas & Almeida (1935)		Freitas et al. (1959)		–	–

[a]Measurements in millimeters; [b]Abbreviations: L = length; W = width; [c]Calculated from anterior extremity; [d]Other hosts cited by Travassos (1915): *Anas crecca* (Linnaeus, 1758) (Syn. *Nettion crecca* (Linnaeus, 1758) (Anseriformes: Anatidae), *Alle alle* (Linnaeus, 1758) (Charadriiformes: Alcidae), *Chroicocephalus ridibundus* (Linnaeus, 1766) (Syn. *Larus ridibundus* Linnaeus, 1766) (Charadriiformes: Laridae), *Larus delawarensis* Ord, 1815 (Syn. *Larus canus* Linnaeus, 1758) (Charadriiformes: Laridae), *Charadrius hiaticula* Linnaeus, 1758 (Syn. *Aegialitis hiaticola* Linnaeus, 1758) (Charadriiformes: Charadriidae), *Recurvirostra americana* (Gmelin, 1789) (Syn. *Recurvirostra avoceta* Linnaeus, 1758) (Charadriiformes: Recurvirostridae), *Calidris pugnax* Linnaeus, 1758 (Syn. *Pavoncella pugnax, Philomachus pugnax, Tringa pugnax* Linnaeus, 1758) (Charidriiformes: Scolopacidae), *Corvus corone corone* (Linnaeus, 1758) (Passeriforme: Corvidae), *Coloeus monedula* (Linnaeus, 1758) (Passeriforme: Corvidae). *Corvus dauuricus* Pallas, 1776 (Syn. *Trypanocorax frugilegus* Linnaeus, 1758) (Passeriforme: Corvidae), *Sturnus unicolor* Temminck, 1820 (Syn. *Sturnus vulgaris* Linaeus, 1758) (Passeriforme: Corvidae), *Erithacus rubecula* (Linnaeus, 1758) (Passeriforme: Muscicapidae), *Buteo brachyurus* Vieillot, 1816, (Syn. *Buteo vulgaris* Linnaeus, 1758) (Accipitriformes: Acipritridae), *Accipiter haplochrous* P. L. Sclater, 1859 (Syn. *Accipiter nisus* Linnaeus, 1758) (Accipitriformes: Acipritridae), *Vanellus miles* Boddaert, 1783 (Syn. *Vanellus vanellus* Linnaeus, 1758) (Charadriiforme: Charadriidae), *Thalasseus elegans* Gambel, 1849 (Syn. *Sterna maxima* Boddaert, 1783) (Charadriiforme: Laridae); [e]Other hosts cited by Freitas & Almeida (1935): *Alle alle* (Linnaeus, 1758), *Chroicocephalus ridibundus* (Linnaeus, 1766), *Larus delawarensis* (Ord, 1815), *Charadrius hiaticula* (Linnaeus, 1758), *Recurvirostra americana* (Gmelin, 1789), *Calidris pugnax* (Linnaeus, 1758), *Corvus corone corone* (Linnaeus, 1758). *Corvus corone americana* (Linnaeus, 1758) (Passeriforme: Corvidae), *Corvus corone cornix* (Linnaeus, 1758) (Passeriforme: Corvidae), *Coloeus monedula* (Linnaeus, 1758), *Corvus dauuricus* (Pallas,1776) (Passeriforme: Corvidae), *Sturnus unicolor* (Temminck, 1820), *Erithacus rubecula* (Linnaeus, 1758), *Accipiter haplochrous* (P. L. Sclater, 1859), *Buteo brachyurus* (Vieillot, 1816), *Vanellus miles* (Boddaert, 1783), *Thalasseus elegans* (Gambel, 1849), *Meleagris gallopavo* (Linnaeus, 1758) (Galliforme: Phasianidae), *Callipepla californica achrustera* (Peters, 1923) (Syn. *Lophortix californica decolorata* Rossem, 1946) (Galliformes: Odontophoridae), *Anser domesticus* Linnaeus, 1758 (Syn. *Anser ferus domestica* Linnaeus, 1758) (Anseriformes: Anatidae); *Anas platyrhynchos* Linnaeus, 1758 (Anseriformes: Anatidae), *Anas bochas domestica* (Linnaeus, 1758) (Anseriformes: Anatidae); [f]North America. Europe. Asia. South America; [g]Calculated from entire esophagus end; [h]Other hosts cited by Freitas & Almeida (1935); Vicente et al. (1995): *Bonasa umbellus* Linnaeus, 1766 (Syn. *Bonasa bonasia* Linnaeus, 1758) (Galliformes:Phasianidae), *Chrysolophus pictus* Linnaeus, 1758 (Galliforme: Phasianidae), *Colinus virginianus* Linnaeus, 1758 (Syn. *Tetrao virginianus* Linnaeus, 1758) (Galliformes: Odontophoridae), *Gallus gallus* Linnaeus, 1758 (Galliformes: Phasianidae), *Lyrurus tetrix* Linnaeus, 1758 (Galliformes: Phasianidae), *Meleagris gallopavo* (Linnaeus, 1758) (Galliforme: Phasianidae), *Numida meleagris* Linnaeus, 1758 (Syn. *Phasianus meleagris* Linnaeus, 1758) (Galliformes: Numididae), *Perdix perdix* Linnaeus, 1758 (Syn. *Tetrao perdix* Linnaeus, 1758) (Galliformes: Phasianidae), *Phasianus colchicus* Linnaeus, 1758 (Galliformes: Phasianidae), *Syrmaticus reevesi* (Gray, 1829), *Tetrao urogallu* Linnaeus, 1758 (Galliformes: Phasianidae); [i]Paraná; [j]Other hosts cited by Freitas & Almeida (1935): *Alle alle* (Linnaeus, 1758), *Chroicocephalus ridibundus* (Linnaeus, 1766), *Larus delawarensis* (Ord, 1815), *Charadrius hiaticula* (Linnaeus, 1758), *Recurvirostra americana* (Gmelin, 1789), *Calidris pugnax* (Linnaeus, 1758), *Corvus corone corone* (Linnaeus, 1758). *Corvus corone americana* (Linnaeus, 1758) (Passeriforme: Corvidae), *Corvus corone cornix* (Linnaeus, 1758) (Passeriforme: Corvidae), *Coloeus monedula* (Linnaeus, 1758), *Corvus dauuricus* (Pallas,1776) (Passeriforme: Corvidae), *Sturnus unicolor* (Temminck, 1820), *Erithacus rubecula* (Linnaeus, 1758), *Accipiter haplochrous* (P. 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Anas clypeata in Northwest Poland, and Oliveira et al. (2017) found 16% of prevalence in *Callipepla californica* of Brazil.

