Revista Mexicana de Biodiversidad 84: 1100-1110, 2013
DOI: 10.7550/rmb.34431

New records and a checklist of trematodes from *Butorides striata* (Aves: Ardeidae)

Nuevos registros y una lista de tremátodos de *Butorides striata* (Aves: Ardeidae)

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Abstract. Seven species of trematodes were identified during the study of helminths found in *Butorides striata* (Linnaeus, 1758) from Belo Horizonte, Minas Gerais, Brazil: *Ascocotyle* (*Phagicola*) *angrense* (Travassos, 1916), *Ascocotyle* (*Phagicola*) *pindoramensis* (Travassos, 1928), *Centrocestus formosanus* (Nishigori, 1924), *Clinostomum heluans* Braun, 1899, *Clinostomum marginatum* (Rudolphi, 1819), *Posthodiplostomum nanum* Dubois, 1937, and *Prosthogonimus ovatus* (Rudolphi, 1803). *Butorides striata* is a new host for *C. heluans*, *P. ovatus*, *A.* (*P.*) *pindoramensis*, and *C. formosanus*. This last species is reported for the first time in a naturally infected definitive host in South America. Additionally, an updated checklist with 31 species of trematodes already reported in *B. striata* is presented.

Key words: Brazil, Clinostomidae, Digenea, Diplostomidae, Heterophyidae, Prosthogonimidae, trematodes.

Resumen. Se identificaron 7 especies de tremátodos durante el estudio de los helmintos hallados en *Butorides striata* (Linnaeus, 1758) de Belo Horizonte, Minas Gerais, Brasil: *Ascocotyle* (*Phagicola*) *angrense* (Travassos, 1916), *Ascocotyle* (*Phagicola*) *pindoramensis* (Travassos, 1928), *Centrocestus formosanus* (Nishigori, 1924), *Clinostomum heluans* Braun, 1899, *Clinostomum marginatum* (Rudolphi, 1819), *Posthodiplostomum nanum* Dubois, 1937, *Prosthogonimus ovatus* (Rudolphi, 1803). *Butorides striata* es un nuevo huésped definitivo para *C. heluans*, *P. ovatus*, *A.* (*P.*) *pindoramensis* y *C. formosanus*. Esta última especie se registra por primera vez en un huésped definitivo naturalmente infectado en América del Sur. Además, se presenta un listado actualizado con 31 especies de tremátodos ya documentados para *B. striata*.

Palabras clave: Brasil, Clinostomidae, Digenea, Diplostomidae, Heterophyidae, Prosthogonimidae, tremátodos.

Introduction

Studies on digenetic trematodes of Neotropical birds have been carried out since the early nineteenth century, and dozens of species of these parasites have been described in Latin America (reviewed by Travassos et al., 1969; Thatcher, 1993; Pérez-Ponce de León et al., 2007; Lunaschi et al., 2007). Despite the diversity of species of trematodes already known, it is possible that several interactions involving birds and trematodes are still unknown in the Neotropics.

Factors related to habitat destruction, climate change, food web alterations, as well as illegal hunting may contribute to population reduction and extinction of bird species, and consequently can cause changes in populations of parasite species, sometimes their co-extinction. Thus, trematodes are more vulnerable to such alterations than other helminths, in part due to their complex life cycle involving intermediate hosts (Dobson et al., 2008). In this regard, studies to expand knowledge about trematodes from birds are still desirable.

Among the bird species that are potential definitive host of trematodes in the Neotropics is the striated heron, *Butorides striata* (Linnaeus, 1758), a small ardeid distributed mainly in South America, but also found in tropical regions of the Old World (Hayes, 2002). Studies on helminth fauna of *B. striata* were performed in different countries, but data on these birds infected with trematodes are relatively scarce and scattered in the scientific literature. In the present study, new host and geographical records as well as a checklist of trematodes reported in *B. striata* are presented.

Materials and methods

A young specimen of *B. striata* was found dead on the banks of the Pampulha Reservoir (43°59'35"

Recibido: 24 noviembre 2012; aceptado: 12 junio 2013

W, 19°50'50" S), Belo Horizonte, State of Minas Gerais, Brazil in May 2010. The bird was transported to the laboratory, identified according to Hayes (2002), and necropsied (authorization number 21590 from the Brazilian Institute of Environment and Renewable Natural Resources – IBAMA). At necropsy, organs were separated, placed in Petri dishes containing saline solution (0.85% NaCl) and examined with the aid of a stereomicroscope. The trematodes found were compressed between glass slides, fixed in 10% formalin at 70° C, stained with alum acetocarmine, dehydrated in ascending series of ethanol, cleared in beechwood creosote, and mounted in Canada balsam. Measurements of the parasites were obtained with the aid of an ocular micrometer and photographs were taken with a Leica ICC50 HD digital camera attached to a light microscope. Taxonomic identifications were based on morphological characters following several authors (Travassos et al., 1969; Kohn and Fernandes, 1972; Ostrowski-de Núñez, 1973; Gibson et al., 2002; Simões et al., 2006; Bray et al., 2008; Caffara et al., 2011). The specimens studied were deposited in the collection of the Laboratory of Taxonomy and Biology of Invertebrates (DPIC), Department of Parasitology, Federal University of Minas Gerais. Furthermore, a checklist was compiled based on the new and previous reports of trematode species from *B. striata*.

Redescriptions

Morphological analyses of parasites permitted the identification of 7 species of trematodes belonging to 5 genera and 4 families. The family and species of the trematodes found in *B. striata* in the present study, as well as taxonomic summaries containing the intensity of infection, site of infection, accession number of deposited specimens, and taxonomic comments for each parasite species are presented below. Measurements of the parasites are given in micrometers with the mean (when possible) followed by the standard deviation and amplitude in parentheses (Table 1).

