Instituto de
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UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"
Campus de Botucatu

PG-BGA

PADRÕES DE INFECÇÃO POR HELMINTOS EM COMUNIDADES DE LAGARTOS DO BRASIL CENTRAL

ROBSON WALDEMAR ÁVILA

Tese apresentada ao Instituto de Biociências, Câmpus de Botucatu, UNESP, para obtenção do título de Doutor no Programa de Pós-Graduação em Biologia Geral e Aplicada, Área de concentração *Biologia de parasitas e microorganismos.*

Reinaldo José da Silva

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SUMÁRIO

RESUMO

O Brasil detém uma das maiores diversidades de lagartos do mundo, com 13 famílias e 236 espécies. Embora várias espécies do território brasileiro tenham sido investigadas nos últimos anos quanto a aspectos de história natural, o conhecimento acerca do parasitismo ainda é escasso e concentrado em alguns ecossistemas, como Restingas e Floresta Atlântica. No presente trabalho, a presença de helmintos foi avaliada em diversas espécies de lagartos de três ecossistemas do Brasil Central: Cerrado, Pantanal e Amazônia. Os espécimes utilizados foram provenientes de cinco coleções científicas: Coleção de Vertebrados da Universidade Federal de Mato Grosso, Coleção de Herpetologia da Universidade Federal de Goiás, Coleção Zoológica de Referência do Campus de Corumbá, Coleção Zoológica de Referência da Universidade Federal de Mato Grosso do Sul e Coleção Herpetológica Arlindo de Figueiredo Béda. Após a necropsia, os helmintos foram identificados e depositados na Coleção Helmintológica do Instituto de Biociências da UNESP de Botucatu. Foram calculados os seguintes parâmetros de infecção: Prevalência (porcentagem de indivíduos infectados em cada espécie hospedeira) e a Intensidade média da infecção (número médio de parasitos nos lagartos infectados). O índice de diversidade de Brillouin foi calculado para cada espécie hospedeira. Relação entre o comprimento rostro-cloacal e número total de parasitas e diversidade de helmintos foi testada através de correlação de Pearson. Análises de agrupamento (UPGMA) foram realizadas para avaliar a similaridade (índice de Sorensen) entre as áreas dentro dos biomas utilizando apenas os dados qualitativos. Um total de 955 indivíduos pertencentes a 66 espécies de lagartos foram necropsiados, dos quais 45,8% estavam parasitados. A prevalência por ecossistema foi de 58% de animais parasitados na amostra do Cerrado (436 indivíduos de 39 espécies), 53,9% no Pantanal (221 indivíduos de 27 espécies) e de 54,2% na Amazônia (295 indivíduos de 31 espécies). O número total de helmintos coletados foi de 156.435 indivíduos, distribuídos em 62 espécies: oito de trematódeos, duas de acantocéfalos, cinco de cestódeos e 47 de nematódeos. Em cada um dos três ecossistemas, as famílias mais parasitadas foram Tropiduridae, Teiidae e Scincidae, enquanto a família menos parasitada foi Gymnophthalmidae. Relação positiva entre o comprimento rostro-cloacal dos lagartos e o número total de parasitas foi verificada em várias espécies. Análises de agrupamento sugerem que as espécies de lagartos foram mais similares na composição da helmintofauna entre as diferentes populações num mesmo ecossistema do que entre espécies filogeneticamente próximas dentro das comunidades.

ABSTRACT

Brazilian diversity of lizards includes 236 species, although many aspects of lizard biology, including parasitism are poorly studied. These few studies are concentrated mostly on animals from Atlantic forest and Restinga. Herein we investigate the helminth parasites of lizards in three biomes of central Brazil Cerrado (savanna-like vegetation), Pantanal (floodplain) and Amazonia (rain forest). We look for helminths within the body cavity, esophagus, stomach, lungs, small and large intestines of each specimen under a stereomicroscope. Nematodes were cleared in phenol; Cestoda, Trematoda and Acanthocephala were stained in Carmim, dehydrated in graded alcohols, cleared in Creosote and after identification, these helminths were deposited in the Coleção Helmintológica do Instituto de Biociências da Unesp de Botucatu, Brazil. A total of 955 individuals from 66 species of lizards representing 9 families were assessed, wherein 45.8% displayed helminthes. In the Cerrado the prevalence was 58% (a total of 436 specimens from 39 species), whereas in the Pantanal the overall prevalence was 53.9% (221 individuals from 27 species) and 54.2% (295 specimens from 31 species) was the prevalence in the Amazon. A total of 156,435 helminths from 62 species, including 8 trematodes, 2 acanthocephalans, 5 cestodes and 47 nematodes were found. Tropiduridae, Teiidae and Scincidae were the most parasitized lizard families in all biomes, while Gymnophthalmidae were lesser infected. Lizards with larger body sizes tend to have richer diversity and abundance of helminths. Cluster analysis revealed higher similarities between different populations of the same lizard species than phylogenetically closest sympatric species.

INTRODUÇÃO GERAL

As relações parasita-hospedeiro são fatores importantes no estudo da dinâmica de populações e estrutura de comunidades (Ernst & Ernst, 1980).

Para anfíbios e répteis, a composição e a estrutura das comunidades de helmintos são, de modo geral, caracterizadas pela baixa riqueza de espécies e compostas por espécies isolacionistas e não interativas (Aho, 1990). Entretanto, estudos com esses vertebrados permitiram o desenvolvimento de vários conceitos em biologia de populações e ecologia de comunidades de parasitas (Goater, 1992; Goater *et al.*, 1987). Além disso, valiosas contribuições para o entendimento dos padrões biogeográficos e co-evolução parasita-hospedeiro foram obtidas através destes hospedeiros (Platt, 1992).

Dentre anfíbios e répteis, os lagartos são considerados os melhores organismos-modelo para estudos ecológicos, uma vez que o grupo taxonômico apresenta ampla diversidade etológica, morfológica e fisiológica (Pianka & Vitt, 2003). Além disso, são abundantes e relativamente fáceis de localizar, observar e capturar, além de ter taxonomia relativamente bem resolvida (Araújo, 1985).

Lagartos são hospedeiros para uma ampla variedade de parasitas, que podem ser adquiridos via ingestão de presas infectadas e material vegetal contaminado, coprofagia, geofagia ou penetração ativa pelas larvas (Anderson, 2000). Assim, a infecção por helmintos é amplamente relacionada à sua dieta, modo de forrageamento e uso de habitat (Telford, 1970; Goldberg & Bursey, 1992; Ribas *et al.* 1998; Roca, 1993), bem como fatores abióticos, como o clima (Ribas *et al.*, 1995; Eisen & Wrigth, 2001). Além desses fatores, a filogenia dos hospedeiros tem grande influência na aquisição e estabelecimento das infracomunidades de parasitas (Poulin & Mouillot, 2003).

Vários estudos com helmintos parasitas de lagartos são disponíveis na literatura (e.g. Baker, 1987), principalmente aqueles relacionados com a descrição de novas espécies e listas taxonômicas (Travassos *et al.*, 1969; Vicente *et al.*, 1993). Nos últimos anos, porém, além da descrição de várias espécies (Vicente *et al.*, 2000a,b; Duret-Desset *et al.*, 2006), estudos de ecologia do parasitismo com lagartos têm aumentado (Van Sluys *et al.*, 1997; Sousa *et al.*, 2007; Vrcibradic *et al.*, 2007). No entanto, a quase totalidade dessa informação é proveniente da região sudeste do Brasil (Fontes *et al.*, 2003; Rocha, 1995; Rocha & Vrcibradic, 2003).

Para a região central do país, a informação relacionada a helmintos associados a lagartos continua escassa e restrita aos trabalhos realizados por Lauro Travassos nos Estados de Mato Grosso e Mato Grosso do Sul (Travassos, 1922; Travassos *et al.*, 1927) e por Cléber J. Alho na região do Distrito Federal (Alho, 1969; Alho & Rodrigues, 1963; Alho & Moura,

1970),. Dada a diversidade de lagartos conhecidos para o Brasil (237 segundo a Sociedade Brasileira de Herpetologia – Bérnils, 2009) e considerando que grande parte das espécies ocorre nos biomas localizados na região central do país (Cerrado, Pantanal e Amazônia), pode-se notar uma grande lacuna no conhecimento da diversidade e relações ecológicas de helmintos parasitas de lagartos no Brasil.

O objetivo desse trabalho, portanto, é contribuir para a caracterização da helmintofauna de lagartos do Brasil Central, fornecendo tanto dados ecológicos em várias comunidades de lagartos em três biomas quanto novos dados taxonômicos e de distribuição de helmintos. Além disso, o presente estudo objetiva atualizar os dados de ocorrência de helmintos em lagartos sulamericanos.

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PARTE 1

REVISÃO DA OCORRÊNCIA DE HELMINTOS EM LAGARTOS

ARTIGO 1

CHECKLIST OF HELMINTHS FROM LIZARDS AND AMPHISBAENIANS OF SOUTH AMERICA

Checklist of Helminths from lizards and Amphisbaenians of South America

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Abstract: A comprehensive and up-to-dated summary of the literature on the helminth parasites of lizards and amphisbaenians from South América is presented. One-hundred two lizard species from twelve countries were reported in literature harboring a total of 148 helminth species, being 9 Acantocephalans, 15 cestodes, 19 trematodes and 105 nematodes. Of these, one record were from Chile and French Guiana, two from Colombia, three from Uruguay, 8 from Bolivia, 9 from Suriman, 12 from Paraguay and Venezuela, 19 from Ecuador, 17 from Argentina, 37 from Peru and 99 from Brazil. This list provides host, geographical distribution (with Biome when possible), and site of infection and references fro the parasites. A systematic list parasite/host is also provided.

Key-words: Cestoda, Nematoda, Trematoda, Squamata, Brazil, Argentina, Paraguay, Bolivia, Ecuador, Peru

Introduction

Parasitological studies with helminths infecting squamates, particularly lizards, in South America have a recent increase in past few years, with many new records of hosts and/or localities and description of several new species (Bursey *et al.*, 2005a; Goldberg *et al.*, 2004; Vrcibradic *et al.*, 2008). Such studies, however, have a longer history since 1920, with the Dr. Lauro Travassos and his colleagues, which give important contributions in the field of helminth systematics (e.g. Travassos, 1920; Travassos, 1931; Travassos *et al.*, 1969).

The first comprehensive efforts to summarize the knowledge about helminths of squamates are those from Baker (1987), who listed all available published data on occurrence of nematodes from reptiles and amphibians. Other studies has a regional scope and treat each helminth group separately, for example, Vicente *et al.* (1993) with nematodes from reptiles of Brazil, Lunaschi & Drago (2007) with digenetic trematodes of amphibians and reptiles from

Argentina and Smales (2007) who summarize the occurrence of acanthocephalans in Amphibians and Reptiles from Brazil and Paraguay.

The present checklist summarizes the diversity of helminths from lizards and amphisbaenians of South America, giving a host/parasite list with localities and biomes.

Materials and Methods

This checklist was prepared with records of nematodes, acanthocephalans, cestodes, and trematodes summarized of data published from 1914 to 2009, excluding material from the called "gray literature", i.e., records of unpublished thesis or scientific meetings. The taxonomy of helminths follows: nematodes – Yamaguti (1961) and Vicente *et al.* (1993); cestodes – Yamaguti (1959) and Schmidt (1986); trematodes – Travassos *et al.* (1969) and Yamaguti (1971) and acanthocephalans – Yamaguti (1963). Whenever possible, taxonomy of hosts is actualized with recent publications.

Each record is constitute by helminth Class, Order, Superfamily, Family, species name and authority and year, host(s), geographic record with country and State/province (when available) and information on biome of host. Comments including taxonomy, synonyms and also changes in the host taxonomy.

Abbreviations for all countries cited in this paper were:
Brazilian States: Acre (AC), Alagoas (AL), Amapá (AP), Amazonas (AM), Bahia (BA), Ceará (CE), Distrito Federal (DF), Goiás (GO), Espirito Santo (ES), Maranhão (MA), Mato Grosso (MT), Mato Grosso do Sul (MS), Minas Gerais (MG), Pará (PA), Paraíba (PB), Paraná (PR), Pernambuco (PE), Piauí (PI), Rio de Janeiro (RJ), Rio Grande do Norte (RN), Rio Grande do Sul (RS), Rondônia (RO), Roraima (RR), São Paulo (SP), Santa Catarina (SC), Sergipe (SE) and Tocantins (TO).

Argentina: Buenos Aires (BA), Catamarca (CA), Córdoba (CR), Corrientes (CO), Chaco (CH), Chubut (CB), Entre Rios (ER), Formosa (FO), Jujuy (JU), La Pampa (LP), La Rioja (LR), Mendoza (ME), Misiones (MI), Neuquén (NE), Rio Negro (RN), Salta (SA), San Juan (SJ), San Luis (SL), Santa Cruz (SC), Santa Fe (SF), Santiago del Estero (SE), Tierra del Fuego (TF) and Tucumán (TU).

Paraguay: Alto Paraguay (AP), Alto Paraná (AA), Amambay (AM), Distrito Capital (DC), Boquerón (BO), Caaguazú (CA), Caazapá (CZ), Canindeyú (CN), Central (CE), Concepción (CO), Cordillera (CR), Guairá (GU), Itapúa (IT), Misiones (MI), Ñeembucú (NE), Paraguarí (PA), Presidente Hayes (PH) and San Pedro (SP).

Bolivia: Chuquisaca (CH), Cochabamba (CO), Beni (BE), La Paz (LP), Oruro (OR), Pando (PA), Potosí (PO), Santa Cruz (SC) and Tarija (TA).

Venezuela: Amazonas (AM), Anzoátegui (AN), Apure (AP), Aragua (AR), Barinas (BA), Bolívar (BO), Carabobo (CA), Cojedes (CO), Delta Amacuro (DA), Falcón (FA), Guárico (GU), Lara (LA), Mérida (ME), Miranda (MI), Monagas (MO), Nueva Esparta (NE), Portuguesa (PO), Sucre (SU), Táchira (TA), Trujillo (TR), Yaracuy (YA), Vargas (VA), and Zulia (ZU).

Ecuador: Azuay (AZ), Bolívar (BO), Cañar (CA), Carchi (CR), Cotopaxi (CO), Chimborazo (CH), Galápagos (GA), Imbabura (IM), Loja (LO), Pichincha (PI), Tungurahua (TU), El Oro (EO), Esmeraldas (ES), Guayas (GU), Los Ríos (LR), Manabí (MA), Morona-Santiago (MS), Napo (NA), Pastaza (PA), Zamora-Chinchipe (ZC), Sucumbíos (SU), and Orellana (OR).

Peru: Amazonas (AM), Ancash (AN), Apurímac (AP), Arequipa (AR), Ayacucho (AY), Cajamarca (CA), Callao (CL), Cusco (CU), Huancavelica (HU), Huánuco (HA), Ica (IC), Junin (JU), La Libertad (LL), Lambayeque (LA), Lima (LI), Loreto (LO), Madre de Dios (MD), Moquegua (MO), Pasco (PA), Piura (PI), Puno (PU), San Martín (SM), Tacna (TA), Tumbes (TU), and Ucayali (UC).

Colombia: Amazonas (AM), Antioquia (AN), Arauca (AR), Atlántico (AT), Bolívar (BO), Boyacá (BY), Caldas (CA), Caquetá (CQ), Casanare (CS), Cauca (CU), Cesar (CE), Chocó (CH), Córdoba (CO), Cundinamarca (CN), Guainía (GU), Guaviare (GA), Huila (HU), La Guajira (LG), Magdalena (MA), Meta (ME), Nariño (NA), Norte de Santander (NS), Putumayo (PU), Quindío (QU), Risaralda (RI), San Andrés (SA), Santander (SN), Sucre (SU), Tolima (TO), Valle del Cauca (VC), Vaupés (VA), and Vichada (VI).

Chile: Aisén (AI), Antofagasta (AN), Araucanía (AU), Arica (AR), Atacama (AT), Biobío (BI), Coquimbo (CO), Los Rios (LR), Los Lagos (LL), Magallanes (MG), Maule (MA), O´Higgins (OH), Santiago (AS), Tarapacá (TA) and Valparaiso (VA).

Uruguay: Artigas (AR), Canelones (CA), Cerro Largo (CL), Colônia (CO), Durazno (DU), Flores (FL), Florida (FO), Lavalleja (LA), Maldonado (MA), Montevidéu (MO), Paysandú (PA), Río Negro (RN), Rivera (RI), Rocha (RO), Salto (SA), San José (SJ), Soriano (SO), Tacuarembó (TA), and Treinta y Tres (TT).

Surinam: Brokopondo (BR), Commewijne (CO), Coronie (CR), Marowijne (MA), Nickerie (NI), Para (PA), Paramaribo (PR), Saramacca (SA), Sipaliwini (SI), and Wanica (WA).

French Guiana: Awala-Yalimapo (AY), Apatou (AP), Camopi (CA), Cayenne (CY), Grand-Santi (GS), Iracoubo (IR), Kourou (KO), Macouria (MC), Mana (MA), Maripasoula (MR), Matoury (MT), Montsinéry-Tonnegrande (MO), Ouanary (OU), Papaïchton (PA), Régina (RE), Remire-Montjoly (RM), Roura (RO), Saint-Élie (SE), Saint-Georges (SG), Saint-Laurent-du-Maroni (SL), Saül (SA), and Sinnamary (SI).

Guyana: Barima-Waini (BW), Pomeroon-Supenaam (PS), Essequibo Islands-West Demerara (EI), Demerara-Mahaica (DM), Mahaica-Berbice (MB), East Berbice-Corentyne (EC), Cuyuni-Mazaruni (CM), Potaro-Siparuni (PS), Upper Takutu-Upper Essequibo (TE), and Upper Demerara-Berbice (DB).

Results

ACANTHOCEPHALA

Hosts: *Tropidurus torquatus* Wied-Neuwied, 1820

Site of infection: Stomach wall

Distribution: ARGENTINA: CO (Chaco)

Comments: No indication of family and/or genus, but probably belong to Centrorhynchidae, since several cystacanths of this family have been reported from South American lizards.

Reference: Lamas & Zaracho (2006).

Archiacanthocephala

Oligacanthorhynchida

Oligacanthorhynchidae

Oligacanthorhynchus Travassos, 1915

Oligacanthorhynchus sp.

Hosts: *Ameiva ameiva* Linnaeus, 1758

Distribution: PARAGUAY: Rio Negro (Chaco), PH

Reference: Smales (2007).

Palaeacanthocephala

Echinorhynchida

Echinorhynchidae

Hosts: *Mabuya macrorhyncha* Hoge, 1946

Site of infection: Stomach wall

Distribution: BRAZIL: Trancoso (Restinga), BA

Comments: No indication of genus.
Reference: Vrcibradic *et al.* (2001).

Acanthocephalus Koelreuther, 1771
Acanthocephalus saurius Bursey & Goldberg, 2003
Hosts: *Cercosaura oshaugnessyi* Boulenger, 1885
Site of infection: Small intestine
Distribution: BRAZIL: AC (Amazon)
Reference: Bursey & Goldberg (2004).

Acanthocephalus sp.
Hosts: *Enyalius perditus* Jackson, 1978
Site of infection: Stomach
Distribution: BRAZIL: São Sebastião (Atlantic Forest), SP
Reference: Vrcibradic *et al.* (2008).

Echinorhynchus Zoega in Müller, 1776
Echinorhynchus sp.
Hosts: *Tropidurus torquatus*
Site of infection: Small intestine
Distribution: BRAZIL
Reference: Vicente (1978).

Polymorphida
Centrorhynchidae
Hosts: *Mabuya macrorhyncha*; *M. agilis* Raddi, 1823, *Hemidactylus mabouia* Moreau de Jonnés, 1818, *Enyalius bilineatus* Duméril & Bibron, 1837
Site of infection: Peritonium, liver; mesentery
Distribution: BRAZIL: Queimada Grande island (Atlantic forest) and Valinhos (Cerrado), SP; Grussaí (Restinga) and Nova Iguaçu (Atlantic Forest), RJ; Praia das Neves (Restinga) and Marechal Floriano (Atlantic Forest), ES
Comments: All citations above consists of cystacanth occurrence and thus difficult to identify to species level, because reproductive structures are needed.

Reference: Vrcibradic & Rocha (2005); Rodrigues (1986); Anjos *et al.* (2005); Vrcibradic *et al.* (2002; 2007).

Centrorhynchus Lühe, 1911
Centrorhynchus tumidulus Rudolphi, 1919
Hosts: *Ameiva ameiva*; *Tropidurus torquatus*; *Tupinambis teguixin* Linnaeus, 1758
Site of infection: Body cavity
Distribution: Brazil: Rio de Janeiro (Atlantic Forest), RJ
Reference: Neiva *et al.* (1914); Travassos (1926).

Centrorhynchus sp.
Hosts: *Tupinambis teguixin*
Site of infection: Not informed
Distribution: PARAGUAY: AP (Chaco)
Reference: Smales (2007).

NEMATODA
Adenophorea
Enoplida
Capilariidae
Capillaria (Zeder, 1800) Bell & Beverley Burton 1981
Capillaria (=*Amphibiocapillaria*) *freitaslenti* Araujo & Gandra, 1941
Hosts: *Tropidurus torquatus*; *Ameiva ameiva*
Site of infection: intestine
Distribution: BRAZIL: GO (Cerrado); PERU: CU (Amazon)
Reference: Vicente *et al.* (1993); Bursey *et al.* (2005a).

Ichthyocapillaria Moravec, 1982
Ichthyocapillaria (=*Pseudocapillaria*) *maricaensis* Rodrigues, 1992
Hosts: *Liolaemus lutzae* Mertens, 1938
Site of infection: small intestine
Distribution: BRAZIL: Maricá (Restinga), RJ
Reference: Rodrigues (1992).

Ascaridida

Anisakidae

Contracaecum Railliet & Henry, 1912

Contracaecum sp.

Hosts: *Tupinambis teguixin*

Site of infection: Not informed

Distribution: SURINAM: PR (Amazon)

Reference: Baylis (1947).

Ascarididae

Dujardinascaris Baylis, 1927

Dujardinascaris sp.

Hosts: *Kentropyx pelviceps* Cope, 1868, *Tupinambis teguixin*

Site of infection: Stomach

Distribution: PERU: CU (Amazon)

Reference: Bursey *et al.* (2005a).

Freitasascaris Sprent, 1983

Freitasascaris alata Baylis, 1947

Hosts: *Tupinambis teguixin*

Site of infection: intestine

Distribution: SURINAM: PR (Amazon); BRAZIL: AM (Amazon); URUGUAY: MO

Reference: Baylis (1947); Lent & Freitas (1948), Sprent (1983).

Hexametra Travassos, 1919

Hexametra boddaertii Baird, 1860

Hosts: *Cnemidophorus littoralis* Rocha, Araujo, Vrcibradic & Costa, 2000, *C. ocellifer* Spix, 1825, *Mabuya agilis*, *M. frenata* Cope, 1862, *M. macrorhyncha*, *Tropidurus torquatus*

Site of infection: Body cavity

Distribution: BRAZIL: Jurubatiba, Grussaí and Marica (Restinga), RJ; Salvador and Trancoso (Restinga), BA; Valinhos (Cerrado), SP

Reference: Dias *et al.* (2005); Ribas *et al.* (1998); Rocha & Vrcibradic (2003); Vrcibradic *et al.* (1999); Vrcibradic *et al.* (2000); Vrcibradic *et al.* (2001); Vrcibradic *et al.* (2002).

Atractidae

Atractis Dujardin, 1945

Atractis cruciata Linstow, 1902

Hosts: *Tupinambis teguixin*

Site of infection: intestine

Distribution: BRAZIL: Belém (Amazon), PA

Comments: Barus & Coy Otero (1969) considered *A. cruciata* a junior synonym of *A. opeatura*, which is follow by Baker (1987). However, Vicente (1966) and Bursey and Flanagan (2002) considered it a valid species.

Reference: Vicente (1966); Vicente *et al.* (1993); Bursey & Flanagan (2002).

Cyrtosomum Gedoelst, 1919

Cyrtosomum longicaudatum Brenes and Bravo Hollis, 1960

Hosts: *Anolis punctatus* Daudin, 1802; *Anolis transversalis* Duméril, 1851

Site of infection: large intestine

Distribution: PERU: CU (Amazon); BRAZIL: AM (Amazon)

Reference: Bursey *et al.* (2005a); Goldberg *et al.* (2006a)

Maracaya Díaz-Ungría, 1964

Maracaya belemensis Adamson & Baccam, 1988

Hosts: *Amphisbaena alba* Linnaeus, 1758

Site of infection: large intestine

Distribution: BRAZIL: Belém (Amazon), PA

Reference: Adamson & Baccam (1988).

Maracaya graciai Díaz-Ungría, 1969

Hosts: *Amphisbaena alba*

Site of infection: intestine

Distribution: VENEZUELA: Maracay, AR

Reference: Baker (1987); Adamson & Baccam (1988).

Maracaya pusilla (Miranda, 1924) Adamson & Baccam, 1988

Hosts: *Amphisbaena* sp.

Site of infection: intestine

Distribution: BRAZIL: BA
Remarks: Adamson & Baccam (1988) transferred *Aplectana pusilla* to *Maracaya*. This is follow by Boaumer & Morand (2006), in their revision of the genus *Maracaya*. In despite of new combination, Ramallo *et al.* (2008) cited *M. pussilla* in the genus *Aplectana*, with no comments.
Reference: Adamson & Baccam (1988); Boaumer & Morand (2006); Ramallo *et al.* (2008).

Cosmocercidae
gen. sp.
Hosts: *Cercosaura argulus* Peters, 1863
Site of infection: small intestine
Distribution: PERU: Rio Nanay (Amazon), LO
Reference: Goldberg & Bursey (2007a).

Aplectana Railliet & Henry, 1916
Aplectana albae Adamson & Baccam, 1988
Hosts: *Amphisbaena alba*
Site of infection: intestine
Distribution: BRAZIL: Belém (Amazon), PA
Reference: Adamson & Baccam (1988).

Aplectana raillieti Travassos, 1925
Hosts: *Amphisbaena alba*
Site of infection: intestine
Distribution: BRAZIL: Angra dos Reis (Insular Atlantic Forest), RJ
Comments: The host *Amphisbaena fusca* as cited by Travassos (1925) is in fact *Amphisbaena alba*.
Reference: Vicente *et al.* (1993); Travassos (1931); Baker (1987).

Aplectana tucumanensis Ramallo, Bursey & Goldberg, 2008
Hosts: *Amphisbaena bolivica* Mertens, 1929
Site of infection: Large intestine
Distribution: ARGENTINA: San Miguel de Tucumán (Chaco), TU
Reference: Ramallo *et al.* (2008).

Aplectana unguiculata Rudolphi, 1819
Hosts: *Amphisbaena* sp.
Site of infection: Not informed
Distribution: BRAZIL
Comments: The species is actually considered as “species inquirendae” (see Baker, 1987).

Aplectana vellardi Travassos, 1926
Hosts: *Enyalius perditus*
Site of infection: intestine
Distribution: BRAZIL: Ibitipoca (Cerrado), MG
Reference: Sousa *et al.* (2007).

***Cosmocerca* Diesing, 1861**
Cosmocerca rara Freitas & Vicente, 1966
Hosts: *Leposternon microcephalum* Wagler, 1824
Site of infection: large intestine
Distribution: BRAZIL: Rio de Janeiro (Atlantic forest), RJ
Reference: Freitas & Vicente (1966); Vicente *et al.* (1993).

Cosmocerca vrcibradici Bursey & Goldberg, 2004
Hosts: *Alopoglossus angulatus* Linnaeus, 1758, *Alopoglossus atriventris* Duellman, 1973, *Anolis fuscoauratus* D’Orbignyi, 1837, *Cercosaura eigenmanni* Griffin, 1917, *C. oshaugnessyi* Boulenger, 1885, *Uranoscodon superciliosus* Linnaeus, 1758
Site of infection: intestine
Distribution: BRAZIL: AC, AM, PA, RO (Amazon); ECUADOR: SU (Amazon)
Reference: Bursey & Goldberg (2004a); Bursey *et al.* (2005b); Goldberg *et al.* (2006b); Goldberg *et al.* (2007a).

Cosmocerca sp.
Hosts: *Enyalius perditus*
Site of infection: stomach
Distribution: BRAZIL: São Sebastião (Insular Atlantic forest), SP
Reference: Vrcibradic *et al.* (2008).

***Paradollfusnema* Baker, 1982**

Paradollfusnema amphisbaenia Baker, 1981

Hosts: *Leposternon microcephalum*

Site of infection: intestine

Distribution: BRAZIL: Recife, PE

Reference: Baker (1981a); Vicente *et al.* (1993).

Heterakidae

***Africana* Travassos, 1920**

Africana chabaudi Baker, 1981

Hosts: *Uranoscodon superciliosus*

Site of infection: intestine

Distribution: BRAZIL: PA, RO and RR (Amazon)

Reference: Baker (1981b); Bursey *et al.* (2005b).

***Moaciria* Freitas, 1956**

Moaciria alvarengai Freitas, 1956

Hosts: *Mabuya atlantica* Schmidt, 1945

Site of infection: large intestine

Distribution: BRAZIL: Fernando de Noronha Island, PE

Reference: Freitas (1956); Vicente *et al.* (1993).

***Spinicauda* Travassos, 1920**

Spinicauda spinicauda Olfers, 1819

Hosts: *Ameiva ameiva*, *Tupinambis teguixin*

Site of infection: intestine

Distribution: BRAZIL: MT (Pantanal), Rio de Janeiro, RJ, São Gonçalo, RN and Fortaleza, CE; PERU: CU (Amazon); SURINAM: PR (Amazon); VENEZUELA: AR

Reference: Diaz-Ungria (1964); Baylis (1947); Bursey *et al.* (2005b); Rodrigues & Feijó (1976); Travassos (1920); Travassos (1923); Baker (1987); Pereira (1935).