In the Marajó Island, the local human population commonly uses Muscovy ducks for food and commerce. Most of these birds live in an open environment, using this space as shelter and to obtain food, besides being raised together with other birds, and domestic and wild animals. Endoparasite infections are almost inevitable in an extensive system due to the prolonged survival of eggs in the environment, especially when there is high humidity, which allows the greater survival of immature forms of helminths and increases the number of infectious stages in the soil, when capillary eggs can survive up to 11 months viable in the environment (YADAV & TANDON, 1991; PERMIN et al., 2002; CARDOZO & YAMAMURA, 2004; SOBRAL et al., 2010). Ruff (1999) and Vita et al. (2014) observed that for birds that are raised free, having access to other birds and domestic or wild animals in places with poor hygiene, in addition to direct contact with the ground, this is the ideal environment for the proliferation of parasitic diseases.

The high prevalence of nematodes in Muscovy duck from the Marajó Island may be related to the interaction of these birds with the soil, which is essential for the maintenance of the life cycle of many parasites, such as *E. contortus*, where the birds ingest the intermediate host, possibly earthworms, besides the viable eggs in the environment (CARDOZO & YAMAMURA, 2004).

Conclusions

The Muscovy duck is an important source of animal protein for the human population of Marajó and the knowledge of its nematofauna is important information to understand the pathogens that can affect poultry and that reduce poultry production in the country, so that measures can be taken for the purpose of avoiding possible zoonoses.

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