Clinostomidae Lühe, 1901
Clinostomum heluans Braun, 1899 (Fig. 1)
Taxonomic summary
Intensity of infection: 1.
Site of infection: oral cavity.
Specimen deposited: DPIC 6240.
Remarks. Trematode species of the genus *Clinostomum* Leidy, 1856 are parasites of the oral cavity and esophagus of fish-eating birds. Three species, namely *C. heluans*, *C. marginatum* (Rudolphi, 1819), and *C. detruncatum* Braun, 1899, have been reported in Brazil (Travassos et al., 1969; Thatcher, 1993). *Clinostomum heluans* was described from a Brazilian specimen of *Egretta caerulea* (Linnaeus, 1758), and differs from other South American species of the genus mainly by the arrangement of reproductive structures in the posterior region of the body and in the position of the genital pore on the margin of anterios testis. The species was later recorded in *Ardea cocoi* Linnaeus, 1766 and *Nyctanassa violacea* (Linnaeus, 1758) in Brazil (Travassos et al., 1969), and in *Ardea herodias* Linnaeus, 1758 and *Ardea alba egreta* Gmelin, 1789 from Cuba (Pérez-Vigueras, 1955), in *A. herodias* from Mexico (Bravo-Hollis, 1947; Pérez-Ponce de León et al., 2007), in *Ardea alba* Linnaeus, 1758 from Venezuela (Caballero and Díaz-Ungría, 1958), and recently in *A. alba* from the Czech Republic (Sitko, 2012).

The life cycle of *C. heluans* remains unknown. Lutz (1934) was believed to have elucidated the life cycle of this parasite, when in fact, he had used material of *C. marginatum* (Travassos et al., 1969). Two species of fish, *Cichla temensis* Humboldt, 1821 and *Geophagus proximus* (Castelnau, 1855), were reported harboring metacercariae of *C. heluans* in Brazil (Vicente et al., 1978; Zago et al., 2012). *Butorides striata* is here registered as a new definitive host for *C. heluans*.

Clinostomum marginatum (Rudolphi, 1819) (Fig. 2)
(Syn: *Distoma marginatum* Rudolphi, 1819)
Taxonomic summary
Intensity of infection: 1.
Site of infection: oral cavity.
Specimen deposited: DPIC 6239.
Remarks. Clinostomum marginatum is widely distributed throughout the Americas, and it has been reported in 13 species of birds from Brazil (Travassos et al., 1969; Arruda et al., 2001; Dias et al., 2003). The species was previously found in *B. striata* in the State of Mato Grosso, Brazil by Travassos (1945) and since then it has not been recorded in this host. Later, *C. marginatum* was reported in *Tigrisoma lineatum* (Boddaert, 1783) from Argentina (Lunaschi and Drago, 2009), and in at least 10 species of birds from Mexico (as *C. complanatum*) (Ramos-Ramos, 1995; Pérez-Ponce de León et al., 2007). *Clinostomum marginatum* had previously been considered a junior synonym of *C. complanatum* (Rudolphi, 1809), a species reported in birds from the Old World. However, morphological and molecular studies showed that *C. marginatum* is a distinct American species (Dzikowski et al., 2004; Caffara et al., 2011). The morphological differences, in particular body width, distance between the suckers, and shape of the sexual organs of the specimen studied are in agreement with those ascribed to *C. marginatum* (Caffara et al., 2011). Moreover, measurements and the disposition of

Figures 1-7. Species of trematodes found in *Butorides striata* from Brazil (ventral views). 1, *Clinostomum heluans* Braun, 1899; 2, *Clinostomum marginatum* (Rudolphi, 1819); 3, *Posthodiplostomum nanum* Dubois, 1937; 4, *Ascocotyle* (*Phagicola*) *angrense* (Travassos, 1916); 5, *Ascocotyle* (*Phagicola*) *pindoramensis* (Travassos, 1928); 6, *Centrocestus formosanus* (Nishigori, 1924); 7, *Prosthogonimus ovatus* (Rudolphi, 1803). Scale bars: 1= 1 mm; 2 and 7= 500 µm; 3= 100 µm; 4-6= 50 µm.

reproductive structures of the specimen of *C. marginatum* reported in the present study differ significantly from that verified in *C. heluans*. The life cycle of *C. marginatum* involves planorbid mollusks of the genera *Biomphalaria* Preston, 1910 in South America, and *Helisoma* Swainson, 1840 in North America, as first intermediate hosts (Lutz, 1934; Krull, 1934; Dias et al., 2003). Metacercariae of *C. marginatum* were reported in several species of fish from the Americas, including more than 20 species of these hosts from Brazil (Pinto and Melo, 2012a).

Diplostomidae Poirier, 1886

Posthodiplostomum nanum Dubois, 1937 (Fig. 3)

(Syn: *Posthodiplostomum antillanum* Pérez-Vigueras, 1944)

Taxonomic summary

Intensity of infection: 183.

Site of infection: small intestine.

Specimens deposited: DPIC 6233.

Remarks. Species of *Posthodiplostomum* Dubois, 1936 are intestinal trematodes of birds; 5 species (*P. grande* (Diesing, 1850), *P. macrocotyle* Dubois, 1937, *P. microsicya* Dubois, 1936, *P. prosostomum* Dubois and Rausch, 1948, and *P. nanum*) were reported in Brazil (Travassos et al., 1969; Thatcher, 1993). *Posthodiplostomum nanum* was described from *B. striata* in Brazil and later recorded in several species of birds in Argentina (Boero et al., 1972; Ostrowski-de Núñez, 1973; Digiani, 2000; Lunaschi et al., 2007; Drago and Lunaschi, 2011), Cuba (Pérez-Vigueras, 1944), and Paraguay (Dubois, 1985). The life cycle of *P. nanum* was studied in Argentina by Ostrowski-de Núñez (1973), who obtained strigeid cercariae in experimentally infected *Uncancylus concentricus* (d'Orbigny, 1835). Metacercariae of the parasite were found in fishes, mainly poeciliids, in Argentina (Ostrowski-de Núñez, 1973; Doma and Ostrowski-de Núñez, 1994) and Brazil (Dubois, 1970; Pinto and Melo, 2012a). Metacercariae found in fishes and identified as *P. nanum* in Africa (Fitschal and Thomas, 1968; Williams, 1967) are conspecific with *Posthodiplostomum biellipticum* Dubois, 1958, and therefore the area of occurrence of *P. nanum* is possibly restricted to the Americas (Ostrowski-de Núñez, 1973).

Heterophyidae Leiper, 1909

Ascocotyle (Phagicola) angrense Travassos, 1916 (Fig. 4)

(Syn: *Phagicola angrense* (Travassos, 1916))

Taxonomic summary

Intensity of infection: 7.

Site of infection: small intestine.

Specimens deposited: DPIC 6236.