***Strongyluris* Mueller, 1894**

Strongyluris oscari Travassos, 1923

Hosts: *Ameiva ameiva*, *Anolis fuscoauratus*, *A. punctatus*, *A. transversalis*, *Enyalius iheringii* Boulenger, 1885, *E. perditus*, *Eurolophosaurus nanuzae* Rodrigues, 1981, *Mabuya agilis*, *Plica plica* Linnaeus, 1758, *Plica umbra* Linnaeus, 1758, *Stenocercus roseiventris* D'Orbigny in Duméril & Bibron 1837, *Tropidurus* sp., *T. guarani* Alvarez, Cei & Scolaro, 1994, *T. spinulosus* Cope, 1862, *T. torquatus*, *T. melanopleurus*
Site of infection: stomach, intestine
Distribution: BRAZIL: AC, AM, BA, CE, DF, ES, GO, MG, MS, PA, PB, RJ, RO, SP (Pantanal, Restinga, Amazon, Caatinga, Atlantic Forest); ARGENTINA (Chaco); PARAGUAY (Chaco); ECUADOR: SU (Amazon); PERU: CU (Amazon); BOLIVIA: Florida province, SC.
Comments: Bursey *et al.* (2003a) summarized morphological characteristics of the 31 recognized species for the genus, pointing that only four occurred in Neotropical region. *Strongyluris oscari* seems to be extremely polymorphic, since the species *S. freitasi*, *S. travassosi* and *S. sai* have been synonimized by Vicente (1981). The records of *S. oscari* infecting *T. spinulosus* in the region of Salobra, MS, Brazil by Vicente (1981) correspond to *T. guarani*, following the revision of Harvey & Gutberlet (1998).
Reference: Alho (1969); Bursey & Goldberg (2004b); Bursey *et al.* (2005a); Goldberg *et al.* (2006a); Goldberg *et al.* (2006b); Fontes *et al.* (2003); Kohn *et al.* (1973); Ribas *et al.* (1998); Sousa *et al.* (2007); Sutton *et al.* (1998); Vicente (1981); Vrcibradic *et al.* (2000); Vrcibradic *et al.* (2008); Pereira (1935); Roca (1997).

Kathlaniidae

***Cruzia* Travassos, 1917**

Cruzia fulleborni Khalil & Vogelsang, 1930
Hosts: *Tupinambis teguixin*
Site of infection: intestine
Distribution: ARGENTINA; PARAGUAY.
Reference: Kalil & Vogelsangi (1930); Ruiz (1947); Schuurmans-Stekhoven (1950); Baker (1987).

Cruzia rudolphii Ruiz, 1947
Hosts: *Hoplocercus spinosus* Fitzinger, 1843
Site of infection: large intestine
Distribution: BRAZIL: Dois Irmãos do Buriti (Cerrado), MS

Reference: Ávila *et al.* (2008).

Cruzia tentaculata Rudolphi, 1819
Hosts: *Tupinambis teguixin*
Site of infection: intestine
Distribution: URUGUAY: MO
Reference: Ruiz (1947); Lent & Freitas (1948).

Cruzia travassosi Kalil & Vogelsangi, 1932
Hosts: *Tupinambis merianae*
Site of infection: intestine
Distribution: BRAZIL: Salobra (Pantanal) MS; BOLIVIA; ARGENTINA
Reference: Ruiz (1947), Baker (1987).

***Falcaustra* Lane, 1915**
Falcaustra belemensis Baker & Bain, 1981
Hosts: *Neusticurus bicarinatus* Linnaeus, 1758, *Potamites ecpleopus* Cope, 1876
Site of infection: intestine
Distribution: BRAZIL: Altamira and Belém (Amazon), PA
Reference: Goldberg *et al.* (2007b); Baker & Bain (1981).

Falcaustra sp.
Hosts: *Anolis punctatus*
Site of infection: large intestine
Distribution: BRAZIL: AM (Amazon)
Reference: Goldberg *et al.* (2006a).

Seuratidae
***Skrjabinelazia* Sypliaxov, 1930**
Skrjabinelazia galliardi Chabaud, 1973
Hosts: *Gonatodes humeralis* Guichenot, 1855
Site of infection: stomach
Distribution: BRAZIL: Belém (Amazon), PA
Reference: Chabaud (1973); Chabaud *et al.* (1988); Vicente *et al.* (1993).

Skrjabinellazia intermedia Freitas, 1940

Hosts: *Anolis puncatus*, *Cnemidophorus nativo* Rocha, Bergallo & Peccinini-Seale, 1997, *Tropidurus guarani*, *T. torquatus*

Site of infection: stomach, intestine

Distribution: BRAZIL: Salobra (Pantanal), MS; Salvador and Guaratiba (Restinga), BA; Jurubatiba (Restinga), RJ; PARAGUAY: (Chaco); PERU: CU (Amazon).

Comments: Originally described as *Salobrella intermedia* from *Tropidurus spinulosus* of Salobra, MS. See comments on host taxonomy at *Strongyluris oscari*.

Reference: Bursey & Goldberg (2004b), Bursey *et al.* (2005a), Freitas (1940), Menezes *et al.* (2004), Vicente (1981), Vrcibradic *et al.* (2000).

Subuluridae

***Subulura* Molin, 1860**

Subulura lacertilia Vicente, Van-Sluys, Fontes & Kiefer, 2000

Hosts: *Eurolophosaurus nanuzae*, *Cnemidophorus nativo*

Site of infection: intestine

Distribution: BRAZIL: Serra do Cipó (Cerrado), MG; Guaratiba (Restinga), BA

Reference: Vicente *et al.* (2000a); Fontes *et al.* (2003); Menezes *et al.* (2004).

Subulura sp.

Hosts: *Tropidurus torquatus*

Site of infection: small intestine

Distribution: BRAZIL: Jurubatiba (Restinga), RJ

Reference: Vrcibradic *et al.* (2000).

Oxyurida

Oxyuridae

***Gynaecometra* Araújo, 1976**

Gynaecometra bahiensis Araujo, 1976

Hosts: *Polychrus acutirostris* Spix, 1825

Site of infection: intestine

Distribution: BRAZIL: Xique-xique (Caatinga), BA

Reference: Araujo (1976).

***Typhlonema* Kreis, 1938**

Typhlonema sp.

Hosts: *Tropidurus guarani*

Site of infection: Not informed

Distribution: BRAZIL: Salobra (Pantanal), MS

Reference: Vicente *et al.* (1993).

Pharyngodonidae

***Alaeuris* Thapar, 1925**

Alaeuris caudatus Lent & Freitas, 1948

Hosts: *Iguana iguana*

Site of infection: intestine

Distribution: BRAZIL: Exu (Caatinga), PE; VENEZUELA: La Puerta, GU; PERU: TU.

Reference: Vicente *et al.* (1993); Lent & Freitas (1948); Tantaléan (1998).

Alaeuris conolophi Cuckler, 1938

Hosts: *Conolophus subcristatus* Gray, 1831

Site of infection: intestine

Distribution: ECUADOR: Galapagos Islands

Reference: Baker (1987).

Alaeuris galapagensis Cuckler, 1938

Hosts: *Conolophus subcristatus* Gray, 1831

Site of infection: intestine

Distribution: ECUADOR: Galapagos Islands

Reference: Baker (1987).

Alaeuris labicula Cuckler, 1938

Hosts: *Conolophus subcristatus*

Site of infection: intestine

Distribution: ECUADOR: Galapagos Islands

Reference: Baker (1987).

Alaeuris longispicula Cuckler, 1938
Hosts: *Conolophus subcristatus*
Site of infection: intestine
Distribution: ECUADOR: Galapagos Islands
Reference: Baker (1987).

Alaeuris vogelsangi Lent & Freitas, 1948
Hosts: *Iguana iguana*
Site of infection: intestine
Distribution: BRAZIL: Exu (Caatinga),PE; CE; VENEZUELA: La Puerta, GU
Reference: Vicente *et al.* (1993); Lent & Freitas (1948); Lopes *et al.* (2007).

***Ozolaimus* Dujardin, 1845**
Ozolaimus cirratus Linstow, 1906
Hosts: *Iguana iguana*
Site of infection: intestine
Distribution: BRAZIL: Santa Luzia (Caatinga),PB; PERU; VENEZUELA: La Puerta, GU, Blanquilla, Los Frailes, Los Testigos and Margarita; COLOMBIA: LG; SURINAM: PR and Marienburg, CO.
Reference: Arrojo (2002); Vicente *et al.* (1993); Lent & Freitas (1948); Inglis *et al.* (1960).

Ozolaimus megatyphlon Rudolphi, 1819
Hosts: *Iguana iguana*
Site of infection: intestine
Distribution: BRAZIL: Santa Luzia (Caatinga),PB; PERU; VENEZUELA: La Puerta, GU, Blanquilla, Los Frailes, Los Testigos and Margarita; COLOMBIA: LG; SURINAM: PR and Marienburg, CO.
Reference: Arrojo (2002); Vicente *et al.* (1993); Lent & Freitas (1948); Inglis *et al.* (1960).

***Paralaeuris* Cuckler, 1938**
Paralaeuris dorochila Cuckler, 1938
Hosts: *Conolophus subcristatus*
Site of infection: intestine
Distribution: ECUADOR: Galapagos Islands

Reference: Baker (1987).

***Parapharyngodon* Chatterji, 1933**

Parapharyngodon alvarengai Freitas, 1957

Hosts: *Mabuya atlantica*, *Ameiva ameiva*

Site of infection: large intestine

Distribution: BRAZIL: Fernando de Noronha Island, PE and Itaguaí (Restinga), RJ

Reference: Freitas (1957a); Padilha & Duarte (1979).

Parapharyngodon arequipensis Calisaya & Córdova, 1997

Hosts: *Microlophus peruvianus* (Lesson, 1826)

Site of infection: large intestine

Distribution: PERU: Omate, MO

Remarks: Apparently ignored by Ramallo *et al.* (2002), Bursey & Brooks (2004) and Bursey & Goldberg (2005), terminar a hora que tiver a descrição para comparações

Reference: Calisaya & Córdova (1997); Morales *et al.* (2005).

Parapharyngodon largitor Alho & Rodrigues, 1963

Hosts: *Ameiva ameiva*, *Mabuya agilis*, *Hemidactylus mabouia*

Site of infection: intestine

Distribution: BRAZIL: Manguinhos and Grumari (Restinga), RJ and Valinhos (Cerrado), SP

Reference: Rodrigues & Pinto (1967); Vicente *et al.* (1993); Rocha & Vrcibradic (2003); Anjos *et al.* (2005).

Parapharyngodon moqueguensis Calisaya & Córdova, 1997

Hosts: *Microlophus peruvianus*

Site of infection: large intestine

Distribution: PERU: Moquegua, MO

Remarks: see *P. arequipensis*

Reference: Calisaya & Córdova (1997); Morales *et al.* (2005).

Parapharyngodon riojensis Ramallo, Bursey & Goldberg, 2002

Hosts: *Phymaturus punae* Cei, Etheridge & Videla, 1985, *P. palluma* Molina, 1782, *Liolaemus buergeri* Werner, 1907

Site of infection: large intestine
Distribution: ARGENTINA: LR
Reference: Ramallo *et al.* (2002a); Goldberg *et al.* (2004).

Parapharyngodon sceleratus Travassos, 1923
Hosts: *Ameiva ameiva*, *Cnemidophorus littoralis*, *Eurolophosaurus nanuzae*, *Hemidactylus mabouia*, *Kentropyx pelviceps*, *Liolaemus lutzae*, *Mabuya agilis*, *M. bistriata*, *M. caissara* Rebouças-Spieker, 1974, *M. frenata*, *M. macrorhyncha*, *Microlophus albermalensis* Baur, 1890, *T. guarani*, *T. hispidus*, *T. itambere*, *T. semitaeniatus* Spix, 1825, *T. torquatus*, *T. melanopleurus* and *Tropidurus* sp.
Site of infection: intestine
Remarks: This species have been widely reported as *P. scleratus* (see Ramallo *et al.* 2002, Bursey *et al.* 2005a), but according to the original description by Travassos (1923) and the redescription by Alho & Rodrigues (1963) the proper spelling of the specific name is *sceleratus*. *Cnemidophorus occelifer* as cited by Ribas *et al.* (1995), actually corresponds to *C. littoralis* (see Dias *et al.*, 2005).
Distribution: BRAZIL: Abrolhos, Trancoso (Restinga) and Canudos, BA; CE; Linhares and Praia das Neves, ES; Serra do Cipó (Cerrado), MG; Salobra (Pantanal), MS; Xavantina, GO; Cachimbo, PA; Mogeiro, Lagoa Remígio, Umbuseiro and João Pessoa, PB; Garanhuns, PE; Grumari, Rio de Janeiro, Arraial do Cabo, Grussaí, Manguinhos and Maricá, RJ; Cruzeta, Currais Novos and Ceará Mirim (Caatinga), RN; Queimada Grande, Caraguatatuba and Valinhos, SP ; BOLIVIA: Florida province, SC and El Carmen; PARAGUAY; PERU: CU; ECUADOR: Galapagos Islands.
Reference: Baker (1987); Rocha & Vrcibradic (2003); Bursey *et al.* (2005a); Fontes *et al.* (2003), Vicente *et al.* (1993); Rodrigues & Pinto (1967); Alho & Rodrigues (1973); Vicente (1981); Vrcibradic *et al.* (1999); Bursey & Goldberg (2004b); Vrcibradic & Rocha (2005); Ribas *et al.* (1998); Ribas *et al.* (1995); Anjos *et al.* (2005); Van Sluys *et al.* (1994); Van Sluys *et al.* (1997); Rodrigues (1992); Lopes *et al.* (2007); Roca (1997); Vrcibradic *et al.* (2001).

Parapharyngodon senisfaciecaudus Freitas, 1957
Hosts: *Liolaemus signifer* Duméril & Bibron, 1837
Site of infection: large intestine
Distribution: BOLIVIA: LP

Comments: originally described infecting *Liolaemus lenzi*, which actually corresponds to *L. signifer*
Reference: Freitas (1957b).

Parapharyngodon verrucosus Freitas & Dobbin, 1959
Hosts: *Diploglossus lessonae*
Site of infection: intestine
Distribution: BRAZIL: João Alfredo (Caatinga), PE; CE (Caatinga)
Reference: Freitas & Dobbin (1959); Lopes *et al.* (2007); Vicente *et al.* (1993).

Parapharyngodon yurensis Calisaya & Córdova, 1997
Hosts: *Microlophus peruvianus*
Site of infection: large intestine
Distribution: PERU: Yura, AR
Remarks: see *P. arequipensis*
Reference: Calisaya & Córdova (1997); Morales *et al.* (2005)

Parapharyngodon sp
Hosts: *Ameiva ameiva*, *Cnemidophorus nativo*, *Hemidactylus mabouia*, *Tropidurus torquatus*, *T. etheridgei*
Site of infection: intestine
Distribution: BRAZIL: Salobra, MS; Cabo Frio, Nova Iguaçu and Maricá, RJ, Salvador and Guaratiba, BA; ARGENTINA: CO ; SA
Reference: Vicente *et al.* (1993); Lamas & Zaracho (2006); Rodrigues (1986); Rodrigues *et al.* (1990); Menezes *et al.* (2004); Zaracho & Lamas (2006); Cruz *et al.* (1998).

***Pharyngodon* Diesing, 1861**
Pharyngodon cesarpintoi Pereira, 1935
Hosts: *Cnemidophorus* sp., *Ameiva ameiva*, *Liolaemus lutzae*
Site of infection: large intestine
Distribution: BRAZIL: Juazeiro and Mogeiro (Caatinga), PB, BA, RN; Maricá (Restinga), RJ
Comments: Pereira (1935) apparently misidentified the type host. According to Rodrigues (1993), *C. lemniscatus* does not occur in the Caatinga biome, but *C. occelifer* and at least three undescribed species.

Reference: Pereira (1935); Rocha (1995); Alho & Moura (1970).

Pharyngodon micrurus Freitas & Ibañez, 1963
Hosts: *Dicrodon heterolepis*
Site of infection: intestine
Distribution: PERU: Trujillo, LL
Reference: Baker (1987), Freitas & Ibañez (1963)

Pharyngodon travassosi Pereira, 1935
Hosts: *Ameiva ameiva*
Site of infection: large intestine
Distribution: BRAZIL: Areia (Caatinga), PB
Reference: Pereira (1935).

Pharyngodon sp.
Hosts: *Tropidurus torquatus, Tropidurus hispidus* Spix, 1825
Site of infection: intestine
Distribution: BRAZIL: Salvador, BA; CE
Reference: Vicente *et al.* (1993); Lopes *et al.* (2007).

***Pseudostrongyluris* Guerrero, 1971**
Pseudostrongyluris polychrus Guerrero, 1971
Hosts: *Polychrus marmoratus*
Site of infection: not informed
Distribution: VENEZUELA: Federal District
Reference: Baker (1987).

***Skrjabinodon* Inglis, 1968**
Skrjabinodon dixoni Bursey & Goldberg, 2007
Hosts: *Uracentron flaviceps* (Guichenot, 1855)
Site of infection: large intestine
Distribution: PERU: LO (Amazon); ECUADOR: SU
Reference: Bursey & Goldberg (2007b).

Skrjabinodon heliocostai Vicente, Vrcibradic, Muniz-Pereira & Pinto, 2000
Hosts: *Mabuya frenata*
Site of infection: large intestine
Distribution: BRAZIL: Valinhos (Cerrado), SP
Reference: Vicente *et al.* (2000b).

Skrjabinodon spinulosus Vicente, Vrcibradic, Rocha & Pinto, 2002
Hosts: *Mabuya dorsivittata*
Site of infection: intestine
Distribution: BRAZIL: Itatiaia (Atlantic Forest), RJ; Itirapina (Cerrado), SP
Reference: Rocha *et al.* (2003); Vicente *et al.* (2002).

***Spauligodon* Skrjabin, Schikhobalova & Lagodovsk., 1960**
Spauligodon loboi Ramallo, Bursey & Goldberg (2002)
Hosts: *Liolaemus capillitas* Hulse, 1979, *L. huacahuasicus* Laurent, 1985, *L. quilmes* Etheridge, 1993, *L. ornatus* Koslowsky, 1898, *L. ramirezae* Lobo, 1999
Site of infection: large intestine
Distribution: ARGENTINA: Tafídel Valle and Amaicha del Valle, TU; El Cerrillo, Andalgalá, Belén, and Santa María, CA; San Antonio de los Cobres, Cachi, and La Poma, SA; and Tilcara and Humahuaca, JU
Reference: Ramallo *et al.* (2002b).

Spauligodon maytacapaci Vicente & Ibañez (1968)
Hosts: *Leiocephalus* sp., *Liolaemus andinus* Koslowsky, 1895, *L. chilensis* Lesson, 1830, *L. elongatus* Koslowsky, 1896, *L. lemniscatus* Gravenhorst, 1838, *L. pictus* Duméril & Bibron, 1837, *L. tenuis* Duméril & Bibron, 1837
Site of infection: intestine
Distribution: PERU: Pumarongo, CA; ARGENTINA; CHILE
Reference: Vicente & Ibañez (1968); Goldberg *et al.* (2004); Goldberg *et al.* (2001).

Spauligodon oxkutzcabiensis (Chitwood, 1938)
Hosts: *Thecadactylus solimoensis* Bergmann & Russell, 2007, *Tropidurus guarani*
Site of infection: intestine
Distribution: PERU: CU, (Amazon); PARAGUAY: Arroyo Corrientes (Chaco), PA

Comments: *Thecadactylus* has recently revised, and a *T. solimoensis* were described by Bergmann & Russel (2007) from localities that encompasses the Cuzco, Peru.
Reference: Bursey *et al.* (2005a), Bursey & Goldberg (2004b).

Spauligodon viracochai Freitas, Vicente & Ibañez, 1968
Hosts: *Phyllodactylus gerrhopygus* Wiegmann, 1834, *P. angustidigitus* Dixon & Huey, 1970
Site of infection: intestine
Distribution: PERU: Trujilo, LL and IC
Reference: Freitas *et al.* (1968a); Pérez *et al.* (2007).

***Thelandros* Wedl, 1862**
Thelandros bulbosus Salas & Campos, 1974
Hosts: *Microlophus peruvianus*
Site of infection: not informed
Distribution: PERU
Remarks: In despite of the citation by Perez *et al.* (2007), this oxyurid were described by Salas & Campos (1974) in the "Libro de Resumenes del IV Congreso Nacional de Biologia", a meeting abstract. For their inaccordance to the article 8.1 and 9.9 of the International Code for Zoological Nomenclature should be therefore considered a "species inquirendae".
Reference: Freitas *et al.* (1968b); Vicente *et al.* (2000b).

Thelandros capacyupanquii Freitas, Vicente & Ibañez, 1968
Hosts: *Dicrodon holmbergi* Schmidt, 1957
Site of infection: intestine
Distribution: PERU: Trujilo, LL and IC
Reference: Freitas *et al.* (1968b); Vicente *et al.* (2000b).

Thelandros sp
Hosts: *Tropidurus etheridgei*
Site of infection: intestine
Distribution: ARGENTINA: Departamento Anta (Chaco), SA
Reference: Cruz *et al.* (1998).

Rhabditida

Rhabdiasidae

Chabirenia Lhermitte Vallarino, Bain, Deharo, Bertani, Voza, Attout & Gaucher, 2005

Chabirenia cayennensis Lhermitte Vallarino, Bain, Deharo, Bertani, Voza, Attout & Gaucher, 2005

Hosts: *Ameiva ameiva*

Site of infection: mouth

Distribution: FRENCH GUIANA: CY

Reference: Lhermitte-Vallarino *et al.* (2005).

Rhabdias **Stiles & Hassall, 1905**

Rhabdias anolis Bursey, Goldberg & Telford, 2003

Hosts: *Anolis punctatus*

Site of infection: lungs

Distribution: PERU: CU (Amazon)

Reference: Bursey *et al.* (2005a).

Rhabdias sp.

Hosts: *Anolis fuscoauratus*, *A. punctatus*, *Enyalius iheringii*, *E. bilineatus*, *E. perditus*

Site of infection: lungs, stomach

Distribution: BRAZIL: Marechal Floraino (Atlantic Forest), ES, PA and AM (Amazon) and São Sebastião (Atlantic Forest), SP; ECUADOR: SU

Comments: Only one species of *Rhabdias* have been described from Neotropical saurian hosts: *R. anolis*, which type host is *Anolis frenatus* in Panama (Bursey *et al.*, 2003b).

Reference: Vrcibradic *et al.* (2008); Goldberg *et al.* (2006a); Goldberg *et al.* (2006b); Vrcibradic *et al.* (2007).

Strongyloididae

Strongyloides **Grassi, 1897**

Strongyloides cruzi Rodrigues, 1968

Hosts: *Hemidactylus mabouia*

Site of infection: small intestine

Distribution: BRAZIL: Manguinhos, RJ

Reference: Vicente *et al.* (1993); Rodrigues (1968).

Spirurida

Acuariidae

Hosts: *Cercosaura argulus*, *Hemidactylus mabouya*, *Mabuya agilis*, *M. macrorhyncha*, *Tropidurus torquatus*, *Enyalius bilineatus*

Site of infection: body cavity

Distribution: BRAZIL: Queimada Grande island (Atlantic forest) and Valinhos (Cerrado), SP; Jurubatiba and Grussaí (Restinga), RJ; Marechal Floriano (Atlantic Forest) and Praia das Neves (Restinga), ES; PERU: Rio Nanay, LO

Comments: all citations above consists of cysts and thus difficult to identify to species level, because reproductive structures are needed.

Reference: Vrcibradic & Rocha (2005); Vrcibradic *et al.* (2000); Anjos *et al.* (2005); Goldberg & Bursey (2007a); Vrcibradic *et al.* (2007); Vrcibradic *et al.* (2002).

Diplotriaenidae

***Hastospiculum* Skrjabin, 1923**

Hastospiculum sp.

Hosts: *Plica umbra*

Site of infection: peritoneum

Distribution: PERU: CU (Amazon)

Reference: Bursey *et al.* (2005a).

Filariidae

***Filaria* Mueller, 1787**

Filaria multipapilla Molin,

Hosts: *Dracaena guianensis* Daudin, 1802

Site of infection: body cavity

Distribution: BRAZIL: Belém (Amazon), PA

Comments: The species is actually considered “species inquirenda” by Freitas & Rodrigues (1964), because the type material is lost and no new information about these species is presented since the description.

Reference: Lent & Freitas (1941), Freitas & Rodrigues (1964), Vicente & Jardim (1980).

Onchocercidae

***Oswaldofilaria* Travassos, 1933**

Oswaldofilaria azevedoi Bain, 1974
Hosts: *Polychrus marmoratus* Linnaeus, 1758, *Stenocercus roseiventris*
Site of infection: body cavity
Distribution: BRAZIL: Belém (Amazon), PA; PERU: CU (Amazon)
Reference: Bain, 1974; Bursey *et al.* (2005a).

Oswaldofilaria belemensis Bain and Dulahian, 1974
Hosts: *Dracaena guianensis*
Site of infection: heart, aorta e vena cavae
Distribution: BRAZIL: Belém (Amazon), PA
Reference: Vicente *et al.* (1993).

Oswaldofilaria brevicaudata Rodhain and Vuylsteke, 1937
Hosts: *Iguana iguana*, *Anolis punctatus*
Site of infection: body cavity
Distribution: BRAZIL: Marajó (Amazon), PA, AM (Amazon), Exu (Caatinga), PE; VENEZUELA: ZU
Reference: Freitas & Lent (1937a); Goldberg *et al.* (2006a); Baker (1987); Díaz-Hungría (1978); Bain (1974); Vicente & Jardim (1980).

Oswaldofilaria petersi Bain and Sulahian, 1974
Hosts: *Tupinambis teguixin*, *Tropidurus hispidus*
Site of infection: body cavity
Distribution: BRAZIL: Belém (Amazon), PA, Ibiraba (Caatinga), BA
Reference: Vicente *et al.* (1993); Silva & Kohlsdorf (2003).

Oswaldofilaria spinosa Bain and Sulahian, 1974
Hosts: *Mabuya bistriata*
Site of infection: body cavity
Distribution: BRAZIL: Belém (Amazon), PA
Reference: Vicente *et al.* (1993).

Oswaldofilaria sp.
Hosts: *Tupinambis teguixin*, *Mabuya frenata*
Site of infection: body cavity
Distribution: SURINAM: PR; BRAZIL: Valinhos (Cerrado), SP
Reference: Baylis (1947); Vrcibradic *et al.* (1999).

***Piratuba* Freitas & Lent, 1947**
Piratuba digiticauda Lent & Freitas, 1941
Hosts: *Tropidurus torquatus*, *Tropidurus guarani*, *Plica umbra*
Site of infection: body cavity, intestine
Distribution: BRAZIL: Salvador, BA, Piratuba (Amazon), PA, Salobra (Pantanal), MS; PERU: CU; PARAGUAY: Chaco
Comments: *Tropidurus spinulosus* from Salobra actually correspond to *T. guarani*, according to Harvey & Gutberlet (1998)
Reference: Vicente (1981); Bursey & Goldberg (2004b); Bursey *et al.* (2005a); Vicente & Jardim (1980).

Piratuba lainsoni Bain, 1974
Hosts: *Anolis punctatus*, *Polychrus marmoratus*
Site of infection: body cavity, large intestine
Distribution: BRAZIL: Belém (Amazon), PA; PERU: CU (Amazon)
Reference: Bain (1974); Bursey *et al.* (2005a).

Piratuba scaffi Bain, 1974
Hosts: *Ameiva ameiva*
Site of infection: body cavity
Distribution: BRAZIL: Belém (Amazon), PA
Reference: Bain (1974).

Piratuba shawi Bain, 1974
Hosts: *Kentropyx calcarata* Spix, 1825
Site of infection: body cavity
Distribution: BRAZIL: Belém (Amazon), PA
Reference: Bain (1974).

***Piratuboides* Bain & Sulahian, 1974**

Piratuboides zeae (Bain, 1974) Bain and Sulahian, 1974

Hosts: *Mabuya bistriata* Spix, 1825

Site of infection: body cavity, large intestine

Distribution: BRAZIL: Belém (Amazon), PA; PERU: CU (Amazon)

Reference: Bain (1974); Bursey *et al.* (2005a).

Physalopteridae

***Abbreviata* Travassos, 1920**

Abbreviata spiralis (Schneider, 1866) Chabaud, 1956

Hosts: *Amphisbaena* sp.

Site of infection: Not informed

Distribution: BRAZIL

Comments: This species is actually considered as "species inquirendae".

Reference: Baker (1987).

***Physaloptera* Rudolphi, 1819**

Physaloptera lutzi Cristofaro, Guimarães & Rodrigues, 1976

Hosts: *Ameiva ameiva*, *Cnemidophorus abaetensis* Reis, Dias, Rocha & Vrcibradic, 2002, *C. littoralis*, *Enyalius bilineatus*, *Eurolophosaurus nanuzae*, *Liolaemus alticolor* Barbour, 1909, *L. ornatus*, *L. quilmes*, *Tropidurus guarani*, *T. itambere*, *T. torquatus*

Site of infection: stomach

Distribution: ARGENTINA: SA, TU; BOLIVIA: Roboré (Pantanal); BRAZIL: Salvador, Serrinha and Canudos (Caatinga), BA; Linhares and Conceição da Barra (Restinga), Marechal Floriano (Atlantic Forest), ES; Serra do Cipó (Cerrado), MG; Porto Esperança and Salobra (Pantanal), MS; Xavantina, MT; Cachimbo (Amazon), PA; Maricá and Jurubatiba (Restinga), RJ; Valinhos (Cerrado), SP; PARAGUAY: Chaco

Reference: Ramallo & Díaz (1998); Vicente *et al.* (1993); Van Sluys *et al.* (1994); Van Sluys *et al.* (1997); Vicente (1981); Fontes *et al.* (2003); Cristofaro *et al.* (1976); Bursey & Goldberg (2004b); Ribas *et al.* (1998); Ribas *et al.* (1995); Vrcibradic *et al.* (2000); Diaz *et al.* (2005); Vrcibradic *et al.* (2007).

Remarks: *Cnemidophorus occelifer* as cited by Ribas *et al.* (1995), actually corresponds to *C. littoralis* (see Dias *et al.*, 2005).

Physaloptera retusa Rudolphi, 1819

Hosts: *Ameiva ameiva*, *Amphisbaena alba*, *Anolis fuscoauratus*, *Anolis punctatus*, *Cnemidophorus abaetensis*, *C. lemniscatus*, *C. littoralis*, *C. nativo*, *C. ocellifer*, *Enyalius bilineatus*, *Iguana iguana*, *Kentropyx altamazonica*, *K. calcarata*, *K. pelviceps*, *Leiosaurus bellii* Duméril & Bibron, 1837, *L. catamarcensis* Koslowsky, 1898, *Liolaemus lutzae*, *L. neuquensis* Cei & Videla, 2003, *Mabuya agilis*, *M. bistriata*, *M. dorsivittata* Cope, 1862, *Ophiodes striatus* Spix, 1824, *Plica plica*, *P. umbra*, *Potamites ecpleopus*, *Stenocercus roseiventris*, *Thecadacytlus solimoensis*, *Tropidurus guarani*, *T. hispidus*, *T. torquatus*, *Tupinambis rufescens* Günther, 1871, *T. teguixin*, *Uracentron flaviceps*, *Tropidurus melanopleurus* Boulenger, 1902

Site of infection: stomach, intestine

Distribution: BRAZIL: Salvador and Guaratiba (Restinga), BA; Conceição da Barra (Restinga) and Marechal Floraino (Atlantic Forest), ES; Salobra (Pantanal), MS; Altamira, Belém, Cachimbo, Novo Progresso and Santarém (Amazon), PA; Itatiaia (Atlantic Forest), Maricá and Jurubatiba (Restinga), RJ; Ilha Seca (Atlantic Forest) and Itirapina (Cerrado), SP ; PARAGUAY: Chaco; BOLIVIA: El Carmen and Florida, SC; ARGENTINA; PERU: CU (Amazon); SURINAM: PR (Amazon); URUGUAY: Montevideo; VENEZUELA: Colón, ZU, Atures, AM, Salamanca, NE, Cumuná (Arid zone) and La Orchila, Mar Caribe

Comments: Baker (1987) cited several species of lizards that not occur in Brazil, such as *Tupinambis rufescens*, *Cnemidophorus lateristrigus*, *Euprepis spixii*, *Podinema graphica*, *P. scripta*. *Pygopus gronovii* also cited in Baker (1987) actually corresponds to *Ophiodes striatus* and *Podinema* corresponds to *Tupinambis*, but no species are currently recognized as synonyms of *P. scripta* and *P. graphica*. *Cnemidophorus occelifer* as cited by Ribas *et al.* (1995) actually corresponds to *C. littoralis* (see Dias *et al.*, 2005).