Remarks. Species of *Ascocotyle* Looss, 1899 are intestinal parasites of birds and mammals with a worldwide distribution. In Brazil, 6 species (*A. angrense*, *A. felippei* Travassos, 1928, *A. arnaldoi* (Travassos, 1928), *A. angeloi* (Travassos, 1929), *A. pindoramensis* (Travassos, 1928), and *A. longa* Ransom, 1920) are currently known (Travassos et al., 1969; Thatcher, 1993; Simões et al., 2006; Santos et al., 2007). *Ascocotyle* (*P.*) *angrense* was described from *B. striata* in Brazil and later reported in *Ixobrychus exilis* (Gmelin, 1789) and *Ardea cocoi* Linnaeus, 1766 (Travassos, 1930; Arruda et al., 2001), and in *Ajaia ajaja* (Linnaeus, 1758), *Ardea alba* Linnaeus, 1758, *Ardea alba egretta* Gmelin, 1789 and *Ixobrychus involucris* (Vieillot, 1823) from Argentina (Ostrowski-de Núñez, 1993; Lunaschi et al., 2007). This heterophyid species presents as differential features the presence of a crown with 20 acicular spines, 18 in a single row and 2 accessories spines (Travassos, 1930; Ostrowski-de Núñez, 1993). The complete life cycle of *A.* (*P.*) *angrense* is unknown (Ostrowski-de Núñez, 1993). Metacercariae of the parasite have been found in the gills of *Phallocerus caudimaculatus* (Hensel, 1868) from Brazil and Argentina (Travassos, 1931; Ostrowski-de Núñez, 1974). Although *A.* (*P.*) *angrense* has been reported in birds and fishes in the United States and Mexico (Sogandares-Bernal and Lumsden, 1963; Salgado-Maldonado and Aguirre-Macedo, 1991), further studies demonstrated that these records correspond to *A.* (*P.*) *diminuta* (Stunkard and Haviland, 1924) and *A.* (*P.*) *nana* Ransom, 1920, and the area of occurrence of *A.* (*P.*) *angrense* is possibly restricted to South America (Ostrowski-de Núñez, 1993; Scholz et al., 1997; Scholz et al., 2001). This is the only report of *A.* (*P.*) *angrense* in *B. striata* from Brazil since the description of the species by Travassos (1916).

Ascocotyle* (*Phagicola*) *pindoramensis (Travassos, 1928) (Fig. 5)

(Syn: *Pygidiopsis pindoramensis* Travassos, 1928; *A.* (*P.*) *mollienisicola* (Sogandares-Bernal and Bridgman, 1960); *Pseudascocotyle mollienisicola* Sogandares-Bernal and Bridgman, 1960)

Taxonomic summary

Intensity of infection: 4.

Site of infection: small intestine.

Specimens deposited: DPIC 6237.

Remarks. Ascocotyle (*P.*) *pindoramensis* was described based on parasites found in *I. exilis* from Brazil, and was later reported in Brazilian specimens of *N. violacea* and *Nycticorax nycticorax* (Linnaeus, 1758) (Travassos, 1928; Arruda et al., 2001). This species was redescribed from parasites obtained experimentally in *Mesocricetus auratus* (Simões et al., 2006). Metacercariae of *A.* (*P.*) *pindoramensis* were reported in *Poecilia latipinna* (Lesueur, 1821) in the United States, *P. velifera* (Regan, 1814) in Nicaragua, and *Poecilia vivipara* Bloch and Schneider, 1801 and *Phalloptychus januarius* (Hensel, 1868) in Brazil (Sogandares-Bernal and Bridgman, 1960, 1963; Aguirre-Macedo et al., 2001; Simões et al., 2006). Parasites found in some bird species (including *B. striata*) in Argentina (Ostrowski-de Núñez, 1976) and metacercariae obtained in poeciliids in Mexico (Scholz et al., 2001) were identified as *Pygidiops pindoramensis*; however, they differ from *A.* (*P.*) *pindoramensis* sensu Travassos, 1928

mainly by the presence of an acicular crown of spines, and are currently considered an undetermined species of *Pygidiopsis* (Simões et al., 2006; Lunaschi et al., 2007; Pérez-Ponce de León et al., 2007). The first intermediate host of *A*. (*P*.) *pindoramensis* also remains unknown. *Butorides striata* is here reported as a new host to *A*. (*P*.) *pindoramensis*.

Centrocestus formosanus (Nishigori, 1924) (Fig. 6)
(Syn: *Stamnosoma formosanus* Nishigori, 1924)
Taxonomic summary
Site of infection: small intestine.
Intensity of infection: 10.
Specimens deposited: DPIC 6235.
Remarks. Centrocestus Looss, 1899 comprises species of intestinal small flukes from birds and mammals, including humans in Asia. *Centrocestus formosanus* is native to Asia; after its introduction in the American continent in the late 1950s it was reported in its first intermediate host, the thiarid *Melanoides tuberculata* (Müller, 1774), so far in 5 countries of this continent (reviewed by Pinto and Melo, 2011). Moreover, the parasite was reported in several fish species in different countries and can cause mortality and losses to fish farming (Scholz and Salgado-Maldonado, 2000; Mitchell et al., 2005; Arguedas-Cortés et al., 2010). Although there are several records of *C. formosanus* in the intermediate hosts in the Americas, studies related to natural definitive hosts are scarce. In fact, the only record is from a bird species identified as *B. striata* in Mexico (Scholz and Salgado-Maldonado, 2000; Pérez-Ponce de León et al., 2007). However, in view of the current knowledge related to the distribution of *Butorides* spp. (Hayes, 2002), the Mexican host of *C. formosanus* from the above record may be *Butorides virescens* (Linnaeus, 1758), the only species of *Butorides* endemic in North America. The present study is the first report of the natural infection of *B. striata* with *C. formosanus* in South America. In Brazil, *C. formosanus* was previously reported in naturally infected *M. tuberculata* (Pinto and Melo, 2010; Paula-Andrade et al., 2012) and fishes, *Australoheros facetus* (Jenyns, 1842) and *Poecilia reticulata* Peters, 1859 (Pinto and Melo, 2012a, b). Aspects of the interaction between the parasite and experimentally infected mice were recently evaluated (Mati et al., 2013). Given the known non-specificity of *C. formosanus*, possibly other Neotropical species of fish-eating birds are involved in the maintenance of the parasite in the Americas.

Prosthogonimidae Lühe, 1909
Prosthogonimus ovatus (Rudolphi, 1803) (Fig. 7)
(Syn: *Fasciola ovata* Rudolphi, 1803; *Distoma ovatum* (Rudolphi, 1803); *Cephalogonimus ovatus* Stossich, 1892; *Prymnoprion ovatus* Looss, 1899)
Taxonomic summary
Intensity of infection: 1.
Site of infection: cloaca.
Specimens deposited: DPIC 6238.
Remarks. Species of the genus *Prosthogonimus* Lühe, 1899 are parasites of the oviduct and cloaca of birds with a worldwide distribution. *Prosthogonimus ovatus*, the type species of the genus, has a cosmopolitan distribution and has already been reported in several countries of the Americas, Europe, Africa, and Asia (Jones, 2008). In Brazil, this species was found for the first time in *Gallus gallus* (Linnaeus, 1758) by Travassos (1920). Later, it was found in about 30 species of birds, and it is considered a species with wide morphological variety and low host specificity (Travassos et al., 1969; Kohn and Fernandes, 1972; Monteiro et al., 2007; Mascarenhas et al., 2009). Despite the diversity of vertebrate hosts already reported infected with *P. ovatus*, this species has not been yet found in *B. striata*. The life cycle of this parasite was elucidated in Europe and involves aquatic mollusks (*Bithynia tentaculata* (Linnaeus, 1758)); xiphidiocercariae are formed, and after emerging, penetrate into dragonfly larvae and develop into metacercariae (Boddeke, 1960a, b). The first intermediate hosts and larval stages have not yet been identified in the Americas.

A checklist of trematodes species from *B. striata* based on 29 previous reports available in the literature and the data obtained in this study are presented in Table 2. To date, trematodes belonging to 11 families, 22 genera, and 31 species were reported infecting *B. striata* in 8 countries. The highest number species of trematodes from *B. striata* (22; 71%) was reported in South America, and over half of these species (16; 52%) were registered in *B. striata* from Brazil. Moreover, Heterophyidae was the family with the highest number of species recorded in *B. striata* (9), followed by Echinostomatidae (5) and Diplostomidae (4). *Postodiplostomum nanum* was the species with the widest distribution, and was recorded to date in 3 countries (Brazil, Argentina, and Paraguay). Interestingly, none of the 9 species of trematodes recorded in *B. striata* in Asia, or the trematodes species reported in this ardeid in Africa, have been recorded for the same host in the Americas. The converse is also true for species reported in the Americas.

Among the 7 species of trematodes found in a single specimen of *B. striata* evaluated in this study, *C. heluans*, *P. ovatus*, *A*. (*P*.) *pindoramensis*, and *C. formosanus* are here recorded in a new host and locality. Overall, there are 16 species of trematodes reported in this host in Brazil, a number significantly higher than that reported for nematodes (4 species) and cestodes (5 species) (Rego

Table 1. Morphometric data for 7 species of trematodes found in *Butorides striata* from Brazil. Measurements are given in micrometers. Abbreviations: L= length, W= width, NP= not present

		Ascocotyle (Phagicola) angrense *n*= 3	*Ascocotyle (Phagicola) pindoramensis* *n*= 7	*Centrocestus formosanus* *n*= 10	*Clinostomum heluans* *n*= 1	*Clinostomum marginatum* *n*= 1	*Posthodiplostomum nanum* *n*= 30	*Prosthogonimus ovatus* *n*= 1
Body	L	609 ± 9 (601-618)	496 ± 87 (422-657)	352 ± 27 (334-423)	14.400	8.200	1.021 ± 113 (751-1.256)	2.231
	W	280 ± 21 (257-298)	228 ± 26 (196-270)	146 ± 26 (109-205)	2.400	3.300	499 ± 106 (280-669)	1.415
Oral sucker	L	66 ± 1 (65-67)	43 ± 6 (37-51)	42 ± 4 (35-52)	307	307	54 ± 5 (45-62)	181
	W	46 ± 9 (38-56)	40 ± 6 (32-49)	42 ± 5 (35-50)	375	409	50 ± 3 (42-53)	171
Pharynx	L	36	40 ± 3 (37-44)	27 ± 2 (25-28)	NP	NP	52 ± 5 (42-58)	116
	W	24	25 ± 6 (20-34)	20 ± 2 (18-22)	NP	NP	32 ± 4 (25 40)	102
Ventral sucker	L	45 ± 5 (36-52)	45 ± 6 (40-54)	33 ± 5 (27-42)	601	945	52 ± 5 (42-62)	401
	W	44 ± 11 (32-52)	48 ± 6 (42-56)	36 ± 4 (33-42)	464	911	54 ± 6 (42-67)	441
Ovary	L	79 ± 7 (72-86)	50 ± 13 (38-72)	40 ± 8 (30-58)	68	239	143 ± 41 (48-205)	306
	W	93 ± 12 (79-102)	62 ± 7 (54-71)	51 ± 12 (35-72)	354	307	166 ± 42 (82-239)	220
Right/anterior testes	L	66 ± 4 (63-68)	49 ± 12 (35-71)	40 ± 6 (33-50)	68	184	182 ± 36 (116-266)	284
	W	89 ± 1 (88-89)	72 ± 14 (56-98)	55 ± 11 (45-75)	320	395	246 ± 58 (130-341)	197
Left/posterior testes	L	61 ± 15 (50-71)	49 ± 9 (41-67)	37 ± 5 (27-43)	143	143	64 ± 10 (48-102)	223
	W	90 ± 8 (84-96)	72 ± 11 (60-87)	53 ± 7 (37-58)	197	150	103 ± 16 (68-130)	253
Tribocytic organ	L	NP	NP	NP	NP	NP	128 ± 20 (96-171)	NP
	W						146 ± 27 (82-197)	
Eggs	L	19 ± 1 (18-21)	22 ± 1 (20-23)	32 ± 2 (30-35)	119 ± 8 (115-128)	119 ± 3 (115-128)	83 ± 4 (75-91)	23 ± 2 (20-25)
	W	11 ± 1 (11-12)	11 ± 1 (10-13)	18 ± 2 (17-20)	70 ± 1 (68-70)	65 ± 3 (60-68)	52 ± 6 (41-63)	15 ± 2 (13-18)

Table 2. Checklist of trematodes reported in *Butorides striata* in countries from South America, Africa and Asia