Reference: Diaz-Ungria (1964); Diaz-Ungria & Gallardo (1968) Rocha *et al.* (2003); Vicente (1981); Vicente & Santos (1967); Vicente *et al.* (1993); Goldberg *et al.* (2006b); Goldberg *et al.* (2007b); Bursey *et al.* (2005a); Noronha *et al.* (2004); Ribas *et al.* (1998); Ribas *et al.* (1995); Goldberg & Bursey (2007b); Baylis (1947); Vrcibradic *et al.* (2000); Lent & Freitas (1948); Menezes *et al.* (2004); Prieto (1980); Dias *et al.* (2005); Caballero & Vogelsangi (1947); Roca (1997); Vrcibradic *et al.* (2007).

Physaloptera sp.

Hosts: *Ameiva ameiva*, *Cercosaura argulus*, *Cnemidophorus litoralis*, *C. ocellifer*, *Hemidactylus mabouia*, *Mabuya agilis*, *M. macrorhyncha*, *Polychrus acutirostris*, *Tropidurus etheridgei*, *T. torquatus*, *Tupinambis merianae* Duméril & Bibron, 1839, *Tupinambis teguixin*.

Site of infection: stomach

Distribution: BRAZIL: Abrolhos and Salvador (Restinga), BA; Linhares and Praia das Neves (Restinga) and Sooretama (Cerrado), ES; Salobra (Pantanal), Ilha Grande, Cabo Frio, Grussaí, Grumari and Jurubatiba (Restinga), RJ; Valinhos (Cerrado), SP; ARGENTINA: SA and FO (Chaco); PERU: Rio Nanay, LO

Comments: *Tupinambis teguixin* of Salobra, MS corresponds to *T. merianae* (personal observation).

Reference: Anjos *et al.* (2005); Zaracho & Lamas (2006); Rocha & Vrcibradic (2003); Vicente *et al.* (1993); Goldberg & Bursey (2007a); Vrcibradic *et al.* (2000); Dias *et al.* (2005); Van Sluys *et al.* (1997); Cruz *et al.* (1998); Lamas & Zaracho (2006).

***Physalopteroides* Wu & Liu, 1940**

Physalopteroides venancioi Lent, Freitas & Proença, 1946

Hosts: *Alopoglossus atriventris* Duellman, 1973, *Ameiva ameiva*, *Cercosaura ocellata* Wagler, 1830, *Cnemidophorus nativo*, *Kentropyx altamazonica*, *K. pelviceps*, *Mabuya agilis*, *M. bistriata*, *M. macrorhyncha*, *Thecadactylus solimoensis*, *Tropidurus torquatus*, *Tupinambis teguixin*

Site of infection: stomach

Distribution: BRAZIL: AC (Amazon); Trancoso and Guaratiba (Restinga), BA; Magé, Grussaí and Jurubatiba (Restinga), RJ; Praia das Neves (Restinga), ES; PERU: CU (Amazon)

Reference: Rocha & Vrcibradic (2003); Fabio & Rolas (1974); Bursey *et al.* (2005a); Vrcibradic *et al.* (2000); Vrcibradic *et al.* (2001); Vrcibradic *et al.* (2002); Goldberg *et al.* (2007a); Menezes *et al.* (2004).

***Thubunaea* Seurat, 1914**

Thubunaea iguanae (Telford, 1965)

Hosts: *Microlophus peruvianus*, *M. thoracicus* (Tschudi, 1845)

Site of infection: stomach

Distribution: PERU: R.N. Paracas, IC

Reference: Pérez *et al.* (2007).

Thubunaea parkeri Baylis, 1926

Hosts: *Microlophus occipitalis* Peters, 1871, *Dicrodon heterolepis*

Site of infection: stomach

Distribution: PERU

Reference: Baylis (1926); Baker (1987).

Spiruridae

Spirurinae

Hosts: *Hemidactylus mabouia*

Site of infection: stomach, lungs, and small intestine

Distribution: BRAZIL: Rio de Janeiro, RJ

Reference: Rodrigues (1970).

Micropleuridae

Micropleura Linstow, 1906

Hosts: *Tupinambis merianae*

Site of infection: body cavity

Distribution: BRAZIL: Salobra (Pantanal), MS

Comments: This record must be discharged, because no mention to *Micropleura* was made in Travassos & Freitas (1941) as cited in Vicente *et al.* (1993). Moreover, species of *Micropleura* are found in the body cavity of crocodiles and turtles (Anderson, 2000).

Reference: Vicente *et al.* (1993); Travassos & Freitas (1941).

Diaphanocephalidae

***Diaphanocephalus* Diesing, 1851**

Diaphanocephalus diesingi Freitas & Lent, 1938

Hosts: *Tupinambis teguixin*

Site of infection: small intestine

Distribution: BRAZIL: Belém (Amazon), PA

Reference: Freitas & Lent (1938).

Diaphanocephalus galeatus Rudolphi, 1819

Hosts: *Tupinambis merianae*, *T. rufescens*, *T. teguixin*

Site of infection: intestine
Distribution: BRAZIL: Salobra (Pantanal), MS; Manguinhos, Angra dos Reis e Rio de Janeiro (Atlantic Forest), RJ; Pedras Altas, RS; Ilha Grande and São Paulo, SP; ARGENTINA; BOLIVIA; SURINAM: PR
Reference: Freitas & Lent (1938); Vicente *et al.* (1993); Spinelli *et al.* (1992); Baylis (1947).

Diaphanocephalus jacuruxi Alho, 1965
Hosts: *Dracaena guianensis*
Site of infection: small intestine
Distribution: BRAZIL: Ilha das Onças (Amazon), PA
Reference: Alho (1965); Vicente *et al.* (1993).

Kalicephalus Molin, 1861
Kalicephalus sp.
Hosts: *Tupinambis teguixin*
Site of infection: intestine
Distribution: BRAZIL: Sooretama, ES
Comments: Species of *Kalicephalus* spp. have been reported in several snake species, and seems to be restricted to these animals, likewise *Diaphanocephalus* spp. (a sister taxon) in Tupinambinae. This record could be a misidentification by Travssos *et al.* (1964) or a case of incidental infection in a *Tupinambis teguixin*.
Reference: Vicente *et al.* (1993), Travassos *et al.* (1964).

Molineidae
***Kentropyxia* Baker, 1982**
Kentropyxia sauria Baker, 1982
Hosts: *Kentropyx calcarata*
Site of infection: small intestine
Distribution: BRAZIL: Belém and Novo Progresso (Amazon), PA
Reference: Baker (1982); Goldberg *et al.* (2007b).

***Oswaldocruzia* Travassos, 1917**
Oswaldocruzia bainae Ben-Slimane & Durette-Desset, 1996
Hosts: *Anolis chrysolepis* Duméril & Bibron, 1837, *A. fuscoauratus*

Site of infection: small intestine
Distribution: ECUADOR: San Pablo (Amazon), LR
Reference: Ben-Slimane & Durette-Desset (1996).

Oswaldocruzia benslimanei Durette-Desset, Anjos & Vrcibradic, 2006
Hosts: *Enyalius bilineatus* Duméril & Bibron, 1837
Site of infection: small intestine
Distribution: BRAZIL: Marechal Floriano, ES
Reference: Durette-Desset *et al.* (2006); Vrcibradic *et al.* (2007).

Oswaldocruzia brasiliensis Lent & Freitas, 1935
Hosts: *Hemidactylus mabouia*
Site of infection: small intestine
Distribution: BRASIL: Rio de Janeiro, RJ
Reference: Lent & Freitas (1935); Vicente *et al.* (1993).

Oswaldocruzia burseyi Durette-Desset, Anjos & Vrcibradic, 2006
Hosts: *Enyalius perditus*
Site of infection: stomach
Distribution: BRAZIL: São Sebastião (Atlantic Forest), SP
Reference: Durette-Desset *et al.* (2006); Vrcibradic *et al.* (2008).

Oswaldocruzia fredi Durette-Desset, Anjos & Vrcibradic, 2006
Hosts: *Enyalius iheringii*
Site of infection: stomach
Distribution: BRAZIL: São Sebastião (Atlantic Forest), SP
Reference: Durette-Desset *et al.* (2006); Vrcibradic *et al.* (2008).

Oswaldocruzia peruensis Ben-Slimane, Verhaag & Durette-Desset, 1995
Hosts: *Stenocercus roseiventris*, *Cercosaura argulus*, *Anolis punctatus*
Site of infection: stomach
Distribution: PERU: HA and CU (Amazon)
Reference: Ben-Slimane *et al.* (1995); Goldberg & Bursey (2007a); Bursey *et al.* (2005)

Oswaldocruzia vitti Bursey & Goldberg, 2004

Hosts: *Alopoglossus angulatus*, *A. atriventris*, *Anolis fuscoauratus*, *A. punctatus*, *Cercosaura eigenmanni*, *C. oshaugnessyi*

Site of infection: intestine

Distribution: BRAZIL: AC, AM, PA, RO (Amazon); ECUADOR: SU (Amazon); PERU: CU (Amazon)

Reference: Bursey & Goldberg (2004a); Goldberg *et al.* (2006a, b); Goldberg *et al.* (2007a); Bursey *et al.* (2005a).

Oswaldocruzia sp

Hosts: *Tropidurus torquatus*, *Enyalius catenatus* (Wied, 1821), *E. perditus*

Site of infection: intestine

Distribution: BRAZIL: Bodoquena (Cerrado) and Salobra (Pantanal), MS, Cachimbo (Amazon), PA, Rio de Janeiro, RJ; Ibitipoca, MG; ARGENTINA: SA, JU and TA (Chaco); PARAGUAY: Assuncion and Chaco

Comments: The above records from *T. torquatus* are those of *O. mazzai* and that of *Enyalius* spp. are from *O. subauricularis*, both considered as *species inquirenda* by Durette-Desset *et al.* (2006).

Reference: Vicente *et al.* (1993); Souza *et al.* (2007); Durette-Desset *et al.* (2006); Freitas (1955).

CESTODA

Cyclophyllidea

Linstowiidae

***Oochoristica* Lühe, 1898**

Oochoristica ameivae (Beddard, 1914)

Hosts: *Ameiva ameiva*, *Cnemidophorus nativo*, *Mabuya agilis*, *M. macrorhyncha*

Site of infection: intestine

Distribution: BRAZIL: Cachimbo (Amazon), PA; Serra do Navio (Amazon), AP; Manaus (Amazon), AM; Guaratiba and Trancoso (Restinga), BA, Praia das Neves (Restinga), ES, Grussaí (Restinga), RJ; PERU: CU (Amazon)

Reference: Vicente & Santos (1971); Bursey *et al.* (2005a); Rego (1973); Pinto & Correa (1976); Menezes *et al.* (2004); Vrcibradic *et al.* (2002); Vrcibradic *et al.* (2001).

Oochoristica bressalui Fürhmann, 1927
Hosts: *Tropidurus guarani*, *T. hispidus*, *T. torquatus*
Site of infection: small intestine
Distribution: BRAZIL: Salvador and Serrinha, BA; Cachimbo (Amazon), Arraial do Cabo, Cabo Frio and Rio de Janeiro, RJ; BOLIVIA: El Carmen; PARAGUAY.
Reference: Vicente (1978); Bursey & Goldberg (2004b); Rego (1973); Rego & Rodrigues (1965).

Oochoristica freitasi Rego & Ibañez, 1965
Hosts: *Dicrodon heterolepis*
Site of infection: small intestine
Distribution: PERU: Trujillo, LL
Remarks: Bursey & Goldberg (1996) apparently ignored the presence of *O. freitasi* in his comparisons of *Oochoristica* spp. parasiting Neotropical lizards, and this is follows by Arizmendi-Espinosa *et al.* (2005). The species is also not included in any synonymy of revisions made by Bursey *et al.* (2007). Moreover, the species was cited in Guillén-Hernández *et al.* (2007).
Reference: Rego & Ibañez (1965).

Oochoristica iguanae (Baylis, 1919) Bursey & Goldberg, 1996
Hosts: *Iguana iguana*
Site of infection: small intestine
Distribution: VENEZUELA: Isla Margarita
Reference: Bursey & Goldberg (1996).

Oochoristica insulamargaritae López-Neyra and Diaz-Ungría, 1957
Hosts: *Ameiva ameiva*
Site of infection: small intestine
Distribution: VENEZUELA: Isla Margarita
Reference: Bursey & Goldberg (1996); López-Neyra and Diaz-Ungría (1957).

Oochoristica travassosi Rego & Ibañez, 1965
Hosts: *Leiocephalus* sp., *Liolaemus vallecurensis* Pereira, 1992
Site of infection: small intestine

Distribution: PERU: Moche; ARGENTINA: SJ
Reference: Rego & Ibañez (1965); Goldberg *et al.* (2004).

Oochoristica vanzolinii Rego & Oliveira-Rodrigues, 1965
Hosts: *Hemidactylus mabouia, Eurolophosaurus nanuzae*
Site of infection: small intestine
Distribution: BRAZIL: Rio de Janeiro, RJ; Serra do Cipó, MG
Reference: Rego & Oliveira-Rodrigues (1965); Fontes *et al.* (2003).

Oochoristica sp.
Hosts: *Alopoglossus atriventris, Mabuya frenata*
Site of infection: small intestine
Distribution: ECUADOR: SU; BRAZIL: Valinhos, SP
Reference: Goldberg *et al.* (2007a); Vrcibradic *et al.* (1999).

***Semenoviella* Spasskii, 1951**
Semenoviella amphisbaenae Rudolphi, 1819
Hosts: *Amphisbaena fuliginosa* Linnaeus, 1758, *A. alba*
Site of infection: intestine
Distribution: BRAZIL: Belém (Amazon), PA; Pirassununga (Cerrado), SP
Reference: Rego (1967).

Mesocestoididae
***Mesocestoides* Vaillant, 1863**
Mesocestoides sp.
Hosts: *Anolis transversalis*
Site of infection: not informed
Distribution: BRAZIL: RO (Amazon)
Reference: Goldberg *et al.* (2006a).

Proteocephalidea
Proteocephalidae
***Cairaella* Coquille & De Chambrier, 2008**
Cairaella henrii Coquille & De Chambrier, 2008

Hosts: *Anolis trachyderma* Cope, 1876
Site of infection: intestine
Distribution: ECUADOR: San Pablo de Kantesyia, SU
Reference: Coquille & De Chambrier (2008).

***Ophiotaenia* La Rue, 1911**
Ophiotaenia flava Rudin, 1917
Hosts: *Kentropyx pelviceps*
Site of infection: not informed
Distribution: PERU: CU (Amazon)
Reference: Bursey *et al.* (2005a).

Ophiotaenia nicoleae Coquille & De Chambrier, 2008
Hosts: *Thecadactylus solimoensis*
Site of infection: intestine
Distribution: ECUADOR: San Pablo de Kantesyia, SU
Comments: *Thecadactylus* has recently revised, and a *T. solimoensis* were described by Bergmann & Russel (2007) from localities that encompasses the San Pablo de Kantesyia, Ecuador.
Reference: Coquille & De Chambrier (2008).

Ophiotaenia sp.
Hosts: *Anolis fuscoauratus*
Site of infection: small intestine
Distribution: BRAZIL: Santarém (Amazon), PA
Reference: Goldberg *et al.* (2006b).

***Tejidotaenia* Freze, 1965**
Tejidotaenia appendiculata (Baylis, 1947)
Hosts: *Tupinambis teguixin*
Site of infection: small intestine
Distribution: SURINAM: PR (Amazon); BRAZIL: Serra do Navio (Amazon), AP; Linhares, ES
Reference: Baylis (1947); Rego & Chambrier (2000).

TREMATODA

Digenea

Echinostomata

Echinostomida

Superfamily Echinostomatoidea Looss, 1899

Cathaemasiidae

***Pulchrossomoides* Freitas & Lent, 1937**

Pulchrosomoides elegans Freitas & Lent, 1937

Hosts: *Tupinambis teguixin*, *Iguana iguana*, *Mabuya macrorhyncha*

Site of infection: stomach

Distribution: BRAZIL: Porto Esperança (Pantanal), MS; Praia das Neves (Restinga), ES

Reference: Hughes *et al.* (1942); Freitas & Lent (1937); Travassos *et al.* (1969), Vrcibradic *et al.* (2002).

Plagiorchiida

Dicrocoeliidae

***Brachycoelium* (Dujardin, 1845)**

Brachycoelium salamandrae (Frolich, 1789) Dujardin, 1845

Hosts: *Leposoma osvaldoi* Ávila-Pires, 1995, *Anolis nitens* Wagler, 1830

Site of infection: small intestine

Distribution: BRAZIL: Novo Progresso (Amazon), PA

Comments: Cited as *B. mesocoeliiformis* in *Anolis scypheus* (= *A. nitens*) by Travassos *et al.* (1969).

Reference: Goldberg *et al.* (2007b); Travassos *et al.* (1969)

Harmotrematidae

***Helicotrema* Odhner, 1912**

Helicotrema asymetricum (Travassos, 1922) Viana, 1924

Hosts: *Iguana iguana*

Site of infection: intestine

Distribution: BRAZIL: Pantanal

References: Travassos (1922); Travassos (1928).

Helicotrema magniovatum Odhner, 1912
Hosts: *Iguana iguana*
Site of infection: intestine
Distribution: BRAZIL
References: Travassos *et al.* (1969).

Helicotrema spirale (Diesing, 1850) Odhner, 1912
Hosts: *Iguana iguana*
Site of infection: intestine
Distribution: BRAZIL
References: Travassos *et al.* (1969).

Pronocephalidae

***Iguanacola* Gilbert, 1938**

Iguanacola navicularis Gilbert, 1938
Hosts: *Amblyrhynchus cristatus* Bell, 1825
Site of infection: not informed.
Distribution: ECUADOR: Galapagos Islands
References: Yamaguti (1971).

Myosaccus Gilbert, 1938

Myosaccus amblyrhynchi Gilbert, 1938
Hosts: *Amblyrhynchus cristatus*
Site of infection: not informed.
Distribution: ECUADOR: Galapagos Islands
References: Yamaguti (1971).

Cetiosaccus Gilbert, 1938

Cetiosaccus galapagensis Gilbert, 1938
Hosts: *Amblyrhynchus cristatus*
Site of infection: not informed.
Distribution: ECUADOR: Galapagos Islands
References: Yamaguti (1971).

***Paradistomum* Kossack, 1910**

Paradistomum parvissimum (Travassos, 1918)

Hosts: *Ameiva ameiva*, *Hemidactylus mabouia*, *Iguana* iguana, *Liolaemus lutzae*, *Mabuya macrorhyncha*, *M. agilis*, *Tropidurus torquatus*, *Tupinambis teguixin*

Site of infection: gall blader, liver, small intestine

Distribution: Brazil: Arraial do Cabo, Grussaí, Nova Iguaçu, Manguinhos, Maricá, RJ; Praia das Neves (Restinga) and Santa Teresa, ES; Salvador and Trancoso (Restinga), BA

Reference: Rodrigues *et al.* (1990); Vicente (1978); Travassos (1919); Travassos (1944); Rodrigues (1970); Rodrigues (1986); Rodrigues (1992); Rodrigues *et al.* (1990); Vrcibradic *et al.* (2001), Vrcibradic *et al.* (2002).

Paradistomum rabusculum Kossack, 1910

Hosts and records: *Gymnodactylus geckoides* Spix, 1825

Site of infection: not informed

Distribution: BRAZIL

References: Travassos *et al.* (1969).

Macroderidae

***Pneumotrema* Bhalerao, 1937**

Pneumotrema travassosi Bhalerao, 1937

Hosts and records: *Amphisbaena alba*

Site of infection: kidney, ureter, intestine.

Distribution: BRAZIL

References: Hughes *et al.* (1942).

Family Plagiorchiidae

***Allopharynx* (Strom, 1928)**

Allopharynx daileyi Bursey, Goldberg & Vitt, 2005

Hosts: *Uranoscodon superciliosus*

Site of infection: small intestine.

Distribution: BRAZIL: PA, RO, RR (Amazon)

References: Bursey *et al.* (2005b).

***Dasymetra* Nicoll, 1911**

Dasymetra tupinambis Nasir & Diaz, 1971

Hosts: *Tupinambis teguixin*

Site of infection: intestine

Distribution: VENEZUELA: Sucre

Reference: Nasir & Díaz (1971)

***Styphlodora* Looss, 1899**

Styphlodora condita Faria, 1911

Hosts: *Tupinambis rufescens* (Günther, 1871).

Site of infection: kidney, ureter, intestine.

Distribution: ARGENTINA

References: see Lunaschi & Drago (2007).

***Plagiorchis* Lühe, 1899**

Plagiorchis freitasi Vicente, 1978

Hosts: *Tropidurus torquatus*

Site of infection: small intestine

Distribution: BRAZIL: Conceição da Barra, ES

References: Vicente (1978).

Plagiorchis vicentei Rodrigues, 1994

Hosts: *Hemidactylus mabouia*

Site of infection: small intestine

Distribution: BRAZIL: Teresópolis, RJ

References: Rodrigues, 1994.

Family Brachycoeliidae

***Mesocoelium* Odhner, 1910**

Mesocoelium monas (Rudolphi, 1819) Freitas, 1958

Hosts: *Alopoglossus angulatus*, *Amphisbaena* sp., *Cercosaura eigenmanni*, *Diploglossus lessonae*, *Mabuya atlantica*, *Leposternon microcephalum*, *Tropidurus torquatus*, *Uranoscodon superciliosus*

Site of infection: intestine

Distribution: BRAZIL: PA, RO, RR (Amazon), João Alfredo (Caatinga) and Fernando de Noronha, PE, Maricá and Rio de Janeiro (Restinga), RJ; ECUADOR: SU (Amazon)
Reference: Bursey & Goldberg (2004a); Bursey *et al.* (2005b); Rodrigues *et al.* (1990); Travassos *et al.* (1969); Goldberg *et al.* (2007a); Rodrigues *et al.* (1990).

Family Urotrematidae
Urotrema Braun, 1900
Urotrema shirleyae Zamparo, Brooks & Tkach, 2005
Hosts: *Anolis fuscoauratus*
Site of infection: small intestine
Distribution: BRAZIL: Santarém (Amazon), PA
Reference: Goldberg *et al.* (2006b).

HOST/PARASITE LIST

FAMILY AMPHISBAENIDAE
Amphisbaena alba
Maracaya belemensis
Maracaya graciai
Aplectana albae
Aplectana raillieti
Physaloptera retusa
Semenoviella amphisbaenae
Pneumotrema travassosi

Amphisbaena bolivica
Aplectana tucumanensis

Amphisbaena fuliginosa
Semenoviella amphisbaenae

***Amphisbaena* sp.**
Maracaya pusilla
Mesocoelium monas

Leposternon microcephalum

Cosmocerca rara

Mesocoelium monas

Paradollfusnema amphisbaenia

FAMILY IGUANIDAE

Amblyrhynchus cristatus

Iguanacola navicularis

Myosaccus amblyrhynchi

Cetiosaccus galapagensis

Iguana iguana

Alaeuris caudatus

Alaeuris vogelsangi

Ozolaimus cirratus

Ozolaimus megatyphlon

Oswaldofilaria brevicaudata

Physaloptera retusa

Oochoristica iguanae

Pulchrosomoides elegans

Paradistomum parvissimun

Helicotrema asymetricum

Helicotrema magniovatum

Helicotrema spirale

Conolophus subcristatus

Alaeuris conolophi

Alaeuris galapagensis

Alaeuris labicula

Alaeuris longispicula

Paralaeuris dorochila

FAMILY HOPLOCERCIDAE

Hoplocercus spinosus

Cruzia rudolphii

FAMILY POLYCHROTIDAE

Anolis chrysolepis

Oswaldocruzia bainae

Anolis fuscoauratus

Cosmocerca vrcibradici

Strongyluris oscari

Rhabdias sp.

Physaloptera retusa

Oswaldocruzia bainae

Oswaldocruzia vitti

Ophiotaenia sp

Urotrema shirleyae

Anolis nitens

Brachycoelium salamandrae

Anolis punctatus

Cyrtosomum longicaudatum

Strongyluris oscari

Falcaustra sp.

Skrjabinellazia intermedia

Rhabdias anolis

Rhabdias sp.

Oswaldofilaria brevicaudata

Piratuba lainsoni

Physaloptera retusa

Oswaldocruzia peruensis

Oswaldocruzia vitti

Anolis trachyderma

Cairaella henrii

Anolis transversalis

Cyrtosomum longicaudatum

Strongyluris oscari

Mesocestoides sp.

Polychrus acutirostris

Gynaecometra bahiensis

Physaloptera sp.

Polychrus marmoratus

Pseudostrongyluris polychrus

Oswaldofilaria azevedoi

Piratuba lainsoni

FAMILY LEIOSAURIDAE

Enyalius bilineatus

Centrorhynchidae

Rhabdias sp.

Acuariidae

Physaloptera lutzi

Physaloptera retusa

Oswaldocruzia benslimanei

Enyalius catenatus

Oswaldocruzia sp

Enyalius iheringii

Strongyluris oscari

Rhabdias sp.

Oswaldocruzia fredi

Enyalius perditus

Acanthocephalus sp.
Aplectana vellardi
Cosmocerca sp.
Strongyluris oscari
Rhabdias sp.
Oswaldocruzia burseyi
Oswaldocruzia sp

Leiosaurus belli
Physaloptera retusa

Leiosaurus catamarcensis
Physaloptera retusa

FAMILY LIOLAEMIDAE
Liolaemus alticolor
Physaloptera lutzi

Liolaemus andinus
Spauligodon maytacapaci

Liolaemus buergeri
Parapharyngodon riojensis

Liolaemus capillitas
Spauligodon loboi

Liolaemus chilensis
Spauligodon maytacapaci

Liolaemus elongatus
Spauligodon maytacapaci

Liolaemus huacahuasicus

Spauligodon loboi

Liolaemus lemniscatus

Spauligodon maytacapaci

Liolaemus lutzae

Ichthyocapillaria (*=Pseudocapillaria*) *maricaensis*

Parapharyngodon sceleratus

Pharyngodon cesarpintoi

Physaloptera retusa

Paradistomum parvissimum

Liolaemus neuquensis

Physaloptera retusa

Liolaemus ornatus

Spauligodon loboi

Physaloptera lutzi

Liolaemus pictus

Spauligodon maytacapaci

Liolaemus quilmes

Spauligodon loboi

Physaloptera lutzi

Liolaemus ramirezae

Spauligodon loboi

Liolaemus signifer

Parapharyngodon senisfaciecaudus

Liolaemus tenuis

Spauligodon maytacapaci

Liolaemus vallecurensis

Oochoristica travassosi

Phymaturus palluma

Parapharyngodon riojensis

Phymaturus punae

Parapharyngodon riojensis

FAMILY TROPIDURIDAE

Eurolophosaurus nanuzae

Strongyluris oscari

Subulura lacertília

Parapharyngodon sceleratus

Physaloptera lutzi

Oochoristica vanzolinii

***Leiocephalus* sp.**

Spauligodon maytacapaci

Oochoristica travassosi

Microlophus albermalensis

Parapharyngodon sceleratus

Microlophus occipitalis

Thubunaea parkeri

Microlophus peruvianus

Parapharyngodon arequipensis

Parapharyngodon moqueguensis

Parapharyngodon yurensis

Thubunaea iguanae

Microlophus thoracicus

Thubunaea iguanae

Plica plica

Strongyluris oscari

Physaloptera retusa

Plica umbra

Strongyluris oscari

Hastospiculum sp.

Piratuba digiticauda

Physaloptera retusa

Stenocercus roseiventris

Strongyluris oscari

Oswaldofilaria azevedoi

Physaloptera retusa

Oswaldocruzia peruensis

Tropidurus etheridgei

Parapharyngodon sp

Thelandros sp

Physaloptera sp.

Tropidurus guarani

Strongyluris oscari

Skrjabinellazia intermedia

Typhlonema sp.

Parapharyngodon sceleratus

Spauligodon oxkutzcabiensis

Piratuba digiticauda

Physaloptera lutzi

Physaloptera retusa

Oochoristica bressalui

Tropidurus hispidus

Parapharyngodon sceleratus

Pharyngodon sp.

Oswaldofilaria petersi

Physaloptera retusa

Oochoristica bressalui

Tropidurus itambere

Parapharyngodon sceleratus

Physaloptera lutzi

Tropidurus melanopleurus

Strongyluris oscari

Parapharyngodon sceleratus

Physaloptera retusa

Tropidurus semitaeniatus

Parapharyngodon sceleratus

Tropidurus spinulosus

Strongyluris oscari

Tropidurus torquatus

Acanthocephala

Echinorhynchus sp.

Centrorhynchus tumidulus

Capillaria (=*Amphibiocapillaria*) *freitaslenti*

Hexametra boddaertii

Strongyluris oscari

Skrjabinellazia intermedia

Subulura sp.

Parapharyngodon sceleratus

Parapharyngodon sp

Pharyngodon sp.

Acuariidae

Piratuba digiticauda

Physaloptera lutzi

Physaloptera retusa

Physaloptera sp.

Physalopteroides venancioi

Oswaldocruzia sp

Oochoristica bressalui

Paradistomum parvissimum

Plagiorchis freitasi

Mesocoelium monas

***Tropidurus* sp.**

Strongyluris oscari

Parapharyngodon sceleratus

Uracentron flaviceps

Skrjabinodon dixoni

Physaloptera retusa

Uranoscodon superciliosus

Cosmocerca vrcibradici

Africana chabaudi

Allopharynx daileyi

Mesocoelium monas

FAMILY GEKKONIDAE

Hemidactylus mabouia

Centrorhynchidae

Parapharyngodon largitor

Parapharyngodon sceleratus

Parapharyngodon sp

Strongyloides cruzi

Acuariidae

Physaloptera sp.