Taxon	*Locality*	*References*
Clinostomidae Lühe, 1901		
Clinostomum heluans Braun, 1899	Brazil	Present study
Clinostomum marginatum (Rudolphi, 1819)	Brazil	Travassos, 1945; present study
Cyathocotylidae Mühling, 1898		
Mesostephanus haliasturis Tubangui and Masilungan, 1941	Indonesia, Malaysia	Cribb et al., 1995
Mesostephanus infecundus Lutz, 1935	Brazil	Arruda et al., 2001
Dicrocoelidae Looss, 1899		
Proacetabulorchis dogieli Belopolskaja and Bykhovskaja-Pavlovskaja, 1953	Malaysia	Fischthal and Kuntz, 1974
Diplostomidae Poirier, 1886		
Diplostomum sp.	Brazil	Arruda et al., 2001
Posthodiplostomum biellipticum Dubois, 1958	Congo	Dubois, 1958
Posthodiplostomum giganteum Dubois, 1988	Paraguay	Dubois, 1988
Posthodiplostomum nanum Dubois, 1937	Brazil	Dubois, 1938; Travassos et al., 1969; present study
	Paraguay	Dubois, 1985
	Argentina	Ostrowski-de Núñez, 1973
Echinostomatidae Looss, 1899		
Echinostoma sp.	Brazil	Travassos et al., 1964
Echinochasmus macrocaudatus Ditrich et al., 1996	Venezuela	Díaz and Bashirullah, 2008
Echinochasmus milvi Yamaguti, 1939	Russia	Besprozvannykh, 1989
Episthmium oscari Travassos, 1922	Brazil	Travassos, 1940
Stephanoprora conciliata (Dietz, 1909)	Brazil	Lutz, 1924
	Venezuela	Lutz, 1928; Caballero and Diaz-Ungria, 1958
Heterophyidae Leiper, 1909		
Ascocotyle (Ascocotyle) felippei Travassos, 1928	Argentina	Ostrowski-de Núñez, 1976, Santos et al., 2007
Ascocotyle (Phagicola) angrense (Travassos, 1916)	Brazil	Travassos, 1916, 1929, 1930; present study
Ascocotyle (Phagicola) pindoramensis (Travassos, 1928)	Brazil	Present study
Centrocestus formosanus (Nishigori, 1924)	Brazil	Present study
Cercarioides aharonii Witenberg, 1929	Malaysia	Pearson and Prévot, 1985
Cercarioides ardeolae Oshmarin, 1970	Malaysia	Pearson and Prévot, 1985
Haplorchis pumilio (Looss, 1896)	Venezuela	Díaz et al., 2008
Pygidiopsis marivillai Refuerzo and Garcia, 1937	Malaysia	Fischthal and Kuntz, 1973
Pygidiopsis sp.	Argentina	Ostrowski-de Núñez, 1976, Simões et al., 2006
Microphallidae Ward, 1901		
Gynaecotyla adunca (Linton, 1905)	Brazil	Arruda et al., 2001; Muniz-Pereira et al., 2004
Maritrema sp.	Brazil	Arruda et al., 2001
Microphallus sabanensis Díaz et al., 2004	Venezuela	Díaz et al., 2004
Proshthogonimidae Lühe, 1909		
Prosthogonimus ovatus (Rudolphi, 1803)	Brazil	Present study
Renicolidae Dollfus, 1939		
Renicola brevipyga Oshmarin, 1963	Russia	Oshmarin, 1963
Opisthorchiidae Looss, 1899		
Amphimerus interruptus (Braun, 1901)	Brazil	Viana, 1924; Travassos et al., 1969
Metorchis butoridi Oshmarin, 1963	Russia	Oshmarin, 1963
Strigeidae Railliet, 1919		
Apharyngostrigea brasiliana (Szidat, 1928)	Brazil	Arruda et al., 2001

and Rolas, 1972; Vicente et al., 1995; Arruda et al., 2001; Pinto et al., 2004, 2012).

Previous extrapolations of the global parasite species richness show that 3 species of the trematodes are estimated for each bird species (Poulin and Morand, 2004; Dobson et al., 2008). However, the fauna of trematodes reported in *B. striata* (31 species) is very high compared to these estimates. Factors such as close contact with aquatic collections may be related to higher parasite richness of trematodes verified in birds (Bush et al., 1990; Gregory et al., 1991; Poulin, 1995; Poulin and Morand, 2004), apparently linked to a greater exposure to a variety of prey species, including different groups of invertebrates, amphibians, and fish, potential intermediate hosts of trematodes. Thus, the habitat and feeding habits of *B. striata* may also be related to the parasite richness observed in this specimen, which may be true for other species of Ardeidae.

Knowledge of the species of trematodes found in birds may still be underestimated, especially in the Neotropics. Therefore, additional parasitological surveys are needed in order to better understand the complex interrelationships among parasites and birds.

Literature cited

Aguirre-Macedo, M. L., T. Scholz, D. González-Solís, V. M. Vidal-Martínez, P. Posel, G. Arjona-Torres, E. Siu-Estrada and S. Dumailo. 2001. Larval helminths parasitizing freshwater fishes from the Atlantic Coast of Nicaragua. Comparative Parasitology 68:42-51.

Arguedas-Cortés, D., G. Dolz, J. J. Romero-Zúñiga, A. E. Jiménez-Rocha and D. León-Alán. 2010. *Centrocestus formosanus* (Opisthorchiida: Heterophyidae) como causa de muerte de alevines de tilapia gris *Oreochromis niloticus* (Perciforme: Cichlidae) en el Pacífico seco de Costa Rica. Revista de Biologia Tropical 58:1453-1465.

Arruda, V. S., R. M. Pinto and L. C. Muniz-Pereira. 2001. New host and geographical records for helminths parasites of Ardeidae (Aves, Ciconiiformes) in Brazil. Revista Brasileira de Zoologia 18 (Suppl. 1):225-232.

Bravo-Hollis, M. 1947. Dos especies de *Clinostomum* (Trematoda), de aves procedentes del Estado de Nuevo León, México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México 18:489-498.

Bray, R. A, D. I. Gibson and A. Jones (eds.). 2008. Keys to the Trematoda, Vol. 3. CAB International and Natural History Museum, London. 824 p.

Besprozvannykh, V. V. 1989. Biology of the trematode *Echinochasmus milvi* from the south of the Far East of the USSR. Parazitologiia 23:237-243.

Boddeke, R. 1960a. The life history of *Prostogonimus ovatus* Rudolphi I. Experiments in birds. Tropical and Geographical Medicine 12:263-292.

Boddeke, R. 1960b. The life history of *Prostogonimus ovatus* Rudolphi II. The intermediate hosts. Tropical and Geographical Medicine 12:363-377.

Boero, J. J., J. E. Led and E. Brandetti. 1972. El parasitismo de la fauna autoctona. Revista de Agronomia y de Veterinaria 1:17-24.

Bush, A. O., J. M. Aho and C. R. Kennedy. 1990. Ecological versus phylogenetic determinants of helminth parasite community richness. Evolutionary Ecology 4:1-20.

Caballero, E. C. and C. Díaz-Ungría. 1958. Intento de un catálogo de los tremátodos digéneos registrados en territorio venezolano. Memoria de la Sociedad de Ciencias Naturales La Salle 18:19-36.

Caffara, M., S. A. Locke, A. Gustinelli, D. J. Marcogliese and M. L. Fioravanti. 2011. Morphological and molecular differentiation of *Clinostomum complanatum* and *Clinostomum marginatum* (Digenea: Clinostomidae) metacercariae and adults. Journal of Parasitology 97:884-891.

Cribb, T. H., S. C. Barrer and J. Beuret. 1995. Taxonomy of *Mesostephanus* Lutz, 1935 (Digenea: Cyathocotylidae) in some Australian water birds. Systematic Parasitology 32:193-204.

Dias, M. L., J. C. Eiras, M. H. Machado, G. T. R. Souza and G. C. Pavanelli. 2003. The life cycle of *Clinostomum complanatum* Rudolphi, 1814 (Digenea, Clinostomidae) on the floodplain of the high Paraná river, Brazil. Parasitology Research 89:506-508.

Díaz, M. T., A. K. Bashirullah and L. E. Hernández. 2004. A new species of *Microphallus* (Trematoda: Microphallidae) from Venezuela. Revista de Biología Tropical 52:363-370.

Díaz, M. T., L. E. Hernández and A. K. Bashirullah. 2008. Studies on the life cycle of *Haplorchis pumilio* (Looss, 1896) (Trematoda: Heterophyidae) in Venezuela. Revista Científica 18:35-42.

Díaz, M. T. and A. K. Bashirullah. 2008. Hallazgo de *Echinochasmus macrocaudatus* Ditrich et al. 1996 (Trematoda: Echinostomatidae) en el Chicuaco Cuello gris, *Butorides striatus*, en Venezuela. Saber, Universidad de Oriente, Venezuela 20:43-46.

Digiani, M. C. 2000. Digeneans and cestodes parasitic in the white-faced ibis *Plegadis chihi* (Aves, Threskiornitidae) from Argentina. Folia Parasitologica 47:195-204.

Dobson, A., K. D. Lafferty, A. M. Kuris, R. F. Hechinger and W. Jetz. 2008. Homage to Linnaeus: How many parasites? How many hosts? Proceedings of the National Academy of Sciences 105(Suppl 1):11482-11489.

Doma, I. L. and M. Ostrowski-de Núñez. 1994. Biologia poblacional de *Posthodiplostomum nanum* Dubois, 1937 (Trematoda, Diplostomidae) en *Jenynsia lineata* y *Cnesterodon decemmaculatus* (Pisces, Atheriniformes), de la laguna de Chi-Chis, Provincia de Buenos Aires, Argentina. Revista Brasileira de Biologia 54:669-679.

Drago, F. B. and L. I. Lunaschi. 2011. Digenean parasites of ciconiiform birds from Argentina. Revista Mexicana de Biodiversidad 82:77-83.

Dubois, G. 1938. Liste systematique dês Strigéidés du Brésil et du Venezuela. *In* Livro Jubilar do Professor Lauro Travassos,

Rio de Janeiro. p. 145-156.

Dubois, G. 1958. Quelques Strigeida (Trematoda) de la collection R. Ph. Dollfus. Bulletin de la Société Neuchâteloise des Sciences Naturelles 81:55-67.

Dubois, G. 1970. Les Strigeata (Trematoda) de la collection A. Lutz. Memórias do Instituto Oswaldo Cruz 68:169-196.

Dubois, G. 1985. Quelques Strigeoidea (Trematoda) récoltés chez des oiseaux du Paraguay par la Mission Claude Weber, automne 1983, du Muséum d'Histoire Naturelle de Genève. Revue Suisse de Zoologie 92:641-648.

Dubois, G. 1988. Quelques Strigeoidea (Trematoda) récoltés au Paraguay par les expéditions du Muséum d'Histoire naturelle de Genève, au cours des années 1979, 1982 et 1985. Revue Suisse de Zoologie 95:521-532.

Dzikowski, R., M. G. Levy, M. F. Poore, J. R. Flowers and I. Paperna. 2004. *Clinostomum complanatum* and *Clinostomum marginatum* (Rudolphi, 1819) (Digenea: Clinostomidae) are separate species based on differences in ribosomal DNA. Journal of Parasitology 90:413-414.

Fischthal, J. H. and J. D. Thomas. 1968. Digenetic trematodes of some freshwater and marine fishes from Ghana. Proceedings of the Helminthological Society of Washington 35:126-140.

Fischthal, J. H. and R. E. Kuntz. 1973. Some digenetic trematodes of birds from North Borneo (Malaysia). Journal of Helminthology 47:311-327.

Fischthal, J. H. and R. E. Kuntz. 1974. Brachylaimid and dicrocoeliid trematodes of birds from North Borneo (Malaysia). Proceedings of the Helminthological Society of Washington 41:94-104.

Gibson, D. I., A. Jones and R. A. Bray (eds.). 2002. Keys to the Trematoda**.** Vol. 1. CAB International, Wallingford and The Natural History Museum, London. 521 p.

Gregory, R. D., A. E. Keymer, and P. H. Harvey. 1991. Life history, ecology and parasite community structure in Soviet birds. Biological Journal of the Linnean Society 43:249-262.

Hayes, F. E. 2002. Geographic variation, hybridization, and taxonomy of New World *Butorides* herons. North American Birds 56:4-10.

Jones, A. 2008. Family Prosthogonimidae Lühe, 1909. *In* Keys to the Trematoda, Vol 3, R. A. Bray, D. I. Gibson and A. Jones (eds.). CAB International, Wallingford and The Natural History Museum, London. p. 577-590.

Kohn, A. and B. M. M. Fernandes. 1972. Sobre a validade das espécies pertencentes ao gênero *Prosthogonimus* Luehe, 1899, da coleção Helmintológica do Instituto Oswaldo Cruz. Memórias do Instituto Oswaldo Cruz 70:309-325.

Krull, W. H. 1934. Some observations of the cercaria and redia of a species of *Clinostomum*, apparently *C. marginatum* (Trematoda: Clinostomidae). Proceedings of the Helminthological Society of Washington 1:34-35.