Spirurinae

Oswaldocruzia brasiliensis

Oochoristica vanzolinii

Paradistomum parvissimum

Plagiorchis vicentei

FAMILY PHYLLODACTYLIDAE

Gymnodactylus geckoides

Paradistomum rabusculum

Phyllodactylus angustidigitus

Spauligodon viracochai

Phyllodactylus gerrhopygus

Spauligodon viracochai

Thecadactylus solimoensis

Spauligodon oxkutzcabiensis

Physaloptera retusa

Physalopteroides venancioi

Ophiotaenia nicoleae

FAMILY SPHAERODACTYLIDAE

Gonatodes humeralis

Skrjabinelazia galliardi

FAMILY ANGUIDAE

Diploglossus lessonae

Parapharyngodon verrucosus

Mesocoelium monas

Ophiodes striatus

Physaloptera retusa

FAMILY TEIIDAE

Ameiva ameiva

Oligacanthorhynchus sp.

Centrorhynchus tumidulus

Capillaria (=*Amphibiocapillaria*) *freitaslenti*

Spinicauda spinicauda

Strongyluris oscari

Parapharyngodon alvarengai

Parapharyngodon largitor

Parapharyngodon sceleratus

Parapharyngodon sp

Pharyngodon cesarpintoi

Pharyngodon travassosi

Chabirenia cayennensis

Piratuba scaffi

Physaloptera lutzi

Physaloptera retusa

Physaloptera sp.

Physalopteroides venancioi

Oochoristica ameivae

Oochoristica insulamargaritae

Paradistomum parvissimum

Cnemidophorus abaetensis

Physaloptera lutzi

Physaloptera retusa

Cnemidophorus lemniscatus

Physaloptera retusa

Cnemidophorus littoralis

Hexametra boddaertii

Parapharyngodon sceleratus
Physaloptera lutzi
Physaloptera retusa
Physaloptera sp.

Cnemidophorus nativo
Skrjabinellazia intermedia
Subulura lacertília
Parapharyngodon sp
Physaloptera retusa
Physalopteroides venancioi
Oochoristica ameivae

Cnemidophorus ocellifer
Hexametra boddaertii
Physaloptera retusa
Physaloptera sp.

Cnemidophorus sp.
Pharyngodon cesarpintoi

Dicrodon heterolepis
Pharyngodon micrurus
Thubunaea parkeri
Oochoristica freitasi

Dicrodon holmbergi
Thelandros capacyupanquii

Dracaena guianensis
Oswaldofilaria belemensis
Diaphanocephalus jacuruxi

Kentropyx altamazonica

Physaloptera retusa

Physalopteroides venancioi

Kentropyx calcarata

Piratuba shawi

Physaloptera retusa

Kentropyxia sauria

Kentropyx pelviceps

Dujardinascaris sp.

Parapharyngodon sceleratus

Physaloptera retusa

Physalopteroides venancioi

Ophiotaenia flava

Tupinambis merianae

Cruzia travassosi

Physaloptera sp.

Diaphanocephalus galeatus

Tupinambis rufescens

Physaloptera retusa

Diaphanocephalus galeatus

Styphlodora condita

Tupinambis teguixin

Centrorhynchus tumidulus

Centrorhynchus sp.

Contracaecum sp.

Dujardinascaris sp

Freitasascaris alata

Atractis cruciata

Spinicauda spinicauda

Cruzia fulleborni
Cruzia tentaculata
Oswaldofilaria petersi
Oswaldofilaria sp.
Physaloptera retusa
Physaloptera sp.
Physalopteroides venancioi
Diaphanocephalus diesingi
Diaphanocephalus galeatus
Tejidotaenia appendiculata
Pulchrosomoides elegans
Paradistomum parvissimum
Dasymetra tupinambis

FAMILY GYMNOPHTHALMIDAE

Alopoglossus angulatus
Cosmocerca vrcibradici
Oswaldocruzia vitti
Mesocoelium monas

Alopoglossus atriventris
Cosmocerca vrcibradici
Physalopteroides venancioi
Oswaldocruzia vitti
Oochoristica sp.

Cercosaura argulus
Cosmocercidae
Acuariidae
Physaloptera sp.
Oswaldocruzia peruensis

Cercosaura eigenmanni
Cosmocerca vrcibradici

Oswaldocruzia vitti
Mesocoelium monas

Cercosaura ocellata
Physalopteroides venancioi

Cercosaura oshaugnessyi
Acanthocephalus saurius
Cosmocerca vrcibradici
Oswaldocruzia vitti

Leposoma osvaldoi
Brachycoelium salamandrae

Neusticurus bicarinatus
Falcaustra belemensis

Potamites ecpleopus
Falcaustra belemensis
Physaloptera retusa

FAMILY SCINCIDAE
Mabuya agilis
Centrorhynchidae
Hexametra boddaertii
Strongyluris oscari
Parapharyngodon largitor
Parapharyngodon sceleratus
Acuariidae
Physaloptera retusa
Physaloptera sp.
Physalopteroides venancioi
Oochoristica ameivae
Paradistomum parvissimum

Mabuya atlantica

Moaciria alvarengai

Parapharyngodon alvarengai

Mesocoelium monas

Mabuya bistriata

Parapharyngodon sceleratus

Oswaldofilaria spinosa

Piratuboides zeae

Physaloptera retusa

Physalopteroides venancioi

Mabuya caissara

Parapharyngodon sceleratus

Mabuya dorsivittata

Skrjabinodon spinulosus

Physaloptera retusa

Mabuya frenata

Hexametra boddaertii

Parapharyngodon sceleratus

Skrjabinodon heliocostai

Oswaldofilaria sp.

Oochoristica sp.

Mabuya macrorhyncha

Echinorhynchidae

Centrorhynchidae

Hexametra boddaertii

Acuariidae

Physaloptera sp.

Physalopteroides venancioi

Oochoristica ameivae
Pulchrosomoides elegans
Paradistomum parvissimum

DISCUSSION

This paper was arranged with a total of 608 records of helminths from lizards. Of these, at least nine species of Acantocephalans, 15 cestodes, 19 trematodes and 105 nematodes were reported, including records in which family or genus were not identified. From the 148 species reported, only one record were from Chile and French Guiana, two from Colombia, three from Uruguay, 8 from Bolivia, 9 from Suriman, 12 from Paraguay and Venezuela, 19 from Ecuador, 17 from Argentina, 37 from Peru and 99 from Brazil. Five species considered "species inquirendae" are also reported.

A total of 102 lizard species were reported as hosts for helminths, an indication that are much work to be done, because estimates of lizard diversity in many countries from South America is usually higher than 150 species (Argentina: 167 species – Lavilla *et al.*, 2000; Brazil: 237 species – Bernils, 2009).

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PARTE 2

NOVOS REGISTROS DE OCORRÊNCIA DE HELMINTOS EM LAGARTOS DO BRASIL CENTRAL

ARTIGO 2

HELMINTHS FROM TEN SPECIES OF LIZARDS (REPTILIA: SQUAMATA) AT THE CERRADO OF MATO GROSSO DO SUL STATE, BRAZIL

RUNNING HEAD: HELMINTH FROM LIZARDS OF CERRADO

HELMINTHS FROM TEN SPECIES OF LIZARDS (REPTILIA: SQUAMATA) AT THE CERRADO OF MATO GROSSO DO SUL STATE, BRAZIL

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ABSTRACT, Twenty-three specimens representing ten species of lizards (*Ameiva ameiva*, *Cercosaura occelata*, *Hoplocercus spinosus*, *Mabuya frenata*, *Ophiodes striatus*, *Polychrus acutirostris*, *Stenocercus caducus*, *Tropidurus guarani*, *Tropidurus itambere*, and *Tupinambis merianae*) collected in the Cerrado biome at the Brazilian State Mato Grosso do Sul were examined for helminths. Three lizard species (*A. ameiva*, *C. occelata*, and *M. frenata*) had no helminths. Eight species of nematodes were recovered from the lizard hosts (*Cruzia travassosi*, *Diaphanocephalus galeatus*, *Gynaecometra bahiensis*, *Pharyngodon cesarpintoi*, *Physaloptera* sp., *Skrjabinellazia intermedia*, *Strongyluris oscari*, and an unidentified species of nematode). Four new host records and two new locality records were reported.

Key Words, Parasites, Nematoda, Sauria, Neotropical, South America

INTRODUCTION

Although the Brazilian State of Mato Grosso do Sul harbors considerable lizard diversity, the knowledge about life-history of many species, specially concerning the parasitism are scarce. Freitas and Lent (1937) described the trematode *Puchrossomoides elegans* from the stomach of *Iguana iguana* Linnaeus, 1758. Other available data were summarized by Vicente *et al.*, (1993), which reported infection by nematodes in five lizard species (*Ameiva ameiva* Linnaeus, 1758, *Polychrus acutirostris*, *Tropidurus guarani* Alvarez, Cei and Scolaro, 1994, *T. torquatus* Wied-Neuwied, 1820, and *Tupinambis merianae* Duméril and Bibron, 1839) from that region. However, these data are almost restricted to the Pantanal, at Salobra region, in the municipality of Miranda with a single record from the Cerrado at Bodoquena municipality (Vicente *et al.*, 1993). Later, Ávila *et al.*, (2008) reported the nematode *Cruzia rudolphii* Ruiz, 1947 from the intestine of *Hoplocercus spinosus* Fitzinger, 1843 at a Cerrado site from Dois Irmãos do Buriti municipality. The purpose of this paper is report and up-to-date the presences of helminths infecting ten lizard species from Cerrado at Mato Grosso do Sul State, Brazil.

MATERIAL AND METHODS

Lizards collected from August 1989 to August 2005 in municipalities of Mato Grosso do Sul State as well as specimens harbored at the Coleção Zoológica de Referência da Universidade Federal de Mato Grosso do Sul (ZUFMS) were examined for the presence of helminths. Lizards were captured by hand or by pitfall-traps during biological surveys, euthanized, fixed in 10% formalin, and preserved in 70% ethanol. For each lizard, the snout-vent length (SVL) was taken using a digital caliper.

The body cavity of each lizard was opened by a longitudinal incision from throat to vent, the gastrointestinal tract was slit longitudinally, and stomach and intestinal contents were removed and examined under a dissection microscope. Helminths found in the gastrointestinal tract, lungs, or body cavity was placed in vials of 70% ethanol for later identification. For species identification, nematodes were cleared in phenol and were examined under a light microscope. Voucher helminth specimens were deposited in the Coleção Helmintológica do Instituto de Biociências da Unesp de Botucatu (CHIBB).

RESULTS

Twenty-three lizards representing ten species were assessed for the analyses: *A. ameiva* (N = 3; SVL = 98.6 ± 35.6 mm), *Cercosaura ocellata* Wagler, 1830 (N = 1, SVL= 41.1 mm), *H. spinosus* (N = 2, SVL = 88.6 ± 19.9 mm), *Mabuya frenata* Cope, 1862 (N = 3, SVL = 68.2 ± 3.6 mm), *Ophiodes striatus* (N = 1, SVL = 329.0 mm), *P. acutirostris* (N = 2, SVL = 102 ± 43.7 mm), *Stenocercus caducus* Cope, 1862 (N = 3, SVL = 61.2 ± 5.7 mm), *T. guarani* (N = 5, SVL = 98.5 ± 16.9 mm), *Tropidurus itambere* Rodrigues, 1987 (N = 1, SVL = 73.6 mm), and *T. merianae* (N = 2, SVL = 216.5 ± 88.4 mm).

A total of 5,164 nematodes representing eight species of nematodes were recovered from the lizard hosts. *Ameiva ameiva*, *C. ocellata*, and *M. frenata* had no endoparasites. Results by host species can be found as follow:

Anguidae

Ophiodes striatus Spix, 1824

One female specimen was collected in September 1992 in Campo Grande municipality (20°26’34”S, 54°38’45”W).

Nematoda larvae (CHIBB 3286)

Prevalence and intensity of infection: one specimen was infected with 16 worms.

Temporal distribution: September 1992.

Site of infection: large intestine.

Remarks: the worms cannot be identified due to the poorly and juvenile condition.

Polychrotidae

Polychrus acutirostris Spix, 1825

Two specimens (one adult male and one pregnant female) were collected in October 1992 and October 1993 in Campo Grande municipality (ZUFMS 23 and 27).

***Gynaecometra bahiensis* Araújo, 1976 (CHIBB 3261)**

Prevalence: One (female) out of two lizards was infected with 5040 worms.

Temporal distribution: October 1993.

Site of infection: large intestine.

Type host: *P. acutirostris*

Other reported hosts: none

Locality records: Xique-Xique municipality (type locality), Bahia State, Brazil (Araújo, 1976).

Remarks: this is the second record of *G. bahiensis*. Mato Grosso do Sul State represents a new locality record.

Teiidae

***Tupinambis merianae* Duméril & Bibron, 1839**

Two specimens (one adult male ZUFMS 54 and one adult female ZUFMS 65) were collected in August 2005 in the Serra da Bodoquena, municipality of Bodoquena (21°08'02"S, 56°48'31"W).

***Cruzia travassosi* Khalil & Vogelsangi, 1932 (CHIBB 3284 and 3285)**

Prevalence: one (female) out of two lizards was infected by 18 worms.

Temporal distribution: August 2005.

Site of infection: small and large intestine.

Type host: *Tolypeutes conurus*

Other reported hosts: *Tupinambis teguixin*

Locality records: Argentina, Bolivia and Mato Grosso State, Brazil

Remarks: three species of *Cruzia* have been reported from lizards: *Cruzia fulleborni* Khalil and Vogelsang, 1930, *Cruzia mexicana* Khalil, 1927 and *Cruzia rudolphi* Ruiz, 1947, while *Cruzia tentaculata* (Rudolphi, 1819) and *C. travassosi* are described as mammal parasites, including Brazilian species, such as the opossum (Bursey *et al.*, 2007). However, both are also cited as a parasite of *Tupinambis teguixin* Linnaeus, 1758 (Lent and Freitas, 1948, Ruiz, 1947: unpublished thesis, Universidade de São Paulo, Brazil.). According to Bursey *et al.* (2007), species of *Cruzia* are distinguished based upon morphology of the esophagus and male caudal papillae. Our identification is based in ratio of esophagous/body. This is the first record of *C. travassosi* in a Cerrado site.

***Diaphanocephalus galeatus* Rudolphi, 1919 (CHIBB 3285)**

Prevalence: One (female) out of two lizards was infected by 18 worms.

Temporal distribution: August 2005.

Site of infection: small intestine.

Type host: *Tupinambis teguixin*

Other reported hosts: *T. merianae* and *T. rufescens*

Locality records: cited at the Brazilian States of Rio de Janeiro, São Paulo, Mato Grosso do Sul and Rio Grande do Sul and from Argentina; Bolivia and Surinam (Freitas and Lent, 1938; Baylis 1947; Spinelli *et al.*, 1992; Vicente *et al.*, 1993)

Remarks: Three species of *Diaphanocephalus* have been recognized: *D. galeatus*, *D. diesingi* Freitas and Lent, 1938 and *D. jacuruxi* Alho, 1965. All records are restricted to the teiid lizards of the subfamily Tupinambinae.

Hoplocercidae

***Hoplocercus spinosus* Fitzinger, 1843**

Two adult males were collected in December 1984 and June 1995 in Campo Grande municipality (ZUFMS 2 and 26).

***Physaloptera* sp. (CHIBB 3286)**

Prevalence and intensity of infection: one out of two specimens was infected by 59 larvae.

Temporal distribution: June 1995.

Site of infection: stomach.

Remarks: the worms cannot be identified at species level due to the juvenile condition. However, *H. spinosus* is a new host record for the genus *Physaloptera*.

Tropiduridae

***Stenocercus caducus* (Cope, 1862)**

Three specimens (two adult males and one adult female) were collected in August 2005 at the Serra da Bodoquena, municipality of Bodoquena.

Skrjabinellazia intermedia Freitas, 1940 **(CHIBB 3278)**

Prevalence and intensity of infection: one out of the three specimens was infected with 1 worm.

Temporal distribution: August 2005.

Site of infection: small intestine.

Type host: *Tropidurus guarani* (as *Tropidurus spinulosus*)

Other reported hosts: *Tropidurus torquatus*, *Cnemidophorus nativo* Rocha, Bergallo and Peccinini-Seale, 1997; *Anolis punctatus* Daudin, 1802.

Locality records: in the Brazilian States of Mato Grosso do Sul at Salobra (type locality, Freitas, 1940), Bahia and Rio de Janeiro (Vicente, 1981; Vrcibradic *et al.*, 2000; Menezes *et al.*, 2004). Paraguay (Bursey and Goldberg, 2004) and Peru (Bursey *et al.*, 2005).

Remarks: *Stenocercus caducus* represents a new host record for *S. intermedia*.

Strongyluris oscari Travassos, 1923 **(CHIBB 3286)**

Prevalence and intensity of infection: two out of three specimens was infected with 8 and 7 worms.

Temporal distribution: August 2005.

Site of infection: small and large intestine

Type host: *Tropidurus* sp.

Other reported hosts and localities: *A. ameiva*, *Anolis fuscoauratus* D'Orbignyi, 1837, *A. punctatus*, *A. transversalis* Duméril, 1851, *Enyalius iheringii* Boulenger, 1885, *E. perditus* Jackson, 1978, *Eurolophosaurus nanuzae* Rodrigues, 1981, *Mabuya agilis* Raddi, 1823, *Tropidurus guarani*, *T. spinulosus*, *T. torquatus*, *Plica plica* Linnaeus, 1758, *P. umbra* Linnaeus, 1758 and *Stenocercus roseiventris* D'Orbigny in Duméril and Bibron 1837.

Locality records: in the Brazilian States of Mato Grosso (type locality), Rio de Janeiro (Ribas *et al.*, 1998a and b), Pará (Goldberg *et al.*, 2006a), Acre, Amazonas and Rondônia (Goldberg *et al.*, 2006b), São Paulo (Vrcibradic *et al.*, 2008); Minas Gerais (Fontes *et al.*, 2003; Sousa *et al.*, 2007); Mato Grosso do Sul, Bahia, Ceará, Distrito Federal, Espírito Santo, Goiás and Paraíba (Vicente, 1981). Peru and Ecuador (Bursey *et al.*, 2005; Goldberg *et al.*, 2006a and b). Paraguay (Bursey and Goldberg, 2004) and Argentina (Sutton *et al.*, 1998).

Remarks: Bursey *et al.* (2003) summarized morphological characteristics of the 31 recognized species for *Strongyluris*, pointing that only four occur in Neotropical region. *Strongyluris oscari* seems to be extremely polymorphic, since the species *S. freitasi* Alho, 1969, *S. travassosi* Alho, 1969 and *S. sai* Travassos, 1926 have been synonimized by Vicente (1981). The records of *S. oscari* infecting *T. spinulosus* in the region of Salobra, MS, Brazil by Vicente (1981) correspond to *T. guarani*, following the revision of Harvey and Gutberlet (1998). *Stenocercus caducus* represents a new host record for *S. oscari*.

Tropidurus guarani **(Cope, 1862)**

One specimen (adult male; ZUFMS 20) collected in August 2005 at the Serra da Bodoquena, municipality of Bodoquena had no endoparasites. One specimen (adult male; ZUFMS 29) collected in June 1996 in Terenos municipality (20°26'32"S, 54°51'37"W) had no endoparasites. Three specimens (one adult male presented endoparasites and one of two adult females were infected with nematodes) collected in February 2002 at Nova Alvorada do Sul municipality (21°41'17"S, 53°53'38"W).

Strongyluris oscari **(CHIBB 2307-2309)**

Prevalence and intensity of infection: two out of five specimens was infected 1 and 2 worms.
Temporal distribution: February 2002.
Site of infection: small and large intestine
Remarks: see comments under *S. caducus*.

***Tropidurus itambere* Rodrigues, 1987**

One specimen (adult male; ZUFMS 20) collected in August 2005 at the Serra da Bodoquena, municipality of Bodoquena.

Pharyngodon cesarpintoi Pereira, 1935 **(CHIBB 3282)**

Prevalence and intensity of infection: one individual was infected with 3 worms.
Temporal distribution: August 2005.
Site of infection: large intestine.
Type host: *Cnemidophorus lemniscatus* Linnaeus, 1758
Other reported hosts: *Ameiva ameiva*, *Liolaemus lutzae* Mertens, 1938.
Locality records: in the Brazilian States of Ceará (type locality; Pereira, 1935) and Rio de Janeiro (Rocha, 1995).
Remarks: Pereira (1935) apparently misidentified the type host (*C. lemniscatus*) from the Caatinga biome from northeastern Brazil. According to Rodrigues (2003), there are no records of *C. lemniscatus* in the Caatinga, which have both *Cnemidophorus occelifer* Spix, 1825 and at least three undescribed species. *Tropidurus itambere* represents a new host record for *P. cesarpintoi* and Mato Grosso do Sul a new locality record.

DISCUSSION

The Brazilian Cerrado covers about 2,000,000 Km^2, representing the largest open-vegetation biome in South America (Oliveira and Marquis, 2002). Lizard fauna of the Cerrado are extremely diverse (more than 50 species), and endemicity can reach 26% of the total species (Colli *et al.*, 2002). The total of lizard species occurring in the Cerrado biome at Mato Grosso do Sul State is unknown; moreover, the knowledge about associated endoparasites are scarce.

Although the sample size from the present work is small, the data presented here increases the knowledge about endoparasites of lizards from Mato Grosso do Sul States and, moreover from the Cerrado. However, because Cerrado has complex and diverse lizard fauna further helminthological studies are needed to access the helminth diversity and ecological relationships between hosts and their parasites.

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ARTIGO 3

HELMINTHS FROM LIZARDS (REPTILIA: SQUAMATA) AT THE CERRADO OF GOIÁS STATE, BRAZIL

RUNNING HEAD: HELMINTHS FROM LIZARDS OF CERRADO

HELMINTHS FROM LIZARDS (REPTILIA: SQUAMATA) AT THE CERRADO OF GOIÁS STATE, BRAZIL.

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ABSTRACT

Seventy specimens representing nineteen species of lizards (*Ameiva ameiva*, *Anolis nitens brasiliensis*, *A. meridionalis*, *Bachia bresslaui*, *Cercosaura schreibersii*, *Cnemidophorus* cf. *parecis*, *Colobosaura modesta*, *Hemidactylus mabouia*, *Kentropyx paulensis*, *Mabuya dorsivittata*, *M. frenata*, *M. nigropunctata*, *Micrablepharus atticolus*, *Ophiodes striatus*, *P. acutirostris*, *Tropidurus itambere*, *T. oreadicus*, *T. torquatus*, and *Tupinambis merianae*) collected in the Cerrado biome in six localities from the Brazilian State of Goiás were examined for helminths. Seven lizard species (*A. meridionalis*, *B. bresslaui*, *C. schreibersii*, *Colobosaura modesta*, *K. paulensis*, *M. frenata*, *Micrablepharus atticolus*, and *T. torquatus*) were uninfected. Thirteen species of nematodes (*Cruzia travassosi*, *Gynaecometra bahiensis*, *Oswaldofilaria* sp., *Parapharyngodon* sp., *P. largitor*, *P. sceleratus*, *Physaloptera* sp., *P. lutzi*, *P. retusa*, *Physalopteroides venancioi*, *Pharyngodon travassosi*, and *Subulura lacertilia*) and an unidentified species of cestodes (*Oochoristica* sp.) were recovered from lizard hosts. Thirteen new host records and seven locality records were reported.

Key Words, Parasites, Nematoda, Sauria, Neotropical, South America

INTRODUCTION

The State of Goiás are located at the mid-western region of Brazil, with your territory situated at the Cerrado domain. The Cerrado (savanna-like vegetation) are the second largest biome of Brazil, with more than 2,000,000 Km^2 and harbors considerable lizard diversity, with a high level of endemism (Colli *et al.*, 2002).

Studies with helminthological surveys on lizards of the Goiás State are older, fragmented and restricted to a few species. Araújo & Gandra (1941) described the nematode *Amphibiocapillaria* (=*Capillaria*) *freitaslenti* and Alho (1969) described *Strongyluris travassosi* (=*S. oscari*), both from *Tropidurus torquatus*. Finally, Vicente (1981) reported *Parapharyngodon sceleratus* and *Strongyluris oscari* from two localities of the State. The purpose of this paper is to report helminths from twenty lizard species of six localities in the Goiás State, thereby increasing the knowledge on helminths from lizards of Brazil.

Material and methods

Lizards collected from November 2005 to October 2008 in six municipalities of Goiás State and housed at the Coleção Zoológica da Universidade Federal de Goiás (ZUFG) were examined for the presence of helminths. Lizards were captured in six localities from the Cerrado Biome at the State of Goiás: Aparecida do Rio Doce (18°17' S; 51°08' W), Barro Alto (14°58' S; 48°54' W), Itarumã (18°46' S; 51°20' W), Niquelândia (14°28' S; 48°27' W), Silvânia (17°50' S; 52°39' W) and at the Parque Nacional das Emas (18°46' S; 51°20' W), in the Mineiros municipality. Lizards were captured by hand or by pitfall-traps during biological surveys, euthanized, fixed in 10% formalin, and preserved in 70% ethanol. For each lizard, the snout-vent length (SVL) was taken using a digital caliper.

The body cavity of each lizard was opened by a longitudinal incision from throat to vent, the gastrointestinal tract was slit longitudinally, and stomach and intestinal contents were removed and examined under a dissection microscope. Helminths found in the gastrointestinal tract, lungs, or body cavity was placed in vials of 70% ethanol for later identification. For species identification, nematodes were cleared in phenol and were examined under a light microscope. Voucher helminth specimens were deposited in the Coleção Helmintológica do Instituto de Biociências da Unesp de Botucatu (CHIBB).

RESULTS

We examined seventy specimens from 19 lizard species: *Ameiva ameiva* (N = 9; SVL = 109.7 ± 38.1 mm), *Anolis nitens brasiliensis* (N = 8; SVL = 56.4 ± 8.1 mm), *Anolis meridionalis* (N

= 5; SVL = 41.5 ± 4.8 mm), *Bachia bresslaui* (Amaral, 1935) (N = 1; SVL 68 mm), *Cercosaura schreibersii* (N = 3; SVL = 31.2 ± 4.0 mm), *Cnemidophorus* cf. *parecis* (N = 3, SVL = 73 ± 25.7 mm), *Colobosaura modesta* (N = 7; SVL = 43.4 ± 8.3 mm), *Hemidactylus mabouia* (N = 2; SVL = 48.8 ± 20.9 mm), *Kentropyx paulensis* (N = 5; SVL = 54.0 ± 10.1 mm), *Mabuya dorsivittata* (N = 4; SVL = 61.8 ± 12 mm), *Mabuya frenata* (N = 2; SVL = 64.5 ± 3.5 mm), *Mabuya nigropunctata* (N = 3; SVL = 65.5 ± 14 mm), *Micrablepharus atticolus* (N = 2; SVL = 35.5 ± 6.4 mm), *Ophiodes striatus* (N = 1; SVL = 253 mm), *Polychrus acutirostris* (N = 5; SVL = 90.2 ± 29.4 mm), *Tropidurus itambere* (N = 1; SVL = 84.5 mm), *Tropidurus oreadicus* (N = 6; SVL = 64.0 ± 14.7 mm), *Tropidurus torquatus* (N = 2; SVL = 77.0 ± 38.2 mm), *Tupinambis teguixin* (N = 1; SVL = 169 mm).

A total of 1,345 helminths from 13 nematode species and unidentified species of cestodes were recovered. *A. meridionalis*, *B. bresslaui*, *C. schreibersii*, *Colobosaura modesta*, *K. paulensis*, *M. frenata*, *Micrablepharus atticolus*, and *T. torquatus* had no endoparasites. Results by host species can be found as follow:

Polychrotidae

***Anolis nitens brasiliensis* Vanzolini & Willians, 1970**

Eight specimens were examined from two localities: one from Silvânia (uninfected) and 7 from Niquelândia. Two of the later were parasitized with nematodes; one of which had an unidentified species (CHIBB 4016).

***Subulura lacertilia* Vicente, Van-Sluys, Fontes & Kiefer, 2000 (CHIBB 4017)**

Prevalence and intensity of infection: one of seven hosts infected with 8 worms.

Temporal distribution: December 2005.

Site of infection: large intestine.

Type host: *Eurolophosaurus nanuzae*.

Other reported hosts: *Cnemidophorus nativo*.

Locality records: Serra do Cipó and Guartiba, in the Brazilian States of Minas Gerais and Bahia, respectively.

Remarks: We refer to the host as *A. nitens brasiliensis* instead of *A. chrysolepis brasiliensis* according to Myers (2008). *Anolis nitens brasiliensis* represents a new host record for *S. lacertilia*; Goiás State is a new locality record.

References: Vicente *et al*. (2000); Fontes *et al*. (2003); Menezes *et al*. (2004).

Polychrus acutirostris Spix, 1825

Five specimens were examined; two from Barro Alto and one from Parque Nacional das Emas are uninfected. The results for the specimens of Silvânia and Niquelândia can be found bellow:

***Gynaecometra bahiensis* Araújo, 1976 (CHIBB 4021 and 4037)**

Prevalence and intensity of infection: one specimen from Niquelândia were infected with 959 worms, and one specimen of Silvânia were infected with 137 worms.

Temporal distribution: November 2005 and August 2008 in Niquelândia and Silvânia, respectively.

Site of infection: large intestine.

Type host: *Polychrus acutirostris*.

Other reported hosts: none.

Locality records: Xique-xique municipality in the Bahia State, Brazil (Araújo, 1976).

Remarks: Goiás State represents a new locality record for *G. bahiensis*.

***Physalopteroides venancioi* Lent, Freitas & Proença, 1946 (CHIBB 4036)**

Prevalence: one specimen from Silvânia was infected with 17 worms.

Temporal distribution: August 2008.

Site of infection: stomach.

Type host: *Rhinella schneideri* (= *Bufo paracnemis*).

Other reported hosts: *Alopoglossus atriventris*, *Ameiva ameiva*, *Cercosaura ocellata*, *Cnemidophorus nativo*, *Kentropyx altamazonica*, *K. pelviceps*, *Mabuya agilis*, *M. bistriata*, *M. macrorhyncha*, *Thecadactylus solimoensis*, *Tropidurus torquatus*, *Tupinambis teguixin*.

Locality records: in the Brazilian States of Acre, Bahia and Rio de Janeiro; Peru; Paraguay.

Remarks: *Polychrus acutirostris* represents a new host record for *P. venancioi*. Goiás State is a new locality record.

References: Rocha & Vrcibradic (2003); Fabio & Rolas (1974); Bursey *et al.* (2005); Vrcibradic *et al.* (2000); Goldberg *et al.* (2007a); Menezes *et al.* (2004).

Tropiduridae

***Tropidurus itambere* Rodrigues, 1987**

***Parapharyngodon sceleratus* Travassos, 1923 (CHIBB 4034-4035)**

Prevalence: one specimen from Aparecida do Rio Doce municipality was infected with 19 worms.

Temporal distribution: December 2006.

Site of infection: small and large intestine.

Type host: *Tropidurus torquatus*

Other reported hosts: *Ameiva ameiva*, *Cnemidophorus littoralis*, *Eurolophosaurus nanuzae*, *Hemidactylus mabouia*, *Kentropyx pelviceps*, *Liolaemus lutzae*, *Mabuya agilis*, *M. bistriata*, *M. caissara*, *M. frenata*, *M. macrorhyncha*, *Microlophus albermalensis*, *T. guarani*, *T. hispidus*, *T. itambere*, *T. semitaeniatus*, *T. torquatus*, *T. melanopleurus* and *Tropidurus* sp.

Locality records: in the Brazilian States of Bahia, Ceará, Espírito Santo, Minas Gerais, Mato Grosso do Sul, Goiás, Pará, Paraíba, Pernambuco, Rio de Janeiro, Rio Grande do Norte, and São Paulo; Bolivia; Paraguay; Peru; Ecuador.

Remarks: actually 6 species of *Parapharyngodon* are recognized in South American lizards: *P. alvarengai*, *P. largitor*, *P. riojensis*, *P. sceleratus*, *P. riojensis*, and *P. verrucosus* (see Ramallo *et al.*, 2002). Ramallo *et al.* (2002) provided a key to identification of the species in the Neotropical region.

References: Baker (1987); Rocha & Vrcibradic (2003); Bursey *et al.* (2005); Fontes *et al.* (2003), Vicente *et al.* (1993); Rodrigues & Pinto (1967); Alho & Rodrigues (1973); Vicente (1981); Vrcibradic *et al.* (1999); Bursey & Goldberg (2004); Vrcibradic & Rocha (2005); Ribas *et al.* (1998); Ribas *et al.* (1995); Anjos *et al.* (2005); Van Sluys *et al.* (1994); Van Sluys *et al.* (1997); Rodrigues (1992); Lopes *et al.* (2007); Roca (1997).

***Tropidurus oreadicus* Rodrigues, 1987**

Six specimens were examined; one from Barro Alto municipality (uninfected) and five from Niquelândia, which results can be found bellow:

***Oochoristica* sp. (CHIBB 4011)**

Prevalence: one out of 5 specimens was infected with 2 worms.

Temporal distribution: May 2006.

Site of infection: small intestine.

Remarks: thirteen species of *Oochoristica* are known from the Neotropical region (see Guillén-Hernández *et al.*, 2007). Our specimens cannot be identified due to the poorly condition.

***Physaloptera lutzi* Cristofaro, Guimarães and Rodrigues, 1976 (CHIBB 4012-4013)**

Prevalence: one out of 5 specimens was infected with 10 worms.

Temporal distribution: January 2006.

Site of infection: stomach and large intestine.

Type host: *Ameiva ameiva*

Other reported hosts: *Ameiva ameiva, Cnemidophorus abaetensis, C. littoralis, Enyalius bilineatus, Eurolophosaurus nanuzae, Liolaemus alticolor, L. ornatus, L. quilmes, Tropidurus guarani, T. itambere, T. torquatus.*

Locality records: in the Brazilian States of Bahia, Espírito Santo, Minas Gerais, Mato Grosso do Sul, Goiás, Pará, Rio de Janeiro and São Paulo; Argentina; Bolívia; Paraguay.

Remarks: four species of *Physaloptera* have been recognized in the South America (*P. liophis, P. obtusissima, P. lutzi* and *P. retusa*), and identification is based on male caudal morphology and spicules length (see Vicente *et al.*, 1993). *Tropidurus oreadicus* represents a new host record for *P. lutzi*.

References: Ramallo & Díaz (1998); Vicente *et al.* (1993); Van Sluys *et al.* (1994); Van Sluys *et al.* (1997); Vicente (1981); Fontes *et al.* (2003); Cristofaro *et al.* (1976); Bursey & Goldberg (2004); Ribas *et al.* (1998); Ribas *et al.* (1995); Vrcibradic *et al.* (2000); Dias *et al.* (2005); Vrcibradic *et al.* (2007).

***Physaloptera retusa* Rudolphi, 1819 (CHIBB 4014)**

Prevalence: one out of 5 specimens was infected with 1 worm.

Temporal distribution: May 2006.

Site of infection: stomach.

Type host: *Tupinambis teguixin*.

Other reported hosts: *Ameiva ameiva, Amphisbaena alba, Anolis fuscoauratus, Anolis punctatus, Cnemidophorus abaetensis, C. lemniscatus, C. littoralis, C. nativo, C. ocellifer, Enyalius bilineatus, Iguana iguana, Kentropyx altamazonica, K. calcarata, K. pelviceps, Leiosaurus bellii, L. catamarcensis, Liolaemus lutzae, L. neuquensis, Mabuya agilis, M. bistriata, M. dorsivittata, Plica plica, P. umbra, Potamites ecpleopus, Stenocercus*

roseiventris, *Thecadactylus rapicauda*, *Tropidurus guarani*, *T. hispidus*, *T. torquatus*, *T. melanopleurus*, *Tupinambis rufescens*, *T. teguixin*, *Uracentron flaviceps.*
Locality records: in the Brazilian States of Bahia, Espírito Santo, Mato Grosso do Sul, Pará, Rio de Janeiro, and São Paulo; Paraguay; Bolívia; Argentina; Peru; Surinam; Uruguay; Venezuela.
Remarks: see comments under *P. lutzi* above. *Tropidurus oreadicus* represents a new host record for *P. retusa*. Goiás State represents a new locality record.
References: Rocha *et al.* (2003); Vicente (1981); Vicente *et al.* (1993); Goldberg *et al.* (2006); Goldberg *et al.* (2007b); Bursey *et al.* (2005); Noronha *et al.* (2004); Ribas *et al.* (1998); Ribas *et al.* (1995); Goldberg & Bursey (2007); Baylis (1947); Vrcibradic *et al.* (2000); Lent & Freitas (1948); Menezes *et al.* (2004); Prieto (1980); Dias *et al.* (2005); Caballero & Vogelsangi (1947); Roca (1997); Vrcibradic *et al.* (2007).

***Physalopteroides venancioi* Lent, Freitas & Proença, 1946 (CHIBB 4009)**
Prevalence: one out of 5 specimens was infected with 7 worms.
Temporal distribution: May 2006.
Site of infection: stomach.
Remarks: see comments under *Polychrus acutirostris*. *Tropidurus oreadicus* represents a new host record for *P. venancioi*.

***Subulura lacertilia* Vicente, Van-Sluys, Fontes & Kiefer, 2000 (CHIBB 4010, 4013, 4015)**
Prevalence and intensity of infection: three out of 5 specimens was infected with 4, 6 and 17 worms, respectively.
Temporal distribution: May 2006.
Site of infection: large intestine.
Remarks: see comments under *A. nitens brasiliensis*. *Tropidurus oreadicus* represents a new host record for *S. lacertilia*.

Gekkonidae

Hemidactylus mabouia

(Moreau de Jonnès, 1818)

***Parapharyngodon* sp. (CHIBB 4043)**
Prevalence: one out of two specimens collected at Itarumã municipality was infected with 8 worms.

Temporal distribution: September 2008.

Site of infection: large intestine.

Remarks: see comments under *Tropidurus itambere*. According to Ramallo *et al.* (2002), species of *Parapharyngodon* are distinguished based upon male caudal characteristics; besides female reproductive features, such as the location of the ovary. Our specimens have the ovary wrapping around the esophagus, and this separated then to *P. riojensis* and *P. senisfasciecaudus*.

Anguidae

***Ophiodes striatus* Spix, 1824**

***Physaloptera retusa* Rudolphi, 1819 (CHIBB 4031-4032)**

Prevalence: one specimen from the Parque Nacional das Emas was infected with 2 worms.

Temporal distribution: December 2006.

Site of infection: stomach and large intestine.

Type host: *Tupinambis teguixin*.

Remarks: see comments under *Tropidurus oreadicus*. *Ophiodes striatus* represents a new host record for *P. retusa*.

***Subulura lacertilia* Vicente, Van-Sluys, Fontes & Kiefer, 2000 (CHIBB 4032)**

Prevalence: one specimen from the Parque Nacional das Emas was infected with 3 worms.

Temporal distribution: December 2006.

Site of infection: large intestine.

Type host: *Eurolophosaurus nanuzae*

Remarks: see comments and remarks under *Anolis nitens brasiliensis*. *Ophiodes striatus* represents a new host record for *S. lacertilia*.

***Oswaldofilaria* sp. (CHIBB 4030)**

Prevalence: one specimen from the Parque Nacional das Emas was infected with 10 worms.

Temporal distribution: December 2006.

Site of infection: body cavity.

Remarks: five species of *Oswaldofilaria* have been recognized from lizards of South America: *O. azevedoi, O. belemensis, O. brevicaudata, O. petersi* and *O. spinosa.* The species identification is based on spicules shape and length, and male caudal papillae (see Bursey *et*

al., 2005). Our specimens cannot be identified because only females were found. *Ophiodes striatus* represents a new host record for the genus *Oswaldofilaria*.

Teiidae

***Ameiva ameiva* (Linnaeus, 1758)**

Nine specimens were examined; two from Itarumã, one from Barro Alto municipality, two from Silvânia and four from Niquelândia, which results can be found bellow:

***Oochoristica* sp. (CHIBB 4029)**

Prevalence: one out of four specimens from Niquelândia was infected with 3 worms.

Temporal distribution: April 2006.

Site of infection: small intestine.

Remarks: see comments under *Tropidurus oreadicus*.

***Parapharyngodon* sp. (CHIBB 4042)**

Prevalence: one out of two specimens from Itarumã municipality was infected with 2 worms.

Temporal distribution: September 2008.

Site of infection: large intestine.

Remarks: see comments under *Hemidactylus mabouia*.

***Pharyngodon travassosi* Pereira, 1935 (CHIBB 4033, 4038-4039)**

Prevalence: one specimen from Barro Alto municipality was infected with 12 worms. Two specimens from Silvânia were infected with 53 worms (100%; 26.5 ± 16.3).

Temporal distribution: February 2008 and August 2008 from Barro Alto and Silvânia municipalities, respectively.

Site of infection: large intestine.

Type host: *Ameiva ameiva*.

Other reported hosts: none.

Locality records: Paraíba State, Brazil.

Remarks: according to Bursey *et al.* (2008), there are currently 36 species of *Pharyngodon*, that are distinguished on the basis of presence and absence of a spicule, the morphology of the caudal alae, the shape of the egg, presence or absence of spines on tail filaments of adults and distributional patterns. Goiás State represents a new locality recod for *P. travassosi*.

***Physaloptera* sp. (CHIBB 4026-4028)**

Prevalence: one of four specimens from Niquelândia municipality was infected with 21 larvae.

Temporal distribution: April 2006.

Site of infection: stomach, small and large intestine.

Remarks: See comments under *P. lutzi* of *T. oreadicus*. Our specimens cannot be identified because are juveniles.

***Physalopteroides venancioi* Lent, Freitas & Proença, 1946 (CHIBB 4024-4025)**

Prevalence: one of four specimens from Niquelândia municipality was infected with 5 worms.

Temporal distribution: April 2006.

Site of infection: stomach and large intestine

Remarks: see comments under *Polychrus acutirostris*.

***Subulura lacertilia* Vicente, Van-Sluys, Fontes & Kiefer, 2000 (CHIBB 4025, 4038)**

Prevalence: one of four specimens from Niquelândia municipality was infected with 8 worms.

Temporal distribution: April 2006.

Site of infection: large intestine.

Remarks: see comments under *A. n. brasiliensis*. *Ameiva ameiva* represents a new host record for *S. lacertilia*.

Cnemidophorus cf. *parecis* Colli *et al*., 2003

***Subulura lacertilia* Vicente, Van-Sluys, Fontes & Kiefer, 2000 (CHIBB 4018-4019)**

Prevalence and intensity of infection: two out of three specimens from Parque Nacional das Emas were infected with 3 and 4 worms, respectively.

Temporal distribution: October-November 2006.

Site of infection: large intestine.

Remarks: see comments under *A. n. brasiliensis*. *Cnemidophorus* cf. *parecis* represents a new host record for *S. lacertilia*.

Tupinambis merianae (Duméril and Bibron, 1839)

***Cruzia travassosi* Khalil & Vogelsangi, 1932 (CHIBB 4040-4041)**

Prevalence: one specimen from Silvânia was infected with 5 worms.

Temporal distribution: October 2008.

Site of infection: small and large intestine

Type host: *Tolypeutes conurus*

Other reported hosts: *Tupinambis teguixin.*

Locality records: Argentina, Bolivia and Mato Grosso State, Brazil.

Remarks: two species of *Cruzia* have been reported from South American lizards: *Cruzia fulleborni* Khalil and Vogelsang, 1930, and *Cruzia rudolphi* Ruiz, 1947. *Cruzia tentaculata* (Rudolphi, 1819) and *C. travassosi* are described as mammal parasites (Bursey *et al.*, 2007). However, both are also cited as a parasite of *Tupinambis teguixin* Linnaeus, 1758 (Lent and Freitas, 1948, Ruiz, 1947: unpublished thesis, Universidade de São Paulo, Brazil.). According to Bursey *et al.* (2007), species of *Cruzia* are distinguished based upon morphology of the esophagus and male caudal papillae. Goiás State represents a new locality record for *C. travassosi*.

Scincidae

***Mabuya dorsivittata* Cope, 1862**

***Parapharyngodon largitor* Alho & Rodrigues, 1963 (CHIBB 4022-4023)**

Prevalence: two out of three specimens from Parque Nacional das Emas were infected with one worm each.

Temporal distribution: November-December 2006.

Site of infection: large intestine.

Type host: *Hemidactylus mabouia*

Other reported hosts: *Ameiva ameiva, Mabuya agilis*

Locality records: in the Brazilian States of Rio de Janeiro and São Paulo.

Remarks: see comments under *T. itambere*. *Mabuya dorsivittata* represents a new host record for *P. largitor*. Goiás State is a new locality record.

***Mabuya nigropunctata* (Spix, 1825)**

***Oochoristica* sp. (CHIBB 4020)**

Prevalence: one out of three specimens from Niquelândia municipality was infected with 2 worms.

Temporal distribution: August 2006.

Site of infection: small intestine.

Remarks: see comments under *T. oreadicus*. *Mabuya nigropunctata* represents a new host record for the genus *Oochoristica*.

DISCUSSION

There were at least 14 helminth species in studied sample, and among then 13 new host records and 7 new locality records were reported. This enhances the knowledge about helminth parasites of lizards from the Cerrado biome; likewise an update on helminth from Brazilian lizards.

Of the 22 infected specimens (overall prevalence of 31.43%) none harbored more than 3 helminth species. Of the infected ones, 14 (63.6%) harbored only one helminth species, 6 (27.3%) harbored 2 helminth species, and only 2 (9.1%) harbored 3 helminth species. There were 1.45 ± 0.67 helminth species/infected lizard. Hosts that harbored 3 helminth species were the tropidurid *T. oreadicus* and the anguid *O. striatus*. All species of Gymnophtalmidae were uninfected, and this may be due to the small body size in this lizard family. Larger body size could facilitate the establishment of a diverse helminth fauna, by facilitating niche differentiation and habitat segregation by competing species than small hosts (Kuris *et al.*, 1980).

No host species harbored more than 5 helminth species. Of the 11 lizard species infected, 7 (63.7%) harbored only one helminth species, 1 (9.1%) harbored 2 helminth species and 2 (18.2%) harbored five species. The species that harbored 5 helminth species were *A. ameiva* and *Tropidurus oreadicus*. There were 2 ± 1.61 helminth species/host species. Aho (1990) compiled information of 100 populations from nine families of lizards, and Stated that mean total number (± SE) of helminth species per host species were 2.06 ± 0.13, with a range of 0-5. Our findings agree with those from Aho (1990), as well other studies with Neotropical lizard assemblages (Bursey *et al*., 2005; Bursey *et al*., 2007).

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ARTIGO 4

HELMINTHS FROM LIZARDS (REPTILIA: SQUAMATA) AT THE MATO GROSSO STATE, BRAZIL

HELMINTHS FROM LIZARDS (REPTILIA: SQUAMATA) AT THE MATO GROSSO STATE, BRAZIL.

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ABSTRACT

Sixty-three specimens from 17 lizard species (*Ameiva ameiva*, *Bachia bresslaui*, *B. scolecoides*, *Cercosaura ocellata*, *C. schreibersii*, *Gonatodes eladioi*, *Hemidactylus mabouia*, *Hoplocercus spinosus*, *Iguana iguana*, *Kentropyx calcarata*, *Mabuya nigropunctata*, *Plica umbra*, *Potamites ecpleopus*, *Tropidurus guarani*, *T. torquatus*, *Tupinambis merianae*, and *T. teguixin*) captured in three biomes (Amazon, Cerrado and Pantanal) from the State of Mato Grosso, mid-western Brazil were accessed for endoparasites. Six lizard species (*B. bresslaui*, *C. schreibersii*, *G. eladioi*, *K. calcarata*, *P. ecpleopus* and *T. guarani*) mainly from the family Gymnophthalmidae were uninfected. Sixteen nematode species (*Alaeuris vogelsangi*, *Cruzia travassosi*, *Diaphanocephalus galeatus*, *Oswaldocruzia* sp., *Oswaldocruzia vitti*, *Oswaldofilaria sp.*, *Ozolaimus megatyphlon*, *Parapharyngodon sceleratus*, *Physaloptera lutzi*, *P. retusa*, *Physaloptera* sp., *Piratuba digiticauda*, *Rhabdias* sp., *Skrjabinodon heliocostai*, *Spinicauda spinicauda*, and *Strongyluris oscari*), two cestodes (*Oochoristica travassosi* and *O. vanzolinii*), and two digenian trematodes (*Eurytrema* sp. and *Paradistomum parvissimum*) were recovered. Eleven new host records and thirteen new locality records were reported.

Key Words, Parasites, Nematoda, Sauria, Neotropical, South America

INTRODUCTION

The State of Mato Grosso is located at mid-western Brazil and encompasses a territory of 906,807.000 Km^2, which contains considerable lizard diversity across three major biomes: Amazon, Cerrado and Pantanal. The herpetofauna of Mato Grosso is poorly studied, with a lack of basic data, such as species distribution (Strussmann & Carvalho, 1998).

Parasitological studies in Mato Grosso State are even scarcer, being restricted to the survey of Rego & Vicente (1988). With respect of lizards, about nothing is known of helminths associated in this Brazilian State, with available data restricted to the records of the nematodes *Parapharyngodon sceleratus* and *Physaloptera lutzi* from tropidurid lizards of Nova Xavantina (see Vicente *et al*., 1993).

The aim of this study is update the knowledge of helminths parasites of lizards from Mato Grosso State.

MATERIAL AND METHODS

Lizard hosts were captured from ten localities from Mato Grosso State: Cuiabá (15° 35’ S; 56° 05’ W), Cláudia 11° 30’ S; 54° 53’ W), Diamantino (14° 24’ S; 56° 26’ W), Itiquira (17° 12’ S; 54° 09’ W), Nova Ubiratã (12° 59’ S; 55° 15’ W), Guarantã do Norte (09° 47’ S; 54° 54’ W), Poconé (16° 15’ S; 56° 37’ W), Santo Antônio do Leverger (15° 51’ S; 56° 04’ W), Rondonópolis (16° 28’ S; 54° 38’ W) and Sapezal (13° 32’ S; 58°48’ W). Lizards were captured from March 1982 to November 2007 in biological surveys mainly from Environmental Impact Studies and were housed at Coleção Zoológica de Vertebrados da Universidade Federal de Mato Grosso.

The body cavity of each lizard was opened by a longitudinal incision from throat to vent, the gastrointestinal tract was slit longitudinally, and stomach and intestinal contents were removed and examined under a dissection microscope. Helminths found in the gastrointestinal tract, lungs, or body cavity was placed in vials of 70% ethanol for later identification. For species identification, nematodes were cleared in phenol, trematodes and cestodes were stained in carmine and cleared with creosote and were examined under a light microscope. Voucher helminth specimens were deposited in the Coleção Helmintológica do Instituto de Biociências da Unesp de Botucatu (CHIBB). Database about other hosts are restricted to the lizards of South America.

RESULTS

Sixty-three specimens from 17 lizard species were examined for helminths: *Ameiva ameiva* Linnaeus, 1758 (N = 2; SVL = 87.7 ± 42.3 mm); *Bachia bresslaui* (N = 2; SVL = 78.8 ± 6.7 mm); *B. scolecoides* (N = 15; SVL = 67.4 ± 5.2 mm); *Cercosaura ocellata* (N = 1; SVL = 47.7 mm); *C. schreibersii* (N = 1; SVL = 33.5 mm); *Gonatodes eladioi* (N = 2; SVL = 32.2 ± 1.7 mm); *Hemidactylus mabouia* (N = 5; SVL = 60.4 ± 4.5 mm); *Hoplocercus spinosus* (N = 4; SVL = 85.2 ± 13.5 mm); *Iguana iguana* (N = 5; SVL = 243.5 ± 117.3 mm); *Kentropyx calcarata* (N = 1; SVL = 73.4 mm); *Mabuya nigropunctata* (N = 7; SVL = 84.1 ± 13.3 mm); *Plica umbra* (N = 1; SVL = 94 mm); *Potamites ecpleopus* (N = 1; SVL = 55.8 mm); *Tropidurus guarani* (N = 1; SVL = 106.8 mm); *T. torquatus* (N = 12; SVL = 99.4 ± 12.8 mm); *Tupinambis merianae* (N = 2; SVL = 332.5 ± 26.2 mm); and *T. teguixin* (N = 1; SVL = 307 mm). A total of 41,349 helminths of 14 species of nematodes, 2 species of cestodes and 2 species of trematodes were recovered from lizard hosts.

Bachia bresslaui Amaral, 1935, *Cercosaura schreibersii* Wiegmann, 1834, *Gonatodes eladioi* Nascimento, Ávila-Pires & Cunha, 1987, *Kentropyx calcarata* Spix, 1825, *Potamites ecpleopus* Cope, 1875, and *Tropidurus guarani* Cope, 1862 had no endoparasites.

Results by host species can be found as follow:

Iguana iguana Linnaeus, 1758

Five specimens captured in Cuiabá municipality were examined. Cuiabá is located in the Cerrado domain.

***Alaeuris vogelsangi* Lent & Freitas, 1948 (CHIBB 5760 and 2880)**

Prevalence and intensity of infection: two out of 5 hosts infected (40%; 9604.5 ± 5424.2).

Temporal distribution: June 2005 and June 2007.

Site of infection: large intestine.

Type host: *Iguana iguana*.

Other reported hosts: none.

Locality records: in the Brazilian States of Ceará and Pernambuco; Venezuela.

Remarks: according to Boaumer *et al* (2001) the genus *Alaeuris* is composed by 39 species and subspecies. The same authors gave diagnostic characters to differentiate these species, but *A. vogelsangi* are wrongly assigned to the Nearctic realm, instead of Neotropical region. Mato Grosso State is a new locality record for *A. vogelsangi*.

References: Vicente *et al* (1993); Lent & Freitas (1948); Boaumer *et al* (2001); Lopes *et al* (2007).

***Helicotrema* sp. (CHIBB 3346)**

Prevalence and intensity of infection: one out of 5 hosts infected with 1 worm.

Temporal distribution: June 2005.

Site of infection: large intestine.

Remarks: three species of *Helicotrema* are known to be parasite of *Iguana iguana* in Brazil (Travassos *et al*. 1969). Our specimens could not be identified due to the poorly condition.

***Ozolaimus megatyphlon* Rudolphi, 1819 (CHIBB 3131 and 3346)**

Prevalence and intensity of infection: two out of 5 hosts infected (40%; 10934 ± 11390.1).

Temporal distribution: May and June 2005.

Site of infection: large intestine.

Type host: *Iguana iguana*.

Other reported hosts: none.

Locality records: in the Brazilian State of Paraíba; Peru; Venezuela; Colombia; Surinam.

Remarks: Two species of *Ozolaimus* are known to be parasites of Neotropical *Iguana iguana*: *O. cirratus* and *O. megatyphlon*, which can be differentiated by esophagus morphology (see Bursey *et al*. 2007). Mato Grosso State is a new locality record for *O. megatyphlon*.

References: Arrojo (2002); Vicente *et al* (1993); Lent & Freitas (1948); Inglis *et al* (1960), Bursey *et al*. (2007).

Hoplocercidae

***Hoplocercus spinosus* Fitzinger, 1843**

Four specimens captured in April 2007 at Guarantã do Norte municipality were examined. Guarantã do Norte is located at the southern Mato Grosso, in the Amazon domain.

***Spinicauda spinicauda* Olfers, 1819 (CHIBB 3173 and 3175)**

Prevalence and intensity of infection: two of four hosts infected (50%) by seven and two worms.

Temporal distribution: April 2007.

Site of infection: small and large intestine

Type host: *Tupinambis teguixin*.

Other reported hosts: *Ameiva ameiva*.

Locality records: in the Brazilian States of Mato Grosso, Rio de Janeiro and Ceará; Peru; Surinam; Venezuela.

Remarks: *Spinicauda spinicauda* is the only species of the genus occurring in the South America (Baker, 1987). *Hoplocercus spinosus* represents a new host record for *S. spinicauda*.

References: Baylis (1947); Bursey *et al* (2005a); Rodrigues & Feijó (1976); Travassos (1920); Travassos (1923); Baker (1987).

Tropiduridae

***Plica umbra* Linnaeus, 1758**

One specimen from Nova Ubiratã municipality was examined. Nova Ubiratã is located at the northern Mato Grosso, in the Amazon domain.

***Oswaldofilaria* sp. (CHIBB 3233)**

Prevalence and intensity of infection: one specimen was infected with 1 worm.

Temporal distribution: June 2006.

Site of infection: body cavity.

Remarks: actually, five species of *Oswaldofilaria* have been recognized from South American lizards (see Vicente *et al*. 1993). Our specimen could not be identified due to poor condition.

***Physaloptera retusa* Rudolphi, 1819 (CHIBB 3231 and 3234)**

Prevalence and intensity of infection: one specimen was infected with 8 worms.

Temporal distribution: June 2006.

Site of infection: stomach and large intestine.

Type host: *Tupinambis teguixin*.

Other reported hosts: *Ameiva ameiva, Amphisbaena alba, Anolis fuscoauratus, Anolis punctatus, Cnemidophorus abaetensis, C. lemniscatus, C. littoralis, C. nativo, C. ocellifer, Enyalius bilineatus, Iguana iguana, Kentropyx altamazonica, K. calcarata, K. pelviceps, Leiosaurus bellii, L. catamarcensis, Liolaemus lutzae, L. neuquensis, Mabuya agilis, M. bistriata, M. dorsivittata, Plica plica, P. umbra, Potamites ecpleopus, Stenocercus roseiventris, Thecadacytlus rapicauda, Tropidurus guarani, T. hispidus, T. torquatus, T. melanopleurus, Tupinambis rufescens, T. teguixin, Uracentron flaviceps.*

Locality records: in the Brazilian States of Bahia, Espírito Santo, Mato Grosso do Sul, Pará, Rio de Janeiro, and São Paulo; Paraguay; Bolívia; Argentina; Peru; Surinam; Uruguay; Venezuela.

Remarks: actually, four species of *Physaloptera* are known to infect reptiles from South America (*P. liophis*, *P. obtusissima*, *P. lutzi* and *P. retusa*), and identification is based on male caudal morphology and spicules length (see Vicente *et al*., 1993). Mato Grosso represents a new locality record for *P. retusa*.

References: Rocha *et al* (2003); Vicente (1981); Vicente *et al* (1993); Goldberg *et al* (2006); Goldberg *et al* (2007); Bursey *et al* (2005b); Noronha *et al* (2004); Ribas *et al* (1998); Ribas *et al* (1995); Goldberg & Bursey (2007); Baylis (1947); Vrcibradic *et al* (2000); Lent & Freitas (1948); Menezes *et al* (2004); Prieto (1980); Dias *et al* (2005); Caballero & Vogelsangi (1947); Roca (1997); Vrcibradic *et al* (2007).

***Rhabdias* sp. (CHIBB 3232)**

Prevalence and intensity of infection: one specimen was infected with 1 worm.

Temporal distribution: June 2006.

Site of infection: lungs.

Remarks: in South America only *Rhabdias anolis* have been described from lizards (Bursey *et al*. 2003). However, several records of *Rhabdias* spp. are available in the literature; these specimens remain undescribed due to the number and condition (Goldberg *et al*. 2006a), like our specimen.

***Tropidurus torquatus* Wied, 1820**

Twelve specimens captured from June 2005 to February 2007 at Cuiabá municipality were examined. Cuiabá is located at Cerrado domain.

***Oochoristica vanzolinii* Rego & Oliveira-Rodrigues, 1965 (CHIBB 3310)**

Prevalence: one out of 12 specimens was infected with 3 worms.

Temporal distribution: November 2006.

Site of infection: small intestine.

Type host: *Hemidactylus mabouia*.

Other reported hosts: *Eurolophosaurus nanuzae*.

Locality records: in the Brazilian States of Minas Gerais and Rio de Janeiro.

Remarks: according to Guillén-Hernández *et al*. (2007), 13 species of cestodes from the genus *Oochoristica* are known from the Neotropical region, and identification is based on sucker and strobila shapes, and by number of testes and ovarian lobes. Mato Grosso represents a new locality record for *O. vanzolinii*. *Tropidurus torquatus* is a new host record for *O. vanzolinii*.
References: Rego & Rodrigues (1965); Fontes *et al* (2003).

***Parapharyngodon sceleratus* Travassos, 1923 (CHIBB 3203, 3206, 3207, 3209-3211, 3228, 3229, 3307-3309, 3311)**

Prevalence: eleven out of 12 hosts infected (91.7; 3.4 ± 2.2).
Temporal distribution: June 2005 to February 2007.
Site of infection: small and large intestines.
Type host: *Tropidurus torquatus*.
Other reported hosts: *Ameiva ameiva*, *Cnemidophorus littoralis*, *Eurolophosaurus nanuzae*, *Hemidactylus mabouia*, *Kentropyx pelviceps*, *Liolaemus lutzae*, *Mabuya agilis*, *M. bistriata*, *M. caissara*, *M. frenata*, *M. macrorhyncha*, *Microlophus albermalensis*, *T. guarani*, *T. hispidus*, *T. itambere*, *T. semitaeniatus*, *T. torquatus*, *T. melanopleurus* and *Tropidurus* sp.
Locality records: in the Brazilian States of Bahia, Ceará, Espírito Santo, Minas Gerais, Mato Grosso do Sul, Goiás, Pará, Paraíba, Pernambuco, Rio de Janeiro, Rio Grande do Norte, and São Paulo; Bolivia; Paraguay; Peru; Ecuador.
Remarks: Ramallo *et al*. (2002) provide a key to the identification of the 6 species of *Parapharyngodon* infecting South American lizards: *P. alvarengai*, *P. largitor*, *P. riojensis*, *P. sceleratus*, *P. riojensis*, and *P. verrucosus*. Mato Grosso represents a new locality record for *P. sceleratus*.
References: Baker (1987); Rocha & Vrcibradic (2003); Bursey *et al* (2005); Fontes *et al* (2003), Vicente *et al* (1993); Rodrigues & Pinto (1967); Alho & Rodrigues (1973); Vicente (1981); Vrcibradic *et al* (1999); Bursey & Goldberg (2004a); Vrcibradic & Rocha (2005); Ribas *et al* (1998); Ribas *et al* (1995); Anjos *et al* (2005); Van Sluys *et al* (1994); Van Sluys *et al* (1997); Rodrigues (1992); Lopes *et al* (2007); Roca (1997).