Lunaschi, L. I., F. Cremonte and F. B. Drago. 2007. Checklist of digenean parasites of birds from Argentina. Zootaxa 1403:1-36.

Lunaschi, L. I. and F. B. Drago. 2009. Digenean parasites of six species of birds from Formosa Province, Argentina. Revista Mexicana de Biodversidad 80:39-46.

Lutz, A. 1924. Estudo sobre a evolução dos endotrematodes brazileiros. Parte especial: 1. Echinostomidae. Memórias do Instituto Oswaldo Cruz 17:55-73.

Lutz, A. 1928. Estudos sobre trematodes observados em Venezuela. *In* Estúdios de zoologia y parasitologia venezolanas, A. Lutz (ed.). Universidad Central de Venezuela, Caracas. p. 101-125.

Lutz, A. 1934. Outro grupo de trematodes nascendo de dicranocercarias e outro caso de especie com coecos abrindo para fóra. Memórias do Instituto Oswaldo Cruz 29:229-248.

Mascarenhas, C. S., C. Krüger and G. Müller. 2009. The helminth fauna of the red-crested cardinal (*Paroaria coronata*) Passeriformes: Emberizidae in Brazil. Parasitology Research 105:1359-1363.

Mati, V. L. T., H. A. Pinto and A. L. Melo. 2013. Experimental infection of Swiss and AKR/J mice with *Centrocestus formosanus* (Trematoda: Heterophyidae). Revista do Instituto de Medicina Tropical de São Paulo 55:133-136.

Mitchell, A. J., R. M. Overstreet, A. E. Goodwin and T. M. Brandt. 2005. Spread of an exotic fish-gill trematode: a far-reaching and complex problem. Fisheries 30:11-16.

Monteiro, C. M., J. F. R. Amato and S. B. Amato. 2007. *Prosthogonimus ovatus* (Rudolphi) (Digenea, Prosthogonimidae) em três espécies de aves aquáticas da Região Sul do Brasil. Revista Brasileira de Zoologia 24:253-257.

Muniz-Pereira, L. C., V. S. Arruda and R. M. Pinto. 2004. Confirmação da sinonímia de *Gynaecotyla jaegerskioeldi* (Travassos) (Digenea, Microphallidae) com *Gynaecotyla adunca* (Linton) (Digenea, Gynaecotylinae). Revista Brasileira de Zoologia 21:801-804.

Oshmarin, P. G. 1963. Helminths of mammals and birds in the Primorsk region. Izdatelstvo Akademii Nauk SSSR, Moscow. 323 p.

Ostrowski-de Núñez, M. 1973. Sobre el ciclo biológico de *Posthodiplostomum nanum* Dubois, 1937 (Trematoda, Diplostomatidae). Physis, Sección B 32:121-132.

Ostrowski-de Núñez, M. 1974. Estudio sobre estadios larvales de trematodes digeneos de peces Cyprinodontiformes. Physis, Sección B 33:45-61.

Ostrowski-de Núñez, M. 1976. Fauna de agua dulce en la República Argentina. VI. Las cercarias de *Ascocotyle (A.) tenuicollis* Price 1935 y de *Pygidiopsis pindoramensis* Travassos, 1929 (Trematoda: Heterophyidae). Physis, Sección B 35:51-57.

Ostrowski-de Núñez, M. 1993. Life history studies of heterophyid trematodes in the Neotropical region: *Ascocotyle (Phagicola) diminuta* (Stunkard & Haviland, 1924) and *A. (P.) angrense* Travassos, 1916. Systematic Parasitology 24:191-199.

Paula-Andrade, C., H. A. Pinto, D. Coscarelli, T. H. D. A. Vidigal and A. L. Melo. 2012. The natural infection of *Melanoides tuberculata* (Müller, 1774) (Mollusca: Gastropoda) by *Centrocestus formosanus* (Nishigori, 1924) (Platyhelminthes:

Trematoda) in Paranoá lake, Brasília, Brazil. Brazilian Journal of Biology 72:419-420.

Pearson, J. C. and G. Prévot. 1985. A revision of the subfamily Haplorchinae Looss, 1899 (Trematoda: Heterophyidae). III - Genera *Cercarioides* and *Condylocotyla* n. g. Systematic Parasitiology 7:169-197.

Pérez-Ponce de León, G., L. García-Prieto and B. Mendoza-Garfias. 2007. Trematode parasites (Platyhelminthes) of wildlife vertebrates in Mexico. Zootaxa 1534:1-250.

Pérez-Vigueras, I. 1944. Trematodes de la super-familia Strigeoidea; descripción de un género y siete especies nuevas. Revista de la Universidad de la Habana 52-54:294-314.

Pérez-Vigueras, I. 1955. Contribución al conocimiento de la fauna helmintológica cubana. Memórias de la Sociedad Cubana de Historia Natural 22:21-71.

Pinto, H. A. and A. L. Melo. 2010. *Melanoides tuberculata* (Mollusca: Thiaridae) as an intermediate host of *Centrocestus formosanus* (Trematoda: Heterophyidae) in Brazil. Revista do Instituto de Medicina Tropical de São Paulo 52:207-210.

Pinto, H. A. and A. L. Melo. 2011. A checklist of trematodes (Platyhelminthes) transmitted by *Melanoides tuberculata* (Mollusca: Thiaridae). Zootaxa 2799:15-28.

Pinto, H. A. and A. L. Melo. 2012a. Infecção natural de *Poecilia reticulata* (Actinopterygii: Poeciliidae) por metacercárias na represa da Pampulha, Belo Horizonte, Minas Gerais, Brasil. Boletim do Instituto de Pesca 38:257-264.

Pinto, H. A. and A. L. Melo. 2012b. Metacercariae of *Centrocestus formosanus* (Trematoda: Heterophyidae) in *Australoheros facetus* (Pisces: Cichlidae) in Brazil. Brazilian Journal of Veterinary Parasitology 21:334-337.

Pinto, H. A., V. L. T. Mati and A. L. Melo. 2012. *Valipora minuta* (Coil, 1950) (Cyclophyllidea: Gryporrynchidae) in *Butorides striata* (Linnaeus, 1758) (Aves: Ardeidae): Distribution extension and new host. Check List 8:714-716.

Pinto, R. M., L. A. Barros, L. Tortelly, R. F. Teixeira and D. C. Gomes. 2004. Prevalence and pathology of helminths of ciconiiform birds from the Brazilian swamplands. Journal of Helminthology 78:259-264.