***Physaloptera retusa* Rudolphi, 1819 (CHIBB 3229, 3306)**

Prevalence and intensity of infection: two out of 12 specimens were infected with 1 and 2 worms (16.7%, 1.5 ± 0.7).
Temporal distribution: June 2005 and January 2007.
Site of infection: stomach.

Remarks: see comments under *Plica umbra*.

***Strongyluris oscari* Travassos, 1923 (CHIBB 3307)**

Prevalence and intensity of infection: one out of 12 specimens was infected with 1 worm.

Temporal distribution: November 2006.

Site of infection: large intestine.

Type host: *Tropidurus* sp.

Other reported hosts: *Ameiva ameiva, Anolis fuscoauratus, A. punctatus, A. transversalis, Enyalius iheringii, E. perditus, Eurolophosaurus nanuzae, Mabuya agilis, Plica plica, P. umbra, Stenocercus roseiventris, Tropidurus* sp., *T. guarani, T. spinulosus, T. torquatus, T. melanopleurus.*

Locality records: in the Brazilian States of Acre, Amazonas, Bahia, Ceará, Distrito Federal, Espirito Santo, Goiás, Minas Gerais, Mato Grosso do Sul, Pará, Paraíba, Rio de Janeiro, Rondônia, and São Paulo; Argentina; Paraguay; Ecuador; Peru; Bolivia.

Remarks: In 1923, Travassos described *S. oscari* from the intestine of a *Tropidurus* sp. from Mato Grosso. Travassos have concentrated much of your work in the southern part of Mato Grosso, which actually corresponds to the state of Mato Grosso do Sul. Thus, Mato Grosso represents a new locality record for *S. oscari*.

References: Alho (1969); Bursey & Goldberg (2004a); Bursey *et al* (2005); Goldberg *et al* (2006a); Goldberg *et al* (2006b); Fontes *et al* (2003); Kohn *et al* (1973); Ribas *et al* (1998); Sousa *et al* (2007); Sutton *et al* (1998); Vicente (1981); Vrcibradic *et al* (2000); Vrcibradic *et al* (2008); Pereira (1935); Roca (1997).

Gekkonidae

***Hemidactylus mabouia* Moreau de Jonnés, 1818**

Five specimens from two municipalities (Cuiabá and Rondonópolis), both located ate the Cerrado domain were examined.

***Paradistomum parvissimum* Travassos, 1918 (CHIBB 3132)**

Prevalence: one out of 4 hosts from Cuiabá municipality was infected with 5 worms.

Temporal distribution: August 2004.

Site of infection: gall bladder.

Type host: *Tupinambis teguixin, Tropidurus torquatus*

Other reported hosts: *Ameiva ameiva, Hemidactylus mabouia, Liolaemus lutzae, Mabuya agilis, M. macrorhyncha.*

Locality records: in the Brazilian States of Bahia, Espírito Santo, and Rio de Janeiro.

Remarks: according to Travassos *et al* (1969) two species of *Paradistomum* are known to infecting South American lizards: *P. rabusculum* and *P. parvissimum*. Mato Grosso is a new locality record for *P. parvissimum*.

References: Rodrigues *et al* (1990); Vicente (1978); Travassos (1919); Travassos (1944); Rodrigues (1970); Rodrigues (1986); Rodrigues (1992); Vrcibradic *et al*. (2002).

***Parapharyngodon sceleratus* Travassos, 1923 (CHIBB 3085)**

Prevalence: one out of 4 hosts from Cuiabá municipality was infected with 3 worms.

Temporal distribution: March 2007.

Site of infection: large intestine.

Remarks: see remarks on *Tropidurus torquatus*.

***Physaloptera* sp. (CHIBB 3119)**

Prevalence and intensity of infection: one specimen from Rondonópolis was infected with 1 worm.

Temporal distribution: May 2004.

Site of infection: stomach.

Remarks: our specimen could not be identified due to juvenile condition.

Teiidae

Ameiva ameiva

Linnaeus, 1758

Two specimens captured in Cuiabá municipality were examined.

***Piratuba digiticauda* Lent & Freitas, 1941 (CHIBB 2607)**

Prevalence: one out of 2 hosts was infected with 1 worm.

Temporal distribution: March 1984.

Site of infection: large intestine.

Type host: unidentified lizard.

Other reported hosts: *Tropidurus torquatus, Tropidurus guarani, Plica umbra.*

Locality records: in the Brazilian States of Bahia, Mato Grosso do Sul and Pará; Paraguay; Peru.

Remarks: four species of *Piratuba* are known to infect South American lizards: *P. digiticauda*, *P. lainsoni*, *P. scaffi* and *P. shawi* (Vicente *et al*. 1993). These species are separated on basis of microfilariae, but caudal papillae and spicule size are usefull (Bursey *et al*. 2005b). *Ameiva ameiva* is a new host record and Mato Grosso represents a new locality record for *P. digiticauda*,

References: Vicente (1981); Bursey & Goldberg (2004a); Bursey *et al* (2005b); Vicente & Jardim (1980).

***Physaloptera* sp. (CHIBB 2608)**

Prevalence and intensity of infection: one out of two specimens was infected with 1 worm.

Temporal distribution: March 1984.

Site of infection: stomach.

Remarks: our specimen could not be identified due to juvenile condition.

***Spinicauda spinicauda* Olfers, 1819 (CHIBB 2607)**

Prevalence and intensity of infection: one out of 2 hosts infected with 1 worm.

Temporal distribution: March 1984.

Site of infection: large intestine.

Remarks: see comments under *Hoplocercus spinosus*.

Tupinambis merianae

Duméril & Bibron, 1839

Two specimens from Cuiabá municipality were examined.

***Cruzia travassosi* Khalil & Vogelsangi, 1932 (CHIBB 3341)**

Prevalence: one out of 2 hosts was infected with 27 worms.

Temporal distribution: March 2006.

Site of infection: large intestine.

Type host: *Tolypeutes conurus*.

Other reported hosts: *Tupinambis teguixin.*

Locality records: Argentina, Bolivia and Mato Grosso state, Brazil.

Remarks: two species of *Cruzia* have been reported from South American lizards: *Cruzia fulleborni* Khalil and Vogelsang, 1930, and *Cruzia rudolphi* Ruiz, 1947. *Cruzia tentaculata* (Rudolphi, 1819) and *C. travassosi* are described as mammal parasites (Bursey *et al*., 2007). However, both are also cited as a parasite of *Tupinambis teguixin* Linnaeus, 1758 (Lent and Freitas, 1948, Ruiz, 1947: unpublished thesis, Universidade de São Paulo, Brazil.). According to Bursey *et al*. (2007), species of *Cruzia* are distinguished based upon morphology of the esophagus and male caudal papillae. Mato Grosso state represents a new locality record and *T. merianae* is a new host record for *C. travassosi*.

***Diaphanocephalus galeatus* Rudolphi, 1819 (CHIBB 3334 and 3342)**

Prevalence: two hosts were infected (100%; 20 ± 22.6).

Temporal distribution: March 2006 and January 2007.

Site of infection: large intestine.

Type host: *Tupinambis teguixin*.

Other reported hosts: *T. merianae* and *T. rufescens*

Locality records: cited at the Brazilian States of Rio de Janeiro, São Paulo, Mato Grosso do Sul and Rio Grande do Sul; Argentina; Bolivia; Surinam.

Remarks: three species of *Diaphanocephalus* have been recognized: *D. galeatus*, *D. diesingi* Freitas and Lent, 1938 and *D. jacuruxi* Alho, 1965. All records are restricted to the teiid lizards of the subfamily Tupinambinae. Mato Grosso is a new locality record for *D. galeatus*.

References: Freitas and Lent, 1938; Baylis 1947; Spinelli *et al*., 1992; Vicente *et al*., 1993.

***Physaloptera retusa* Rudolphi, 1819 (CHIBB 3332)**

Prevalence and intensity of infection: one out of 2 specimens was infected with 22 worms.

Temporal distribution: January 2007.

Site of infection: stomach.

Remarks: see comments under *Plica umbra*.

***Spinicauda spinicauda* Olfers, 1819 (CHIBB 3333, 3341 and 3342)**

Prevalence and intensity of infection: two hosts were infected (100%; 20.5 ± 24.7).

Temporal distribution: March 2006 and January 2007.

Site of infection: small and large intestine.

Remarks: see comments under *Hoplocercus spinosus*. *Tupinambis merianae* represents a new host record for *S. spinicauda*.

Tupinambis teguixin

Linnaeus, 1758

One specimen from Cuiabá municipality was examined.

***Physaloptera retusa* Rudolphi, 1819 (CHIBB 3337)**

Prevalence and intensity of infection: one specimen was infected with 2 worms.

Temporal distribution: November 1983.

Site of infection: stomach.

Remarks: see comments under *Plica umbra*.

Gymnophthalmidae

Bachia scolecoides

Vanzolini, 1961

Fifteen specimens from four localities of northern and mid-western Mato Grosso were examined: four from Cláudia municipality, four from Guarantã do Norte, three from Nova Ubiratã municipality and four from Sapezal municipality. Individuals from Sapezal municipality are from transition zones between Cerrado and Amazon; previous localities are located in the Amazon domain.

***Physaloptera* sp. (CHIBB 3336)**

Prevalence and intensity of infection: one out of 4 specimens from Guarantã do Norte municipality was infected with 6 worms.

Temporal distribution: March 2003.

Site of infection: stomach.

Remarks: our specimen could not be identified due to juvenile condition. *Bachia scolecoides* represents a new host record for the genus *Physaloptera*.

***Paradistomum parvissimum* Travassos, 1918 (CHIBB 3347)**

Prevalence: one out of 4 hosts from Sapezal municipality was infected with 3 worms.

Temporal distribution: September 2006.

Site of infection: small intestine.

Remarks: see comments under *Hemidactylus mabouia*. *Bachia scolecoides* represents a new host record for *P. parvissimum*.

Cercosaura ocellata

Wagler, 1830

***Oswaldocruzia vitti* Bursey & Goldberg, 2004 (CHIBB 3106)**

Prevalence: one host from Guarantã do Norte municipality was infected with 3 worms.

Temporal distribution: April 2007.

Site of infection: large intestine.

Type host: *Cercosaura eigenmanni*.

Other reported hosts: *Alopoglossus angulatus, A. atriventris, Anolis fuscoauratus, A. punctatus, Cercosaura oshaugnessyi*.

Locality records: in the Brazilian States of Acre, Amazonas, Pará,and Rondônia; Ecuador; Peru.

Remarks: numerous species of *Oswaldocruzia* have been described from South American lizards in the past few years, with many remain still undescribed. Species differentiation is based mainly on spicule shape and size, as well by the number of cuticular ridges (Durette-Desset *et al*. 2006). *Cercosaura ocellata* is a new host record, and Mato Grosso represents a new locality record for *O. vitti.*

References: Bursey & Goldberg (2004b); Goldberg *et al* (2006a, b); Goldberg *et al* (2007); Bursey *et al* (2005b).

Scincidae

Mabuya nigropunctata

Spix, 1825

Seven specimens from three localities were examined: four from Guarantã do Norte municipality, 2 from Nova Ubiratã municipality, both from Amazon domain. Finally, one specimen from Cáceres municipality at the Pantanal was examined.

***Oochoristica travassosi* Rego & Ibañez, 1965 (CHIBB 3322 and 3325)**

Prevalence: two hosts from Guarantã do Norte municipality were infected with 1 and 6 worms, respectively.

Temporal distribution: April 2007.

Site of infection: small intestine.

Type host: *Leiocephalus* sp.

Other reported hosts: *Liolaemus vallecurensis.*

Locality records: Argentina; Peru.
Remarks: see comments on *Tropidurus torquatus*. *Mabuya nigropunctata* is a new host record and Brazil is a new country record for *O. travassosi*.
References: Rego & Ibañez (1965); Goldberg *et al* (2004).

***Oswaldocruzia* sp. (CHIBB 3321, 3327-3329)**
Prevalence: three out of four hosts from Guarantã do Norte municipality were infected with 1, 1 and 2 worms, respectively.
Temporal distribution: April 2007.
Site of infection: small and large intestine.
Remarks: see comments on *Cercosaura ocellata*. Our specimens could represent a new species, but more detailed studies are necessary.

Physaloptera lutzi Cristofaro, Guimarães and Rodrigues, 1976 **(CHIBB 3326 and 3327)**
Prevalence: one out of 4 hosts from Guarantã do Norte municipality was infected with 2 worms.
Temporal distribution: April 2007.
Site of infection: stomach and large intestine.
Type host: *Ameiva ameiva*
Other reported hosts: *Cnemidophorus abaetensis, C. littoralis, Enyalius bilineatus, Eurolophosaurus nanuzae, Liolaemus alticolor, L. ornatus, L. quilmes, Tropidurus guarani, T. itambere, T. torquatus.*
Locality records: in the Brazilian States of Bahia, Espírito Santo, Minas Gerais, Mato Grosso, Mato Grosso do Sul, Pará, Rio de Janeiro, São Paulo; Argentina; Bolívia; Paraguay.
Remarks: see comments under *Plica umbra*. *Mabuya nigropunctata* represents a new host record for *P. lutzi*.
References: Ramallo & Díaz (1998); Vicente *et al* (1993); Van Sluys *et al* (1994); Van Sluys *et al* (1997); Vicente (1981); Fontes *et al* (2003); Cristofaro *et al* (1976); Bursey & Goldberg (2004a); Ribas *et al* (1998); Ribas *et al* (1995); Vrcibradic *et al* (2000); Diaz *et al* (2005); Vrcibradic *et al* (2007).

***Physaloptera retusa* Rudolphi, 1819 (CHIBB 3337)**
Prevalence and intensity of infection: five out of seven specimens were infected (71.4%; 5.4 ± 2.2); of these, the specimen from Porto Jofre were uninfected, the two individuals of Nova

Ubiratã were infected with 7 worms each and three out of 4 specimens from Guarantã do Norte were infected.
Temporal distribution: June-July 2006 and April 2007.
Site of infection: stomach.
Remarks: see comments under *Plica umbra*. *Mabuya nigropunctata* is a new host record for *P. retusa*.

Skrjabinodon heliocostai Vicente, Vrcibradic, Muniz-Pereira & Pinto, 2000 **(CHIBB 3324)**
Prevalence: one out of 4 hosts from Guarantã do Norte municipality was infected with 1 worm.
Temporal distribution: April 2007.
Site of infection: small intestine.
Type host: *Mabuya frenata*.
Other reported hosts: none.
Locality records: State of São Paulo, Brazil.
Remarks: seven species of *Skrjabinodon* are currently recognized in Neotropical region: *S. caudolumarius*, *S. crassicauda*, *S. cricosaurae*, *S. dixoni*, *S. heliocostai*, *S. spinulosus* and *S. scelopori*. Species differentiation is based mainly on morphology and number of spines on tail filament (Bursey and Goldberg, 2007). *Mabuya nigropunctata* represents a new host record, and Mato Grosso is a new locality record for *S. heliocostai*.
References: Vicente *et al*. (2000).

DISCUSSION

Our study represents an update of 13 new locality records and 11 new host records. In despite of the recently increase of studies with helminths from Brazilian lizards, this study enhance the knowledge in a poorly studied region and, moreover, across three biomes from South America.

The overall prevalence of helminths in lizards from Mato Grosso was 52.4%, and maximum number of helminth species per individual lizard was three. Of the infected ones (33), 24% harbored 3 helminth species, 12.2% harbored 2 helminth species and the majority (63.3%) harbored only one species of helminth. There were 1.6 ± 0.9 helminth species/infected lizard. Lizard species that harbored 3 helminth species were the iguanid *Iguana iguana*, the tropidurids *Plica umbra* and *Tropidurus torquatus*, the scincid *Mabuya nigropunctata* and the teiids *Ameiva ameiva* and *Tupinambis merianae*. According to Aho

(1990) foraging mode have a deep impact on the establishment of associated helminth fauna in amphibians and reptiles, with active foragers having a richer fauna. In our study, the lizards harboring three helminth species, i.e., the iguanids and tropidurids were sit-and-wait foragers and the teiids are active foragers. The foraging mode of scincids are not well established, but both foraging modes could occur (Cooper & Whiting, 2000). Thus, our data do not agree with those from Aho (1990), likewise the study of Ribas *et al*. (1998) from coastal sand dunes from Brazil where tropidurids shows a higher diversity than active foragers.

Moreover, body size could constrain the establishment of richer helminth fauna in lizards, acting as real islands (Kuris *et al*, 1980). This relationship has been observed in several studies (Rocha *et al*. 2003; Fontes *et al*. 2003; Anjos *et al*. 2005). In the present study, the majority of species from the family Gymnophtalmidae plus the small sphaerodactylid *Gonatodes eladioi* showed no endoparasites; even infected gymnophthalmids (e.g. *Bachia scolecoides* and *Cercosaura ocellata*) presented only one helminth species/host.

The maximum number of helminth species/host species was 5, in the scincid *Mabuya nigropunctata*. The tropidurid *Tropidurus torquatus* and the teiid *Tupinambis merianae* have 4 helminth species, followed by *Plica umbra*, *Iguana iguana* and *Ameiva ameiva* with 3 helminth species. *Bachia scolecoides* presented two helminth species and the remaining (*Cercosaura ocellata* and *Hoplocercus spinosus*) have only one helminth species. There were 2.7 ± 1.3 helminth species/host species, a number slightly higher than those from Aho (1990), who found a mean 2.06 ± 0.13. Beyond the study of Aho (1990), our findings agree with those from other Neotropical lizard assemblages (see Bursey *et al*. 2005b; Bursey *et al*. 2007).

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ARTIGO 5

HELMINTHS OF THE TEIID LIZARD *KENTROPYX CALCARATA* (SQUAMATA) FROM AN AMAZONIAN SITE IN WESTERN BRAZIL

Helminths of the teiid lizard *Kentropyx calcarata* (Squamata) from an Amazonian site in western Brazil.

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ABSTRACT

Although constitute conspicuous elements on neotropical lizards communities, the life history aspects of many teiid lizards species are poorly known, specially endoparasites infecting the genus *Kentropyx*. We studied seven specimens of *K. calcarata* collected in an Amazonian site at Mato Grosso state, Central Brazil in 2007. Four species of helminth were recovered: *Oswaldocruzia* sp., *Piratuba digiticauda*, *Physaloptera retusa*, and *Physalopteroides venancioi*. *Piratuba digiticauda*, a body cavity parasite, presented a highest prevalence (42.9%), whereas the stomach parasites *P. venancioi* and *P. retusa* presented the highest intensity of infection and abundance, respectively. Moreover, *Oswaldocruzia* sp., *P. digiticauda* and *P. venancioi* were first reported for *K. calcarata* and new locality records for all nematodes were assigned.

INTRODUCTION

South American lizards of the family Teiidae are conspicuous members of the major biomes, occurring in a wide variety of habitats (Pianka and Vitt 2003). Although several aspects of many teiids have been studied in the past few years, such as reproduction, activity, diet and parasitism (Vitt 1991, Vitt and Colli 1994), there is a lack of knowledge in some genera (e. g. *Tupinambis*, *Dracaena* and *Kentropyx*). To our knowledge, the only records of helminths infecting *Kentropyx* species are those from *K. altamazonica* and *K. pelviceps* in Amazonian Peru (Bursey *et al.* 2005) and *K. calcarata* from the Pará state, in the Brazilian Amazon (see Vicente *et al.* 1993, Goldberg *et al.* 2007).

Kentropyx calcarata is a teiid lizard commonly found in open habitats and forest edge throughout the central and eastern Amazonia, in Guyana, French Guiana, Suriname and six states of Amazonian Brazil (Ávila-Pires 1995). Studies with helminths of a widespread host along their geographical distribution are important to highlight the importance of habitat types and biogeographical patterns of the parasites (Aho 1990, Rocha *et al.* 2003). Thus, the purpose of this article is to present data on the helminths of *K. calcarata* from the southern Amazon, Mato Grosso state, Brazil and compare the helminth fauna of this population with those of other populations and congenerics with available data.

MATERIALS AND METHODS

Lizards (n = 7) were collected by hand or pitfall traps in August 2007 in a tropical rain forest (Amazon) of Juara municipality (57º38`W, 10º25`S, datum: SAD69), Mato Grosso State, Brazil. The hosts were euthanatized with a lethal injection of sodium Tiopental, fixed in 10% formalin and stored in 70% alcohol. Lizards were deposited in the Coleção Zoológica de Vertebrados da Universidade Federal de Mato Grosso (UFMT 6876, 5982, 6562, 5986, 6761, 5985, 6003).

Subsequently lizards were necropsied and lungs, body cavity, and digestive tract were surveyed under a stereomicroscope for endoparasites. Helminths were cleared in phenol, identified and deposited in the Coleção Helmintológica do Instituto de Biociências da Universidade Estadual Paulista Júlio de Mesquita Filho, Instituto de Biociências de Botucatu, São Paulo State, Brazil, under the acronym CHIBB (2647-2653 and 3044).

Prevalence was calculated as infected lizards/examined lizards x 100, mean intensity of infection as arithmetic mean number of worms from infected lizards and mean abundance as total number of a particular parasite divided by total number of hosts (both infected and uninfected hosts) (Bush *et al.* 1997). Means are ± 1 standard deviation.

RESULTS

From the seven specimens of *K. calcarata* examined, 57.1% were found to harbour nematodes (Table 1). Seventeen helminths of four nematode species were recovered and were identified as *Oswaldocruzia* sp., *Piratuba digiticauda*, *Physaloptera retusa*, and *Physalopteroides venancioi*. Nematode cysts were also found in the lungs of one specimen. Of these, the body cavity parasite *P. digiticauda* presented the higher prevalence (42.9%), followed by the intestinal and stomach parasites, *Oswaldocruzia* sp. and *Physaloptera retusa* respectively, which has the same prevalence (28.6%). The species of the highest intensity of infection was the stomach parasite *P. venancioi*, and the highest abundance was shown by *P. retusa*. Three lizards (42.9%) had no parasites, one presented just one parasite species, two harbour two parasite species and one was infected by three parasite species (Table 1).

DISCUSSION

Aside from our small sample size, the helminth richness found in *K. calcarata* in the Mato Grosso state was higher than those reported for other congeneric populations (Table 2). Reports on endoparasites of *Kentropyx* species are scarce and restricted to the Pará State and Departamento Madre de Dios, Cuzco Amazonico in Peru (Baker 1982, Baker 1987, Bursey *et al.* 2005; Goldberg *et al.* 2007; Vicente *et al.* 1993). Thus, Mato Grosso state represents a new locality record for all the nematodes found and *K. calcarata* represents a new host record for *Oswaldocruzia* sp., *P. digiticauda* and *P. venancioi*.

The stomach parasites *P. retusa* and *P. venancioi* were widely recorded in South America in a wide variety of reptilian and amphibian hosts (see Bursey *et al.* 2007). On the other hand, the body cavity parasite *P. digiticauda* was recorded only in sit-and-wait foragers lizard hosts (Bursey and Goldberg 2004), thus is the first record of *P. digiticauda* in an active foraging lizard. In the present study we did not find *Kentropyxia sauria*, which is recorded only in *K. calcarata* in the Pará state. Another Molineidae nematode was found infecting *K. calcarata* in the Mato Grosso state: *Oswaldocruzia* sp. Differences in helminth communities in different populations of *K. calcarata* along their geographical range may be the result of changes in habitat characteristics and biological features of hosts, as noted by Rocha *et al.* (2003) in the scincid *Mabuya* species

Moreover, the small sample size may be responsible for the low helminth richness found in the genus *Kentropyx*, because large sample size enhances the possibility of recording rare and accidental helminth species (Rocha *et al.* 2003). Also, all reports on *Kentroyx*

endoparasites come from Amazonian sites and more helminth species would be recorded in other species inhabiting different habitats, such as the Cerrado and Pantanal in central Brazil.

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Table 1 – Epidemiological data for seven *Kentropyx calcarata* and their nematode parasites at the Rain forest of Juara municipality, Mato Grosso State, Brazil. For each nematode the total number (N), prevalence, intensity of infection (mean ± one standard deviation), mean abundance and the sites of infection are given. Abbreviations are: LI = Larger intestine, SI = Small intestine, BC = Body cavity and ST = Stomach.

Parasite species	**N**	**Prevalence (%)**	**Intensity of Infection**	**Mean Abundance**	**Site of Infection**
Oswaldocruzia sp.	2	28.6	1	0.3	LI, SI
Piratuba digiticauda	5	42.9	1.3 ± 0.6	0.6	BC
Physaloptera retusa	6	28.6	3 ± 2.8	0.9	ST
Physalopteroides venancioi	4	14.3	4	0.6	ST

Table 2 – Comparison of helminths in different species and populations of *Kentropyx*.

Host species	**N**	**Helminth composition**	**Locality**	**Source**
K. altamazonica	11	*Physaloptera retusa*	Cuzco, Peru	Bursey *et al.* 2005
		Physalopteroides venancioi		
K. calcarata	7	*Oswaldocruzia* sp.	Juara, Mato Grosso, Brazil	This study
		Piratuba digiticauda		
		Physaloptera retusa		
		Physalopteroides venancioi		
K. calcarata		*Piratuba shawi*	Belém, Pará, Brazil	Baker 1982, Baker 1987
		Kentropyxia sauria		
K. calcarata	17	*Kentropyxia sauria*	Novo Progresso, Pará, Brazil	Goldberg *et al.* 2007
		Physaloptera retusa		
K. pelviceps	15	*Ophiotaenia flava*	Cuzco, Peru	Bursey *et al.* 2005
		Dujardinascaris sp.		
		Parapharyngodon sceleratus		
		Physaloptera retusa		
		Physalopteroides venancioi		

PARTE 3

RELAÇÕES ECOLÓGICAS EM COMUNIDADES DE LAGARTOS DO BRASIL CENTRAL

ARTIGO 6

HELMINTHS OF LIZARDS FROM PANTANAL, BRAZIL

HELMINTHS OF LIZARDS FROM PANTANAL, BRAZIL

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ABSTRACT

Two hundred-twenty seven specimens from 27 lizard species from four localities at the Pantanal, western Brazil were examined for helminths. Twenty-four species of helminths were recovered from the lizard hosts, with 45 new host records, 12 new State records and 3 new country records reported. *Physalopteroides venancioi* infected the higher number of hosts, and the majority of species infected only one host species. Scincids, teiids and tropidurids, three families with different foraging modes, had the highest helminth diversity. Lizard body sizes were correlated with both total number of helminths and helminth richness. Similarities within communities are generally higher between species not closely phyllogenetically, and between communities the different populations of lizard species are more similar, rather than sympatric species.

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INTRODUCTION

Although studies of helminths infecting lizards have recently increased in Brazil (Vrcibradic *et al*. 2008; Goldberg *et al*., 2007), ecological relationships about lizards and their parasites is poorly investigated (Vrcibradic *et al*., 1999). The best studies dealing with host/parasites relation in lizards come from coastal sand dunes from southeastern Brazil (Vrcibradic *et al*., 2000; 2002).

In the present study, we survey the helminth community associated with lizards of the Pantanal, a huge, low-lying floodplain covering an area of some 140.000 km^2 in the western part of Brazil (Ratter *et al.*, 1988). Studies with helminth fauna of lizards from the Pantanal consist basically of faunal lists in few localities, such as Poconé (Travassos, 1928) and Miranda (Travassos & Freitas, 1942, 1943; Freitas, 1940; Vicente, 1981). Since no detailed ecological studies have yet been conducted in Pantanal, we address the following questions: 1) What helminth species are associated with each lizard species? 2) What are the prevalence and intensity of infection intensities for each host species? 3) Are similarities between parasites diversity more related to geographic or phyllogenetic patterns?

MATERIALS AND METHODS

Specimens (n = 221) of 27 lizard species collected in four localities of the Pantanal were used in this study: in the region of Corumbá (19º04'S, 57º29'W), from August 1998 to January 2004; in the Miranda region, at Base de Estudos do Pantanal da Universidade Federal de Mato Grosso do Sul (19º34'S, 57º00'W), Nhecolândia region, from August 2002 to March 2006; and the Poconé region, from May 1989 to September 2003. Habitats of all areas are characterized in Ratter *et al*. (1988). In the latter, host lizards were housed at Coleção de Vertebrados da Universidade Federal de Mato Grosso (UFMT) and the previous localities housed in both Coleção Zoológica de Referência do Campus de Corumbá (CEUCH) and the Coleção de Vertebrados da Universidade Federal de Mato Grosso do Sul (ZUFMS).

Lizards were captured by hand or by pitfall-traps during biological surveys, euthanized, fixed in 10% formalin, preserved in 70% ethanol. For each lizard, we took the snout-vent length (SVL) with digital calipers.

The body cavity of each lizard was opened by a longitudinal incision from throat to vent, the gastrointestinal tract was slit longitudinally, and stomach and intestinal contents were removed and examined with a dissection microscope. Helminths found in the gastrointestinal tract, lungs, or body cavity was placed in vials of 70% ethanol for later identification. For species identification, nematodes and acanthocephalans were cleared in

phenol, trematodes and cestodes were stained in carmine cleared with creosote, and were examined under a light microscope. Voucher specimens were deposited in the Coleção Helmintológica do Instituto de Biociências da Unesp de Botucatu.

Ecological terms used throughout the text follows Bush *et al*. (1997). Relations of lizard SVL and intensity of infection were tested using a linear regression. The diversity of the nematode fauna associated with each host species was estimated using the Brillouin's Diversity Index (Magurran, 1988), considering only parasitized individuals. For evaluate the effect of lizards body size, we made a Pearson correlation between lizard SVL and both the total number of parasites and number of helminth species for each lizard host. Differences in overall prevalence between areas were tested using the Z-test for proportions and for differences in diversity between areas we performed an ANOVA (Zar, 1984). For avoid comparisons between specimens collected in different areas and seasons, we performed between-species similarities in nematode community composition using Jaccard index for qualitative data only. To evaluate the similarity between areas qualitative data were subjected to UPGMA cluster analysis, using the Sorensen's coefficient of MVSP version 3.1 (Kovach Computing Services 2006).

RESULTS

A total of 2136 helminths from twenty-four species were recovered from the lizards. The species of Acanthocephala and the Trematoda could not be identified, due to damaged state. Other individuals were identified as nematode, Cosmocercidae, Centrorhynchidae and *Physaloptera* sp. could not be assigned to genus/species due to their young state. *Parapharyngodon* sp. has not males in the sample, necessary for species level identification due to caudal papillae pattern and spicule size. *Rhabdias* sp. and *Oswaldocruzia* sp. are in revision and may constitute new species.

Only the nematode *Physalopteroides venancioi* were found to infecting eleven host species, followed by the cestode *Oochoristica vanzolini*, and the nematodes *Physaloptera retusa* and *Parapharyngodon* sp. (five hosts each). In the other hand, twelve species were found infecting only one host species (Table 1).

The overall prevalence was 53.85%, being 54.17% in Corumbá, 72.55% in Miranda, 46.51% in Nhecolândia and 41.82% in Poconé. The highest prevalence noted in the Miranda region were different from Corumbá ($Z = 3.12$, $P = 0.02$) and Nhecolândia ($Z = 2.64$, $P = 0.008$), but not from Poconé ($Z = 1.57$, $P = 0.11$). The Poconé region were different from

Corumbá (Z = 3.12, P = 0.02), but not from Nhecolândia (Z = 1.15, P = 0.248). Finally, Corumbá and Nhecolândia had no differences (Z = -1.39, P = 0.164).

Total number of parasites were correlated with lizard SVL (r = 0.66, P < 0.001), as well helminth richness (r=0.56 P<0.001).

One individual of *Mabuya nigropunctata* were found harboring 5 helminth species, and other three individual lizards (2 *Tupinambis merianae* and 1 *M. nigropunctata*) harbored four helminth species. On the other hand, 7.7% of the infected individual hosts harbored three, 15.82% harbored two and 28.5% harbored only one helminth species. The scincid *M. nigropunctata* had the highest diversity in Corumbá, followed by the teiids *Ameiva ameiva* and *Teius teyou* (Table 2), while in Miranda, the tropidurid *T. guarani* showed the highest diversity followed by the teiid *A. ameiva* (Table 3).The teiid *Tupinambis merianae* showed the highest diversity in two areas: Nhecolândia and Poconé, also followed by other teiids and tropidurids (Table 4 and 5). In despite of species differentiation, there no difference in overall diversity between areas (Nhecolândia x Poconé: $F_{1,16}$ = 0.51, P = 0,48; Nhecolândia x Corumbá: $F_{1,16}$ = 0.06, P = 0,81; Nhecolândia x Miranda: $F_{1,12}$ = 0.31, P = 0,58; Poconé x Corumbá: $F_{1,20}$ = 0.25, P = 0,62; Poconé x Miranda: $F_{1,16}$ = 0.02, P = 0,89; Miranda e Corumbá: $F_{1,16}$ = 0.11, P = 0,74).

Within communities, the similarities were higher between species that belong to the same family only at Corumbá, where *Teius teyou* x *Ameiva ameiva* and *Tropidurus spinulosus* and *Stenocercus caducus* are more similar (Table 2). In the other localities, similarity between species was higher between species that are not phylogenetic closest (Tables 3-5). Similarities between the same species from different areas were higher than the similarity between species from the same areas, as showed by the Figure 2. However, pairs of species can be found in the same analysis.

DISCUSSION

Despite of our small sample size for many lizard species, the present study gives an important contribution for the knowledge of helminth parasites of lizards from Brazil. Thus, 45 new hosts, 12 new State and 3 new country records are reported.

Both the overall prevalence and local prevalence can be considered similar to other Neotropical lizard assemblages. In a parasitological study in Panama, Bursey *et al*. (2007) found an overall prevalence of 82%, while 51% were found in Cuzco amazónico (Bursey *et al*. 2005).

Reptiles have a depauperate helminth fauna, when compared with other classes of vertebrates (Aho, 1990). In the same study, the author compiled information of 100 populations from nine families of lizards, and stated that mean total number (± SE) of helminth species per host species were 2.06 ± 0.13, with a range of 0-5. Our findings agree with those from Aho (1990), although many studies have indicated higher values for Neotropical assemblages, such as Cuzco Amazónico (Bursey *et al*. 2005) and coastal sand dunes of Brazil (Vrcibradic *et al*. 2000).

According to Aho (1990), wide foraging lizards tend to harbor higher helminth diversity than sit-and-wait foragers. This is true in two areas in the present study (Poconé and Nhecolândia), where *T. merianae* had the highest diversity. However, in Corumbá a scincid lizard had the highest diversity and in Miranda the tropidurid *T. guarani* showed more helminth species. Studies in the coastal sand dunes from Brazil reported higher helminth diversity in sit-and-wait tropidurid lizards (Ribas *et al*. 1998), and the foraging mode of scincids are not well established, were both foraging modes could occur (Cooper & Whiting, 2000). Differences in diet in both scincids and tropidurids from other lizards within the community could enhance the helminth diversity, because as the two types of foraging mode could occur and this could facilitate the infection by helminths that occur in both active and sit-and-wait lizards. In the case of tropidurids, the ingestion of plant matter for many species (Van Sluys *et al*. 2004; Ávila *et al*. 2008; Rocha & Siqueira, 2008), could increase the helminth richness, as shown by many studies (see Aho, 1990; Roca, 1999; Roca *et al*. 2005).

Moreover lizard body size may act in helminth diversity independently from foraging mode, because the gymnophthalmids harbor a lesser diversity in all studied areas, and the species that had highest diversities are heavy bodied. The effect of lizard body size on parasite diversity and abundance is largely reported from many species (Rocha *et al*. 2003; Anjos *et al*. 2005; Fontes *et al*. 2003). This could be explained by the island biogeography theory of MacArthur & Wilson (1967), because sites on larger hosts may facilitate niche differentiation and habitat segregation by competing parasite species more so than corresponding sites on small hosts (see Kuris *et al*. 1980).

The similarities between species across areas were higher than similarity of species from the same areas. Aho (1990) stated that regional and local richness of helminths in reptile communities are closely linked, but that ecological factors and habitat availability are responsible for many differences observed.

In conclusion, the results of the present study agree with the patterns cited in Aho (1990), mainly for values of helminth richness and general patterns, although other features,

such as the importance of lizard body size and ecological factors should be better investigated.

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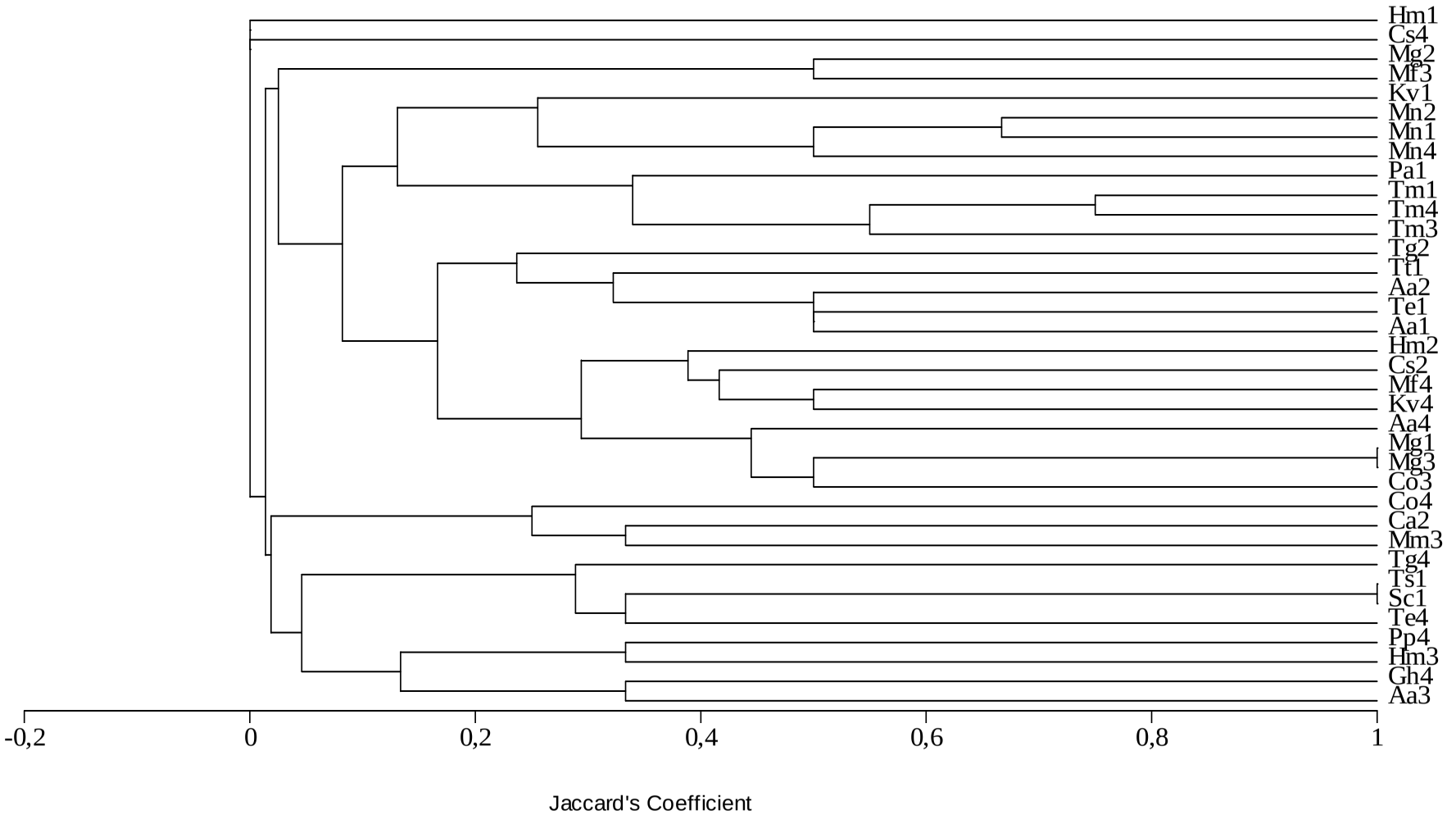

FIGURE 1.Cluster analysis of similarities in helminth community composition of lizards from four areas from the Pantanal, Brazil. 1 = Corumbá, 2 = Miranda, 3 = Nhecolândia, 4 = Poconé.

Table 1 – Epidemiological data from lizards (N = number of lizards examined) and their respectives parasites in four regions of the Pantanal, Brazil. For each host species the prevalence (P), intensitiy of infection (mean ± sd) and sites of infection of each nematode are given. Abbreviations for sites of infection are: BC = Body cavity, S = Stomach, LI = Large intestine, SI = Small intestine, L = Lungs. The symbols capitalized are: [a]=new host record, [b]=new state record, [c]=new country record

HOST	PARASITES	CORUMBÁ			MIRANDA			NHECOLÂNDIA			POCONÉ			SITE
		N	P	I	N	P	I	N	P	I	N	P	I	
IGUANIDAE														
Iguana iguana	Not parasitized	-	-	-	3	-	-	-	-	-	-	-	-	
POLYCHROTIDAE														
Anolis cf. meridionalis	Not parasitized	-	-	-	-	-	-	-	-	-	5	-	-	
Polychrus acutirostris	*Allopharynx daileyi* [a, b]	5	40	19±21.2	-	-	-	-	-	-	-	-	-	SI
	Cruzia travassosi [a]		40	1		-	-		-	-		-	-	SI, LI
	Parapharyngodon largitor [a, b]		20	1		-	-		-	-		-	-	LI
	Physaloptera retusa [a]		60	42±32.1		-	-		-	-		-	-	S
TROPIDURIDAE														
Stenocercus caducus	*Strongyluris oscari* [a]	9	11.1	4	-	-	-	-	-	-	2	-	-	LI
Tropidurus etheridgei	*Oochoristica vanzolini* [a, b]	13	-	-	-	-	-	-	-	-	5	60	3.3±4	SI
	Parapharyngodon riojensis [a, b, c]		15.4	1.5±0.7		-	-		-	-		-	-	LI
	Parapharyngodon sp.		-	-		-	-		-	-		20	2	LI
	Physaloptera retusa [a]		23.1	1		-	-		-	-		-	-	S
	Physalopteroides venancioi [a, b]		7.7	1		-	-		-	-		-	-	S
	Strongyluris oscari [a]		-	-		-	-		-	-		40	4.5±4.9	LI
Tropidurus gr. torquatus	Not parasitized	-	-	-	-	-	-	2	-	-	-	-	-	
Tropidurus guarani	Nematode cysts	-	-	-	19	10.5	-	-	-	-	1	-	-	BC
	Oswaldocruzia sp. [a]		-	-		10.5	1		-	-		-	-	SI
	Parapharyngodon riojensis [a]		-	-		26.3	2.2±2.7		-	-		-	-	LI

	P. sceleratus		-	-		-	-		-	-		100	2	LI
	Physaloptera sp. (larvae)		-	-		10.5	8		-	-		-	-	S
	Physalopteroides venancioi [a]		-	-		10.5	1		-	-		-	-	S
	Strongyluris oscari		-	-		89.5	5.5±4.5		-	-		100	3	SI, LI
	Skrjabinellazia intermedia		-	-		15.8	25±40.1		-	-		100	9	S, SI
Tropidurus spinulosus	*Strongyluris oscari* [a]	2	50	5	-	-	-	-	-	-	-	-	-	LI
GEKKONIDAE														
Hemidactylus mabouia	*Parapharyngodon alvarengai* [a, b]	3	33.3	3	7	-	-	1	-	-	-	-	-	LI
	P. largitor		-	-		28.6	2		-	-		-	-	LI
	Physalopteroides venancioi [a]		-	-		28.6	1		-	-		-	-	S
	Spauligodon oxkutzcabiensis [a, b]		-	-		-	-		100	4		-	-	LI
PHYLLODACTYLIDAE														
Phyllopezus pollicaris	*Parapharyngodon* sp. [a]	1	-	-	-	-	-	-	-	-	5	20	7	LI
	Physaloptera sp. (larvae) [a]		-	-		-	-		-	-		20	2	S
	Spauligodon oxkutzcabiensis [a]		-	-		-	-		-	-		20	15	LI
SPHAERODACTYLIDAE														
Coleodactylus brachystoma	Not parasitized	-	-	-	-	-	-	-	-	-	5	-	-	
Gonatodes hasemani	Not parasitized	-	-	-	-	-	-	-	-	-	2	-	-	
Gonatodes humeralis	*Parapharyngodon* sp. [a]	4	-	-	-	-	-	-	-	-	2	50	1	LI
TEIIDAE														
Ameiva ameiva	*Oochoristica ameivae* [b]	8	37.5	3±2.7	10	20	1.5±0.7	2	50	7	6	-	-	SI
	O. vanzolini [a, b]		-	-		-	-		-	-		16.7	1	SI
	Parapharyngodon riojensis [a]		62.5	4.8±4.8		50	3±3.6		-	-		-	-	LI
	P. senisfasciecaudus [a]		-	-		-	-		-	-		50	2.3±2.3	LI
	Parapharyngodon sp.		-	-		-	-		50	1		-	-	LI

	Physaloptera retusa		37.5	3±2.7		-	-		-	-		-	-	S, SI
	Physalopteroides venancioi		-	-		30	1		-	-		16.7	2	S
	Spinicauda spinicauda		-	-		-	-		-	-		16.7	1	LI
	Nematode cysts		-	-		10	-		-	-		-	-	BC
	Centrorhynchidae larvae		-	-		-	-		50	1		-	-	BC
Cnemidophorus ocellifer	*Oochoristica vanzolini* [a]	-	-	-	-	-	-	14	35.7	5.2±2.4	7	-	-	SI
	Nematode larvae		-	-		-	-		-	-		14.3	1	LI
	Parapharyngodon sp.		-	-		-	-		7.1	1		-	-	LI
	Pharyngodon cesarpintoi [a, b]		-	-		-	-		7.1	25		28.6	32.5±2.1	LI
	Physaloptera sp.		-	-		-	-		-	-		14.3	1	S
	Physalopteroides venancioi [a]		-	-		-	-		7.1	2		-	-	S
Dracaena paraguayensis	Not parasitized	1	-	-	-	-	-	-	-	-	-	-	-	
Kentropyx aff. *viridistriga*	*Oswaldocruzia* sp. [a]	1	100	1	1	-	-	-	-	-	5	20	1	SI
	Physalopteroides venancioi [a]		-	-	-	-	-	-	-	-		20	1	S
	Trematoda not identified		100	4		-	-	-	-	-		-	-	SI
Teius teyou	Acanthocephala not identified	9	11.1	2	-	-	-	-	-	-	-	-	-	SI
	Cruzia travassosi [a]		11.1	49		-	-		-	-		-	-	LI
	Parapharyngodon riojensis [a]		77.8	4.9±3.1		-	-		-	-		-	-	LI
	Physalopteroides venancioi [a]		11.1	6		-	-		-	-		-	-	S
Tupinambis merianae	Acanthocephala not identified	6	-	-	-	-	-	3	33.3	5	1	-	-	LI
	Cruzia travassosi		83.3	106.6±57.6		-	-		33.3	99		100	5	SI, LI
	Diaphanocephalus galeatus		83.3	20.8±21.8		-	-		100	13.7±13.3		100	2	LI
	Freitasascaris alata [c]		-	-		-	-		66.6	19.5±26.2		-	-	LI
	Physaloptera retusa		83.3	7±4.7		-	-		100	59±18.1		100	3	S
	Spinicauda spinicauda [a]		-	-		-	-		-	-		100	1	LI

GYMNOPHTALMIDAE														
Cercosaura albostrigata	Nematode larvae	-	-	-	2	50	1	-	-	-	-	-	-	LI
	Nematode cysts	-	-	-		50	-	-	-	-	-	-	-	BC
	Centrorhynchidae larvae [a]	-	-	-		50	5	-	-	-	-	-	-	BC
Cercosaura ocellata	Not parasitized	-	-	-	-	-	-	-	-	-	1	-	-	
Cercosaura schreibersii	Cosmocercidae larvae	2	-	-	1	-	-	-	-	-	1	100	1	LI
	Oswaldofilaria sp. [a]		-	-		100	1		-	-		-	-	LI
	Physalopteroides venancioi [a]		-	-		100	2		-	-		-	-	S
Micrablepharus maximiliani	Nematode larvae	-	-	-	-	-	-	4	25	3	-	-	-	LI
	Skrjabinodon spinulosus [a, b]	-	-	-	-	-	-		25	6	-	-	-	LI
Vanzosaura rubricauda	Not parasitized	-	-	-	-	-	-	11	-	-	-	-	-	
SCINCIDAE														
Mabuya frenata	*Oochoristica travassosi* [a, b, c]	3	-	-	-	-	-	3	66.6	3.5±2.1	3	-	-	SI
	Parapharyngodon largitor [a]		-	-		-	-		66.6	1		-	-	LI
	Physalopteroides venancioi [a]		-	-		-	-	-	-	-		33.3	1	S
Mabuya guaporicola	*Oochoristica travassosi* [a]	3	-	-	1	100	12	3	-	-	-	-	-	SI
	O. vanzolini [a]		66.6	3.5±3.5		-	-		66.6	6±4.2		-	-	SI
	Physalopteroides venancioi [a]		33.3	9		-	-		66.6	9.5±0.7		-	-	S
Mabuya nigropunctata	*Oochoristica vanzolini* [a]	2	50	1	7	14.3	2	-	-	-	4	-	-	SI
	Oswaldocruzia sp. [a]		50	23		28.6	3±2.8		-	-		25	2	SI
	Parapharyngodon largitor [a]		100	2±1.4		42.9	1		-	-		25	9	LI
	Physaloptera retusa [a]		100	5		100	17.1±11		-	-		75	17±15.1	S
	Physalopteroides venancioi [a]		-	-		14.3	7		-	-		-	-	S
	Rhabdias sp. [a]		-	-		-	-		-	-		25	1	L
	Trematoda not identified		100	2		-	-		-	-		-	-	SI

Table 2 – Similarity (Jaccard index) and Brillouin diversity index (bold type in diagonal) of helminth for lizards at the Corumbá region of Pantanal, Brazil. Aa = *Ameiva ameiva*, Hm = *Hemidactylus mabouia*, Kv = *Kentropyx viridistriga*, Mg = *Mabuya guaporicola*, Mn = *Mabuya nigropunctata*, Pa = *Polychrus acutirostris*, Sc = *Stenocercus caducus*, Tt = *Teius teyou*, Te = *Tropidurus etheridgei*, Ts = *Tropidurus spinulosus*, Tm = *Tupinambis merianae*.

	Aa	Hm	Kv	Mg	Mn	Pa	Sc	Tt	Te	Ts	Tm
Aa	**0,95**	0	0	0	0,14	0,17	0	0,17	0,5	0	0,2
Hm		**0**	0	0	0	0	0	0	0	0	0
Kv			**0,32**	0	0,4	0	0	0	0	0	0
Mg				**0,58**	0,17	0	0	0,2	0,25	0	0
Mn					**1,06**	0,29	0	0	0,14	0	0,14
Pa						**0,60**	0	0,14	0,17	0	0,4
Sc							**0**	0	0	1	0
Tt								**0,90**	0,4	0	0,17
Te									**0,71**	0	0,2
Ts										**0**	0
Tm											**0,67**

Table 3 – Similarity (Jaccard index) and Brillouin diversity index (bold type in diagonal) of helminth for lizards at the Miranda region of Pantanal, Brazil. Aa = *Ameiva ameiva*, Ca = *Cercosaura albostrigata*, Cs = *Cercosaura schreibersii*, Hm = *Hemidactylus mabouia*, Mg = *mabuya guaporicola*, Mn = *Mabuya nigropunctata*, Tg = *Tropidurus guarani.*

	Aa	Ca	Cs	Hm	Mg	Mn	Tg
Aa	**0,62**	0	0,25	0,25	0	0,14	0,29
Ca		**0,30**	0	0	0	0	0
Cs			**0,37**	0,33	0	0,17	0,14
Hm				**0,45**	0	0,4	0,14
Mg					**0**	0	0
Mn						**0,51**	0,22
Tg							**1,04**

Table 4 – Similarity (Jaccard index) and Brillouin diversity index (bold type in diagonal) of helminth for lizards at the Nhecolândia region of Pantanal, Brazil. Aa = *Ameiva ameiva*, Co = *Cnemidophorus ocellifer*, HM = *Hemidactylus mabouia*, Mf = *Mabuya frenata*, Mg = *Mabuya guaporicola*, Mm = *Micrablepharus maximiliani*, Tm = *Tupinambis merianae*.

	Aa	Co	Hm	Mf	Mg	Mm	Tm
Aa	**0,48**	0,17	0	0	0	0	0
Co		**0,82**	0	0	0,5	0	0
Hm			**0**	0	0	0	0
Mf				**0,40**	0	0	0
Mg					**0,61**	0	0
Mm						**0,49**	0
Tm							**1,22**

Table 5 – Similarity (Jaccard index) and Brillouin diversity index (bold type in diagonal) of helminth for lizards at the Poconé region of Pantanal, Brazil. Aa = *Ameiva ameiva*, Cs = *Cercosaura schreibersii*, Co = *Cnemidophorus ocellifer*, Kv = *Kentropyx viridistriga*, Mf = *Mabuya frenata*, Mn = *Mabuya nigropunctata*, Pp = *Phyllopezus pollicaris*, Te = *Tropidurus etheridgei*, Tg = *Tropidurus guarani*, Tm = *Tupinambis merianae*.

	Aa	Cs	Co	Gh	Kv	Mf	Mn	Pp	Te	Tg	Tm
Aa	**0,75**	0	0	0	0,2	0,25	0	0	0,17	0	0,15
Cs		**0**	0	0	0	0	0	0	0	0	0
Co			**0,13**	0	0	0	0	0,2	0	0	0
Gh				**0**	0	0	0	0,33	0,33	0	0
Kv					**0,35**	0,5	0,2	0	0	0	0
Mf						**0**	0	0	0	0	0
Mn							**0,57**	0	0	0	0,15
Pp								**0,74**	0,2	0	0
Te									**0,75**	0,2	0
Tg										**0,71**	0
Tm											**0,93**

ARTIGO 7

HELMINTHS OF A LIZARD COMMUNITY AT A CERRADO SITE FROM CENTRAL BRAZIL

HELMINTHS OF A LIZARD COMMUNITY AT A CERRADO SITE FROM CENTRAL BRAZIL

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ABSTRACT

One hundred-thirty four specimens of 19 lizard species from two localities at the Cerrado biome from the Mato Grosso do Sul State, Brazil were surveyed for helminths. A total of 22 helminth species, including 3 cestodes and 21 nematodes were found with an overall prevalence of 42.65%. Twenty-five new host records and seven new locality records were reported. *Physaloptera retusa* and *Parapharyngodon largitor* were found to infecting five lizard species, and the majority of helminths infect only one lizard species. There is a correlation between lizard body size and number of parasite species. Active foragers showed a higher diversity, although the sit-and-wait foragers of the genus *Tropidurus* were infected by a highest number of helminth species. There was a difference in overall diversity between areas, and similarities were higher between phyllogenetic related species within communities.

Key-words: Cestoda, Nematoda, Squamata, Parasitism

INTRODUCTION

Although studies dealing with helminths from tropical lizards have recently increased, especially from open-habitat species, there is a concentration in some areas, such as the coastal sand dunes from Brazil (Van Sluys *et al.* 1997; Vrcibradic *et al.* 2000). From the Cerrado, the second largest biome from Brazil, available data are restricted from species descriptions (e.g. Alho 1969; Vicente *et al.* 2000) or ecology of a single species (Alho, 1970; Vrcibradic *et al.* 1999). In despite of autoecological works, studies with an entirely community provides an outstanding opportunity to understand the effects of habitat, phylogeny and ecological features in determining the structure and dynamics of helminth communities (Aho, 1990). Thus, this paper deals with an ecological study on helminth parasites of a lizard community in Cerrado of two localities from Mato Grosso do Sul State, Brazil.

MATERIALS AND METHODS

Fieldwork was taken in two localities of Mato Grosso do Sul State located at the Cerrado Biome: Dois Irmãos do Buriti municipality (20° 41' S; 55° 16' W) and Aquidauana municipality (20° 28' S; 55° 47' W). Lizards of Dois Irmãos do Buriti municipality (N = 45) were captured from September 2003 to October 2004 in pitfall traps with drift fences. In Aquidauana municipality, lizards (N = 89) were captured from September 1989 to March 2007 by hand. Lizard host were euthanized, fixed in formalin 10%, and preserved in 70% ethanol. Voucher hosts were housed at the Coleção Herpetológica Arlindo de Figueiredo Béda (CHAFD).

Parasitological studies consisted of a carefully examination of the body cavity, lungs, gall bladder and the gastrointestinal tract after a longitudinal incision in hosts. Helminths found were placed in vials of 70% ethanol for latter identification. For species identification, nematodes were cleared in phenol, trematodes and cestodes were stained in carmine cleared with creosote. All helminths were examined under a light microscope. Voucher specimens were deposited in the Coleção Helmintológica do Instituto de Biociências da Unesp de Botucatu (CHIBB).

Ecological terms used throughout the text follows Bush *et al.* (1997). Relations of lizard snout-vent length (SVL) and intensity of infection were tested using a linear regression. The diversity of the nematode fauna associated with each host species was estimated using the Brillouin's Diversity Index (Magurran, 1988), considering only parasitized individuals. For evaluate the effect of lizards body size, we made a Pearson

correlation between lizard SVL and both the total number of parasites and number of helminth species for each lizard host. Differences in overall prevalence between areas were tested using the Z-test for proportions and for differences in diversity between areas we performed an ANOVA (Zar, 1984). For avoid comparisons between specimens collected in different areas and seasons, we performed between-species similarities in nematode community composition using Jaccard index for qualitative data only. To evaluate the similarity between areas qualitative data were subjected to UPGMA cluster analysis, using the Sorensen's coefficient of MVSP version 3.1 (Kovach Computing Services 2006).

RESULTS

A total of 7940 helminths from 22 species were recovered from the 19 species of lizards hosts (N = 134). The helminths found include 3 cestodes and 21 nematodes (Table 1). Few specimens could not be identified, due to juvenile condition (e.g. *Physaloptera* sp.) or poor condition (e.g. *Oochristica* sp.).

The nematodes *Physaloptera retusa* and *Parapharyngodon largitor* were found infecting five lizard hosts, followed by the nematode *Skrjabinodon spinulosus* and the cestode *Oochoristica vanzolini*, with 3 lizard hosts each. Fourteen (63.6 %) helminth species were found infecting only one species of lizard (Table 1).

The overall prevalence was 42.65% and no siginificant difference ($Z = 1.141$, $P = 0.16$) was observed between the prevalence of Aquidauna municipality (46.07%) and Dois Irmãos do Buriti municipality (33.33%). The total number of parasite species were correlated with lizard SVL ($R = 0.34$, $P < 0.001$), but no correlation were verified between total number of parasites and host SVL ($R = 0.12$, $P = 0.17$).

Individuals of the tropidurid lizard *Tropidurus oreadicus* were found to harbor five and four helminths species, whereas another *T. oreadicus*, one specimen of teiid *Ameiva ameiva* and the anguid *Ophiodes striatus* harbored three species. Fourty-eight lizards (35.29%) harbor only one species of helminth and 6.62% harbored two helminth species. *Ophiodes striatus* showed the highest diversity in the Aquidauana municipality (Table 2), whereas *Ameiva ameiva* presented the highest diversity in Dois Irmãos do Buriti municipality (Table 3).

Overall diversity of helminths in Aquidauana municipaliy were higher than the Dois Irmãos do Buriti municipality ($F_{1,24} = 11.47$, $P = 0.002$). Mean number of helminth species/host species (infected ones) in Aquidauana municipality was 2.75 ± 1.71 and in

Dois Irmãos do Buriti was 1.60 ± 0.89. *Tropidurus oreadicus* were found to harbor 7 helminth species, followed by *Tropidurus guarani*, with 5 helminth species in Aquidauana municipality. *Ameiva ameiva* showed the highest number of helminth species (n = 3) in Dois Irmãos do Buriti municipality.

Both local conditions and phylogeny seems to be responsible for the helminth community composition in Aquidauana and Dois Irmãos do Buriti municipalities, because similarities within community are higher between species phyllogenetically closer (Table 2-3; Figure 1). Beyond similaritities between related genera and families, lizard species between communities are grouped also by the different populations of the same species, such as *Ameiva ameiva* (Figure 1).

DISCUSSION

Results presented herein provide an update to the knowledge about endoparasites of Brazilian lizards, especially from the Cerrado biome, with 25 new host records and seven new locality records for helminth species.