Poulin, R. 1995. Phylogeny, ecology, and the richness of parasite communities in vertebrates Ecological Monographs 65:283-302.

Poulin, R. and S. Morand. 2004. Parasite biodiversity. Smithsonian Institution Press, Washington D. C. 216 p.

Ramos-Ramos, P. 1995. Algunos tremátodos de vertebrados de la presa Miguel Alemán en Temascal, Oaxaca, México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología 66:241-246.

Rego, A. A. and F. J. T. Rolas. 1972. Cestóides parasitos de *Butorides virescens* (L.). Atas da Sociedade de Biologia do Rio de Janeiro 16:35-37.

Salgado-Maldonado, G. and L. Aguirre-Macedo. 1991. Metacercarias parásitas de *Cichlasoma urophthalmus* (Cichlidae) *Pelaezia loossi* n. comb. y *Phagicola angrense* con descripción de adultos recuperados experimentalmente. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología 62:391-407.

Santos, C. P., S. B. E. Simões, H. S. Barbosa and T. Scholz. 2007. Redescription of *Ascocotyle (Ascocotyle) felippei* Travassos, 1928 (Digenea: Heterophyidae) with new synonymies. Journal of Parasitology 93:1468-1475.

Scholz, T. and G. Salgado-Maldonado. 2000. The introduction and dispersal of *Centrocestus formosanus* (Nishigori, 1924) (Digenea: Heterophyidae) in Mexico: a review. American Midland Naturalist 143:185-200.

Scholz, T., L. Aguirre-Macedo and G. Salgado-Maldonado. 2001. Trematodes of the family Heterophyidae (Digenea) in Mexico: a review of species and new host and geographical records. Journal of Natural History 35:1733-1772.

Scholz, T., J. Vargas-Vázquez, L. Aguirre-Macedo and V. M. Vidal-Martínez. 1997. Species of *Ascocotyle* Looss, 1899 (Digenea: Heterophyidae) of the Yucatán Peninsula, Mexico, and notes on their life-cycles. Systematic Parasitology 36:161-181.

Simões, S. B. E., T. Scholz, H. S. Barbosa and C. P. Santos. 2006. Taxonomic status, redescription, and surface ultrastructure of *Ascocotyle (Phagicola) pindoramensis* n. comb. (Digenea: Heterophyidae). Journal of Parasitology 92:501-508.

Sitko, J. 2012. Trematodes of herons (Aves: Ciconiiformes) in the Czech Republic. Helminthologia 49:33-42.

Sogandares-Bernal, F. and J. F. Bridgmen. 1960. Three *Ascocotyle* complex trematodes (Heterophyidae) encysted in fishes from Louisiana including the description of a new genus. Tulane Studies in Zoology 8:31-39.

Sogandares-Bernal, F. and R. D. Lumsden. 1963. The generic status of the heterophyid trematodes of the *Ascocotyle* complex, including notes on the systematics and biology of *Ascocotyle angrense* Travassos, 1916. Journal of Parasitology 49:264-274.

Thatcher, V. E. 1993. Trematódeos Neotropicais. Instituto Nacional de Pesquisas da Amazônia, Manaus. 553 p.

Travassos, L. 1916. Informações sobre a fauna helmintolójica sul-fluminense. Brazil Médico 30:1-2.

Travassos, L. 1920. Um verme de galinha. *Prosthogonimus cuneatus* (Rud. 1803). A Folha Médica 1:134.

Travassos, L. 1928. Sur une nouvelle espèce du genre *Pygidiopsis*, *Pygidiopsis pindoramensis* n. sp. (Trematoda). Comptes Rendus de la Société de Biologie, Paris 100:956-957.

Travassos, L. 1929. Alguns trematódeos da família Heterophyidae observados no Brasil. Annaes da Academia Brasileira de Sciencias 1:14-17.

Travassos, L. 1930. Revisão do gênero *Ascocotyle* Looss, 1899: (Trematoda: Heterophyidae). Memórias do Instituto Oswaldo Cruz 23:61-97.

Travassos, L. 1931. Note sur l´évolution de l´*Ascocotyle (Phagicola) angrense* Trav. 1916. Comptes Rendus de la Société de Biologie, Paris 106:512.

Travassos, L. 1940. Relatório da terceira excursão a zona da estrada de ferro noroeste do Brasil realizada em fevereiro e março de 1940: I – Introdução. Memórias do Instituto Oswaldo Cruz 35:607-696.

Travassos, L. 1945. Relatório da excursão do Instituto Oswaldo Cruz ao Rio Paraná (Porto Cabral), em março e abril de 1944.

Memórias do Instituto Oswaldo Cruz 42:151-165.

Travassos, L., J. F. T. Freitas and J. M. Mendonça. 1964. Relatório da excursão do Instituto Oswaldo Cruz ao Parque de Reserva e Refúgio Soóretama no estado do Espírito Santo, em outubro de 1963. Boletim do Museu de Biologia Professor Mello Leitão 23:1-26.

Travassos, L., J. F. T. Freitas and A. Kohn. 1969. Trematódeos do Brasil. Memórias do Instituto Oswaldo Cruz 67:1-886.

Viana, L. 1924. Tentativa de catalogação das especies brazileiras de trematodeos. Memórias do Instituto Oswaldo Cruz 17:95-227.

Vicente, J. J., E. S. Santos and S. V. Souza. 1978. Helmintos de peixes de rios amazônicos da Coleção do Instituto Oswaldo Cruz. I. Trematoda. Atas da Sociedade de Biologia do Rio de Janeiro 25:9-16.

Vicente, J. J., H. O. Rodrigues, D. C. Gomes and R. M. Pinto. 1995. Nematóides do Brasil. Parte IV: Nematóides de aves. Revista Brasileira de Zoologia 12(Suppl.1) 1-273.

Zago, A. C., L. Franceschini, M. C. Zocoller-Seno, R. Veríssimo-Silveira, A. A. D. Maia, C. V. Ikefuti and R. J. Silva. 2012. The helminth community of *Geophagus proximus* (Perciformes: Cichlidae) from a tributary of the Paraná River, Ilha Solteira Reservoir, São Paulo State, Brazil. Journal of Helminthology 87:203-211.

Williams, M. O. 1967. The Neascus (Posthodiplostomulum) stage of *Posthodiplostomun nanum* Dubois and an experimental determination of part of the life cycle. Journal of Helminthology 41:269-276.