Like other parasitological studies with Neotropical lizard communities (e.g. Bursey *et al.* 2005; Bursey *et al.* 2007), the majority of helminth species were found infecting only one host species. Except for *Skrjabinodon spinulosus*, actually known only from *Mabuya dorsivittata* (Vicente *et al.* 2002), helminths found in the present study are widespread, such as *Physaloptera retusa*, which was reported infecting more than 60 host species (Bursey *et al.* 2007). Overall and local prevalence found is also similar to those studies cited above; i.e., Bursey *et al.* (2005) in Peru found an overall prevalence of 51%.

Many studies have shown a positive relationship between lizard body size and both diversity and abundance of helminths (Rocha *et al.* 2003; Anjos *et al.* 2005; Fontes *et al.* 2003). According to Kuris *et al.* (1980) sites on larger hosts may facilitate niche differentiation and habitat segregation by competing parasite species more so than corresponding sites on small hosts. Thus, it is possible that the lower diversity of helminth fauna in gymnophthalmid lizards be a result to the reduced body size. Also, lizard body sizes have a significant effect in diet, with larger lizard species taking on a wide size range of prey (Vitt, 1995).

Feeding habits and helminth diversity relationships have been widely studied worldwide (e.g. Roca 1999, Roca *et al.* 2005). One of the most differences observed is that between active and sit-and-wait foragers, where according to Aho (1990) active

ones tend to harbor richer and more complex helminth communities. In spite of *Tropidurus oreadicus* (a sit-and-wait forager) harbor more helminth species; two active foragers (*A. ameiva* and *Ophiodes striatus*) attain the highest diversity in the two studied areas, corroborating those predictions by Aho (1990). However, many studies, especially in Neotropical region have showed an opposite trend (e.g. Ribas *et al.* 1998; Vrcibradic *et al.* 2000).

Only lizards from Aquidauana municipality showed a number of helminth species similar to those reported by Aho (1990) for a compilation of 100 studied populations of lizards between nine families (2.06 ± 0.13). Other findings from Neotropical lizard communities (e.g. Bursey *et al.* 2005; Bursey *et al.* 2007; Vrcibradic *et al.* 2000) also agree to those statements of Aho (1990). However, unusual helminth richness of tropidurids has also been reported, and abundance, wide geographic distribution, and a diet composed by both animal and plant material may be related with this pattern (Vrcibradic *et al.* 2000). Also, the lower helminth richness from Dois Irmãos do Buritit may be due to local conditions or inadequate sample size for this locality.

Aho (1990) stated that similarities in helminth faunas among closely related sympatric hosts usually high, commonly equal or exceeding values obtained for interpopulational comparisons of a single host species. These patterns have been observed in other studies, such as in lizards from coastal sand dunes from Brazil (Vrcibradic *et al.* 2000) and in the present study, except for a few cases (e.g *Ameiva ameiva*).

In conclusion, our findings agree to those patterns reported for many helminth fauna from lizard communities; i.e. the presence of a generalist helminth species, the low number of species, and relationships of phylogeny and body size.

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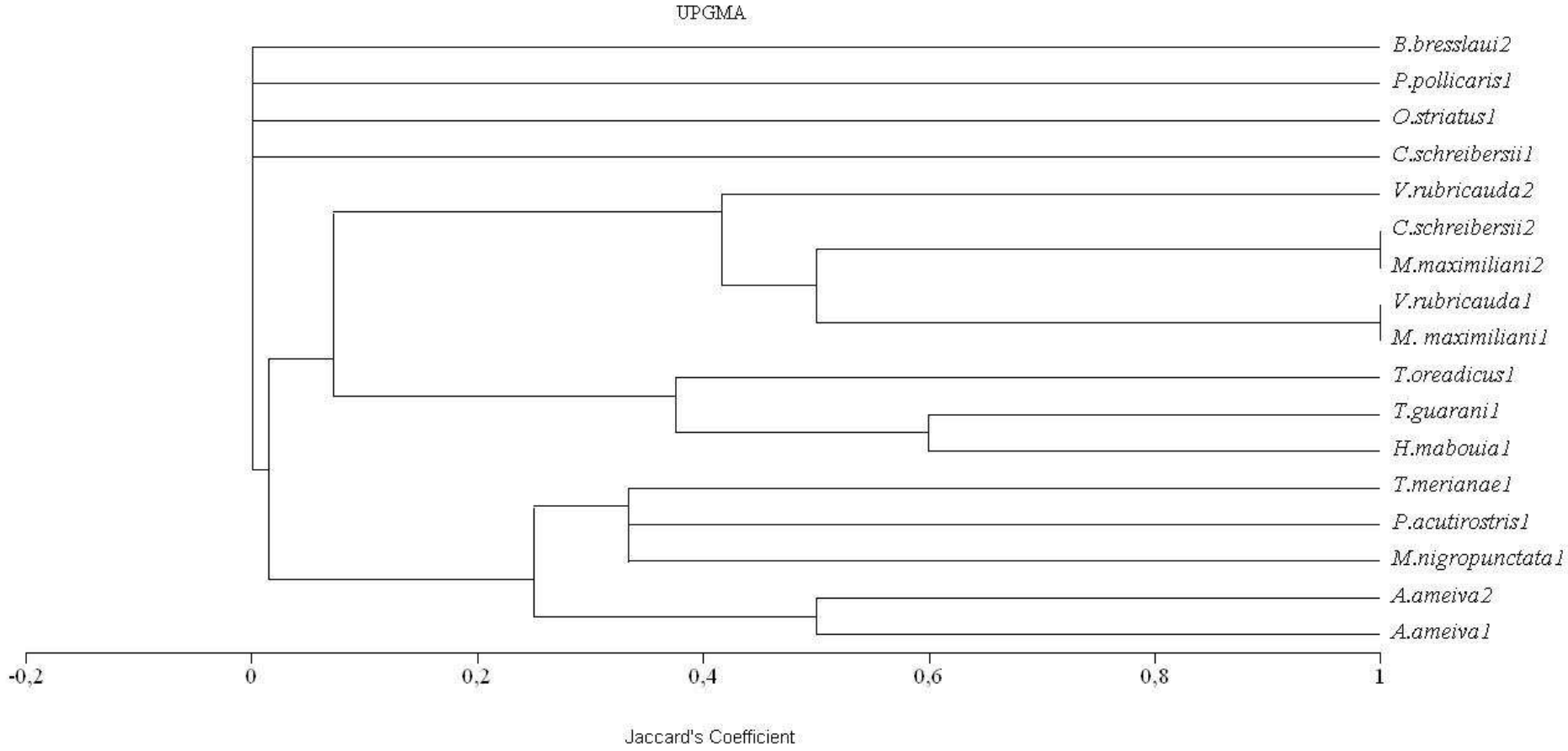

Figure 1 – Cluster analysis of helminth communities of lizards at two Cerraod sites in Mato Grosso do Sul State. 1 = Aquidauana, 2 = Dois Irmãos do Buriti.

Table 1 - Epidemiological data from lizards (N = number of lizards examined) and their respectives parasites in Cerrado at two municipalities of the Mato Grosso do Sul State, Brazil. For each host species the prevalence (P), mean intensitiy of infection (MII; mean ± sd) and sites of infection of each nematode are given. Abbreviations for sites of infection are: BC = Body cavity, S = Stomach, LI = Large intestine, SI = Small intestine, L = Lungs. The symbols capitalized are: [a] = new host record, [b] = new state record.

Host	**Parasite**	**Aquidauna**			**Dois Irmãos do Buriti**			**SITE**
		N	**P**	**MII**	**N**	**P**	**MII**	
Ameiva ameiva	*Oochoristica ameivae*[b]	9	-	-	4	25	1	SI
	Parapharyngodon riojensis[a]		44.4	3±1.4		100	6.3±6.1	LI
	Physaloptera retusa		11.1	1		25	2	S
	Spinicauda spinicauda		11.1	3		-	-	LI
Anolis meridionalis	Not parasitized	2	-	-	-	-	-	
Bachia bresslaui	*Oochoristica* sp.[a]	-	-	-	4	25	1	SI
Cercosaura parkeri	Not parasitized	-	-	-	2	-	-	
Cercosaura schreibersii	*Physaloptera lutzi*[a, b]	4	25	1	7	-	-	S
	Skrjabinodon spinulosus[a,b]		-	-		14.3	3	LI

Cnemidophorus ocellifer	Not parasitized	5	-	-	-	-	-	
Coleodactylus brachystoma	Not parasitized	5	-	-	-	-	-	
Colobosaura modesta	*Skrjabinodon spinulosus*[a]	3	33.3	1	3	-	-	LI
Hemidactylus mabouia	*Oochoristica vanzolinii*[b]	11	36.4	2.7±1.3	-	-	-	SI
	Parapharyngodon largitor[b]		27.3	2.3±1.1		-	-	LI
	Physaloptera sp.		9.1	6		-	-	S
Mabuya nigropunctata	*Parapharyngodon* sp.	2	50	1	-	-	-	LI
	Physaloptera retusa[a]		50	3				S
Micrablepharus maximiliani	*Parapharyngodon largitor*[a]	8	12.5	1	10	50	3.6±2.4	LI
	Skrjabinodon spinulosus[a]		37.5	3.7±0.6		-	-	LI
Ophiodes striatus	*Oswaldocruzia* sp.[a]	1	100	2	-	-	-	SI
	Rhabdias sp.[a]		100	6		-	-	L
	Strongyloides cf. *cruzi*[a, b]		100	46		-	-	LI

Phyllopezus pollicaris	*Spauligodon oxkutzcabiensis*[a, b]	3	100	25.3±26.9	-	-	-	SI, LI
Polychrus acutirostris	*Gynaecometra bahiensis*[a, b]	7	28.6	3747±4358.6	-	-	-	LI
	Physaloptera retusa[a]		28.6	40±49.5		-	-	S
Stenocercus caducus	Not Parasitized	-	-	-	2	-	-	
Tropidurus guarani	*Oochoristica vanzolinii*[a]	9	11.1	3	1	-	-	SI
	Parapharyngodon largitor[a]		11.1	15		-	-	LI
	Skrjabinellazia intermedia		22.2	4.5±4.9		-	-	LI, SI
	Strongyluris oscari		22.2	6.5±7.8		-	-	LI
	Physaloptera sp. (larvae)		11.1	2		-	-	S
Tropidurus oreadicus	Nematode cysts	10	20	-	-	-	-	BC
	Oochoristica vanzolinii[a]		10	1		-	-	SI
	Parapharyngodon largitor[a]		30	1		-	-	LI
	Piratuba digiticauda[a]		10	1		-	-	BC
	Physaloptera retusa[a]		30	2.7±1.5		-	-	S
	Physalopteroides venancioi[a]		20	1.5±0.7		-	-	S
	Skrjabinellazia intermedia[a]		20	1		-	-	SI, LI

	Strongyluris oscari[a]		30	5.3±2.1		-	-	L, SI, LI
Tupinambis merianae	*Diaphanocephalus galeatus*	2	100	13±11.3	-	-	-	LI, SI
	Physaloptera retusa		50	9		-	-	S
Vanzosaura rubricauda	Cosmocercidae	8	-	-	10	10	4	LI
	Parapharyngodon largitor[a]		12.5	1		-	-	LI
	Skrjabinodon spinulosus[a]		25	2.5±2.1		30	1	LI

Table 2 – Brillouin diversity index (bold) and similarity coefficients (Jaccard) for lizard community at Aquidauana municipality. Aa = *Ameiva ameiva*, Cs = *Cercosaura schreibersii*, Hm = *Hemidactylus mabouia*, Mn = *Mabuya nigropunctata*, Os = *Ophiodes striatus*, Pp = *Phyllopezus pollicaris*, Pa = *Polychrus acutirostris*, Tg = *Tropidurus guarani*, To = *Tropidurus oreadicus*, Tm = *Tupinambis merianae*, Vr = *Vanzosaura rubricauda*.

	A.a	**C.s**	**H.m**	**M.n**	**M. m**	**O.s**	**P.p**	**P.a**	**T.g**	**T.o**	**T.m**	**V.r**
A.a	**0.04 ± 0.12**											
C.s	0	**0**										
H.m	0	0	**0.03 ± 0.10**									
M.n	0.25	0	0	**0**								
M. m	0	0	0.25	0	**0.04 ± 0.11**							
O.s	0	0	0	0	0	**0.45**						
P.p	0	0	0	0	0	0	**0**					
P.a	0.25	0	0	0.33	0	0	0	**0.01 ± 0.01**				
T.g	0	0	0.6	0	0.17	0	0	0	**0.15 ± 0.23**			
T.o	0.11	0	0.25	0.13	0.13	0	0	0.13	0.5	**0.26 ± 0.37**		
T.m	0.25	0	0	0.33	0	0	0	0.33	0	0.13	**0.27 ± 0.39**	
V.r	*0*	0	0.25	0	1	0	0	0	0.17	0.13	0	**0.04 ± 0.12**

Table 3 – Brillouin diversity index (bold) and similarity coefficients (Jaccard) for lizard community at Dois Irmãos do Buriti municipality.

	A.ameiva	*B.bresslaui*	*C.schreibersii*	*M.maximiliani*	*V.rubricauda*
A.ameiva	**0.13 ± 0.26**				
B.bresslaui	0	**0**			
C.schreibersii	0	0	**0**		
M.maximiliani	0	0	1	**0**	
V.rubricauda	0	0	0.5	0.5	**0**

ARTIGO 8

HELMINTHS OF A LIZARD COMMUNITY AT A CERRADO SITE FROM CHAPADA DOS GUIMARÃES, MATO GROSSO, BRAZIL

HELMINTHS OF A LIZARD COMMUNITY AT A CERRADO SITE FROM CHAPADA DOS GUIMARÃES, MATO GROSSO, BRAZIL

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ABSTRACT

One hundred-seventy specimens from 26 lizards species captured during the Environmental Impact Study and Monitoring program of the Manso Hydroelectric Power Plant, Chapada dos Guimarães municipality, Mato Grosso state, in the Cerrado of Central Brazil were examined for helminths. A total of 28 species, being 1 trematode, 3 cestodes and 24 nematode species were recovered, with an overall prevalence of 41.76%. Fifty-one new host records, 19 new state records and 3 new country records were reported. A lower number of specialists and core helminth species were found. There is a positive correlation with lizard body size and both total number of helminth species and individuals. Trends found worldwide, such as active foragers harboring the higher helminth diversity, and similarities between helminth fauna higher between phylogenetic closest host species were noted in the present study.

Key-words: Nematoda, Cestoda, Trematoda, Parasitism, Squamata, Neotropical

INTRODUCTION

Studies with helminth parasites of Brazilian lizards have experienced an increase in the past few years (Vrcibradic *et al*., 2008). Many subjects of these studies deals with prevalence and intensity of infection, linking the observed patterns with ecological features of both host and parasite (see Fontes *et al*., 2003). However, many articles are focused on a single lizard species (Anjos *et al*., 2005; Dias *et al*., 2005; Menezes *et al*., 2004), while lizard communities are poorly studied.

Comprehensive parasitological surveys on lizard community are available mainly from temperate zones (Aho 1990), and the observed patterns, such as the influence of foraging mode of host, have been controversial with the few studies of Neotropical species (Ribas *et al*., 1998; Vrcibradic *et al*., 2000).

Herein, we conducted a parasitological study with a lizard community at Chapada dos Guimarães municipality, Mato Grosso State, Central Brazil, attempting to link parasitic features with ecological and phyllogenetic aspects of the hosts.

MATERIALS AND METHODS

Lizards (N=170) from 26 species were captured at Chapada dos Guimarães municipality (14°30' S , 55°00' W), Mato Grosso State, from June 1998 to February 2002 during the Environmental Impact Study and Monitoring program of the Manso Hydroelectric Power Plant (APM Manso). Techniques for capturing lizards included pitfall traps with drift fences and visual encounter surveys. Lizard hosts were euthanized, fixed in formalin 10%, and preserved in 70% ethanol. Voucher hosts were housed at the Coleção Zoológica de Vertebrados do Instituto de Biociências da Universidade Federal de Mato Grosso (UFMT).

Parasitological studies consists of a longitudinal incision in hosts, being examined for endoparasites the body cavity, lungs, gall bladder and the gastrointestinal tract. Helminths found were placed in vials of 70 % ethanol for latter identification. For species identification, nematodes were cleared in phenol, trematodes and cestodes were stained in carmine cleared with creosote, and were examined under a light microscope. Voucher specimens were deposited in the Coleção Helmintológica do Instituto de Biociências da Unesp de Botucatu (CHIBB).

Ecological terms used throughout the text follows Bush *et al*. (1997). Relations of lizard snout-vent length (SVL) and intensity of infection were tested using a linear regression. The diversity of the nematode fauna associated with each host species was

estimated using the Brillouin's Diversity Index (Magurran, 1988), considering only parasitized individuals. Classification of helminths follows Roca (1993): prevalences greater than 30% are considered core species and between 10-30% are considered secondary species. Generalists (not restricted to a single host species) and specialists (in single host species) helminths classification follows Bursey *et al*. (2005).

For evaluate the effect of lizards body size, a Pearson correlation between lizard SVL and both the total number of parasites and number of helminth species for each lizard host were used. To evaluate the similarity between lizard species, the qualitative data were subjected to UPGMA cluster analysis, using the Sorensen's coefficient of MVSP version 3.1 (Kovach Computing Services 2006).

RESULTS

A total of 24,044 helminths from 28 species, including 1 trematode, 3 cestodes and 24 nematode species were recoverd. Some individuals, such as Filariidae and Cosmocercidae could not be identified due to juvenile and/or poor condition of the preserved specimens. The overall prevalence was 41.76%. The stomach nematode *Physaloptera retusa* infect a more number of hosts (n = 11), followed by the intestinal nematode *Subulura lacertilia* (n = 5; Table 1). Of the 72 records of parasites, 47.2% can be considered a core species and 60.7% of helminth species were found to infect more than one lizard host.

The maximum number of helminth species per lizard species was five, diversity attained by three lizards: the scincid *Mabuya nigropunctata*, the tropidurid *Tropidurus guarani* and the anguid *Ophiodes striatus*. Seven individuals (4.12%) harbored three helminth species (one *Cercosaura ocellata*, one *Tupinambis merianae*, one *T. teguixin*, two *M. nigropunctata*, and two *O. striatus*), while 9.41% harbored two helminth species, and the majority (27.65%) harbored only one helminth species. Two active foragers (*T. teguixin* and *T. merianae*) attained the highest diversity, and sit-and-wait foragers showed intermediary values (Table 2).

Lizard SVL were correlated with total number of helminth species ($R = 0.62$, $P < 0.001$) and weakly with total number of parasites ($R = 0.16$, $P = 0.04$).

Lizard species were grouped by phyllogenetic relationship, and many species grouped by family or genus (Figure 1). *Iguana iguana* showed no similarity with any lizard species.

DISCUSSION

In this paper, there is an expressive contribution to the knowledge of helminths parasites of lizards from South America, because 51 new host records, 19 new State records and 3 new country records were reported. Besides, a contribution to the knowledge of ecological patterns of helminth from lizard hosts was presented.

In general, the patterns found here agree with those reported from amphibians and reptiles, e.g. a depauperate parasite fauna compared with other classes of vertebrates, a predominance of generalist and secondary species instead of core species, and relationships between parasitological features with ecological aspects of lizards, such as foraging mode and body size (see Aho, 1990). However, the present data disagree from many studies from South America, which states that the general patterns cited above, especially regarding foraging mode are different from Aho (1990). In Temperate areas active foragers tend to harbor a richer and complex helminth fauna than sit-and-wait foragers, while in coastal sand dunes (Restinga) from Brazil, sit-and-wait foragers showed a higher diversity (Ribas *et al*., 1998; Vrcibradic *et al*., 2000). Although, this pattern is a result of Tropiduridae influences, which generally presents more helminth species associated than sympatric active foragers, but other factors, such as the inclusion of vegetal matter in diet of many species may be related (Vrcibradic *et al*., 2000). An herbivorous diet or at least, the ingestion of vegetal matter provides richer and more diverse structure of helminth communities for reptilian hosts (Roca, 1999; Roca *et al*., 2005).

Moreover, the relationship between host size and abundance and diversity of helminths have proven in several studies (Rocha *et a.l*, 2003; Anjos *et al.*, 2005), due to habitat segregation and niche differentiation opportunities provide by larger sites in heavy bodied lizards than smaller ones (Kuris *et al*., 1980). In addition, phylogenetic relationships of lizard hosts influences the helminth communities composition (see Aho, 1990; Poulin and Mouillot, 2003), as well other ecological aspects of lizards (see Pianka and Vitt, 2003).

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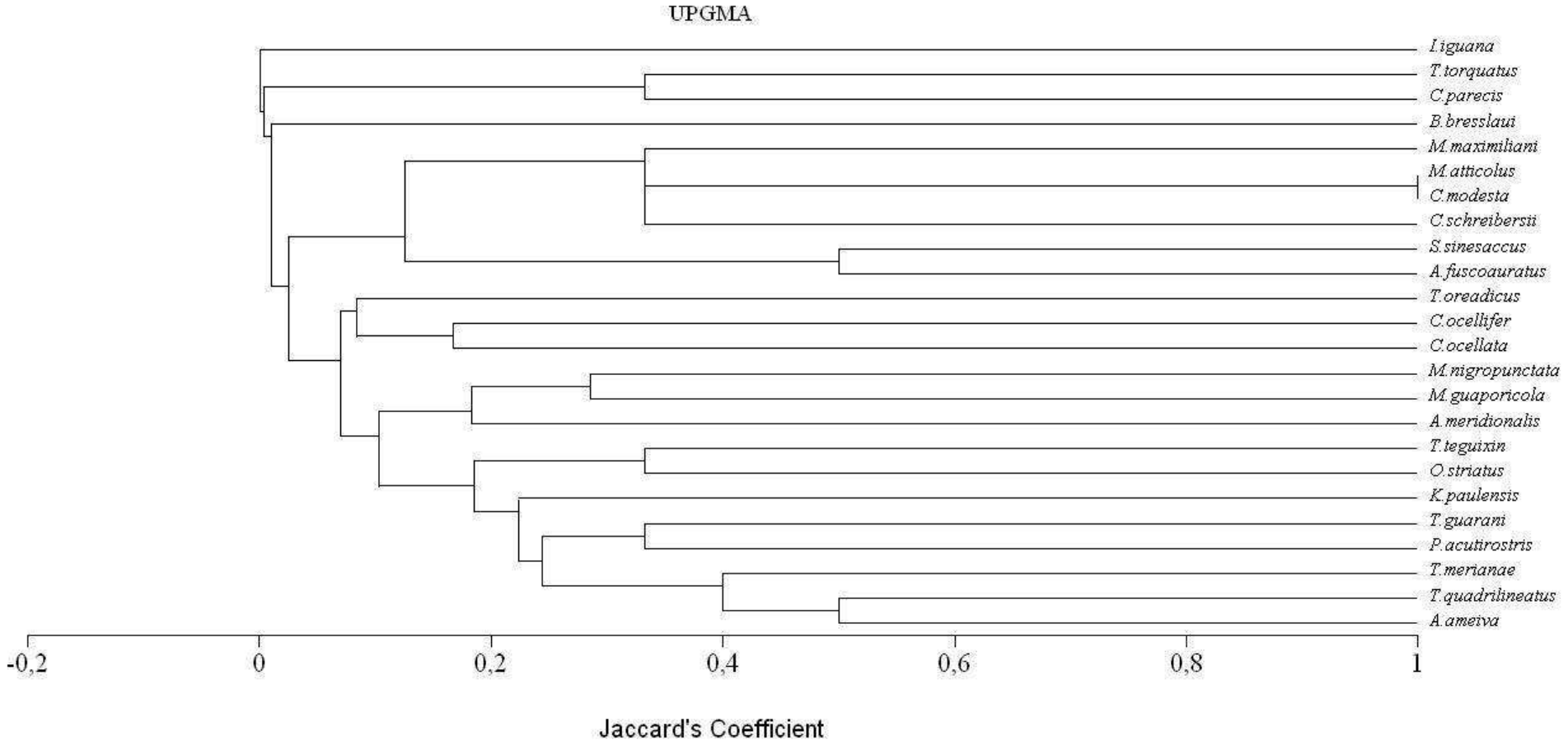

Figure 1 – Cluster analyses of similarities of helminth communities of lizards from a Cerrado site at Chapada dos Guimarães municipality, Mato Grosso State, Central Brazil.

Table 1 - Epidemiological data from lizards (N = number of lizards examined) and their respectives parasites in Cerrado at Chapada dos Guimarães, Mato Grosso state, Brazil. For each host species the prevalence (P), mean intensitiy of infection (MII; mean ± sd) and sites of infection of each nematode are given. Abbreviations for sites of infection are: BC = Body cavity, S = Stomach, LI = Large intestine, SI = Small intestine, L = Lungs. The symbols capitalized are: [a]=new host record, [b]=new state record, [c] = new country record.

Host	**N**	**SVL**	**Parasite**	**P**	**MII**	**SITE**
Ameiva ameiva	5	98.96 ± 32.18	*Parapharyngodon senisfasciedaudus*[a,b, c]	20	5	LI
			Physaloptera retusa	40	14.5 ± 17.7	S
			Spinicauda spinicauda	40	29 ± 12.7	LI
Anolis fuscoauratus	9	39.81 ± 5.13	*Oswaldocruzia* sp.	11.1	2	SI
			Rhabdias sp.	11.1	1	L
			Subulura lacertilia[a,b]	22.2	1.5 ± 0.7	SI, LI
Anolis meridionalis	12	43.24 ± 3.83	*Oochoristica iguanae*[a,b, c]	8.3	2	SI
			Skrjabinodon heliocostai[a,b]	8.3	1	LI
Bachia bresslaui	10	70.37 ± 11.87	Cosmocercidae not identified	10	2	LI
Cercosaura ocellata	12	40.40 ± 8.05	*Oochoristica* sp.[a]	8.3	4	SI
			Oswaldofilaria brevicaudata[a,b]	8.3	1	SI

			Piratuba digiticauda[a,b]	8.3	2	BC
			Physaloptera retusa[a]	8.3	5	S
Cercosaura schreibersii	9	33.80 ± 6.43	*Oswaldocruzia* sp.[a]	11.1	1	LI
			Skrjabinodon spinulosus[a,b]	22.2	2 ± 1.4	LI
Cnemidophorus cf. *parecis*	7	77.98 ± 13.14	*Parapharyngodon largitor*[a,b]	14.3	2	LI
			Parapharyngodon sceleratus[a]	14.3	3	LI
			Pharyngodon cesarpintoi[a,b]	28.6	1.5 ± 0.7	LI
Cnemidophorus ocellifer	13	55.33 ± 7.05	*Oochoristica travassosi*[a,b,c]	7.69	10	SI
			Parapharyngodon senisfasciedaudus[a]	7.69	2	LI
			Piratuba digiticauda[a]	15.38	1	BC
Colobosaura modesta	12	39.47 ± 6.32	*Oochoristica* sp.[a]	8.33	2	SI
			Skrjabinodon spinulosus[a]	8.33	1	LI
Hoplocercus spinosus	5	76.73 ± 29.25	Not parasitized	-	-	-
Iguana iguana	1	85.78	*Ozolaimus megatyphlon*	100	1300	LI

Kentropyx paulensis	3	63.30 ± 8.47	*Piratuboides zeae*[a,b]	33.3	2	BC
			Physaloptera retusa[a]	33.3	1	S
Mabuya frenata	9	60.03 ± 7.72	Not parasitized	-	-	-
Mabuya guaporicola	11	68.77 ± 9.81	*Pharyngodon cesarpintoi*[a]	63.64	12.85 ± 8.86	LI
			Physaloptera retusa[a]	9.09	1	S
			Physalopteroides venancioi[a]	9.09	1	S
			Skrjabinodon heliocostai[a,b]	18.18	31.5 ± 36.06	SI, LI
Mabuya nigropunctata	4	93.12 ± 2.75	Nematoda cysts	25	-	BC
			Oswaldocruzia sp.[a]	25	2	LI
			Piratuba shawi[a]	25	6	BC
			Physaloptera retusa[a]	100	29.75 ± 50.23	S
			Skrjabinodon heliocostai[a]	50	9 ± 4.24	LI
Micrablepharus atticolus	10	32.22 ± 2.48	*Oochoristica sp.*[a]	10	1	SI
			Skrjabinodon spinulosus[a]	20	1.5 ± 0.7	LI

Micrablepharus maximiliani	10	35.95 ± 3.16	Filariidae not identified	10	1	LI
			Skrjabinodon spinulosus [a]	10	1	LI
Ophiodes striatus	2	190 ± 19.80	*Aplectana travassosi* [a,b]	50	4	SI
			Cosmocercidae not identified	50	1	LI
			Mesocoelium monas [a,b]	50	3	SI
			Nematoda cysts	50	9	BC
			Physaloptera retusa [a]	100	30.5 ± 9.19	S
Polychrus acutirostris	10	102.34 ± 9.81	*Gynaecometra bahiensis* [a,b]	50	4389.6 ± 3130.9	LI
			Physaloptera retusa	40	4 ± 5.3	S
			Subulura lacertilia [a]	10	5	LI
Stenocercus sinesaccus	3	68.48 ± 7.38	*Oochoristica* sp. [a]	33.3	7	SI
			Oswaldocruzia sp. [a]	33.3	1	SI
			Subulura lacertilia [a]	66.7	20.5 ± 10.61	LI
Tropidurus guarani	4	86 ± 10.61	*Physaloptera lutzi* [b]	50	1	S
			Physaloptera retusa	25	1	S
			Skrjabinellazia intermedia [b]	25	16	SI
			Strongyluris oscari	25	1	LI

			Subulura lacertilia [a]	25	6	LI
Tropidurus oreadicus	2	70.13 ± 5.44	*Parapharyngodon senisfasciedaudus* [a]	50	2	LI
			Physaloptera lutzi [a]	50	19	S
			Physalopteroides venancioi [a]	50	1	S
			Strongyluris oscari [a]	50	8	LI
Tropidurus torquatus	1	75.98	*Parapharyngodon sceleratus*	100	1	LI
Tupinambis merianae	2	273 ± 159.98	*Cruzia travassosi* [a]	50	4	LI
			Diaphanocephalus galeatus [b]	50	8	SI
			Physaloptera retusa [a]	50	2	S
			Spinicauda spinicauda [a]	100	1.5 ± 0.7	LI
Tupinambis quadrilineatus	2	179.86 ± 36.93	*Physaloptera retusa* [a]	100	34 ± 43.84	S
			Spinicauda spinicauda [a]	50	1	SI
			Subulura lacertilia [a]	50	36	SI, LI
Tupinambis teguixin	1	271	*Diaphanocephalus galeatus*	100	4	SI
			Mesocoelium monas [a,b]	100	1	SI
			Physaloptera retusa	100	5	S

Table 2 – Brillouin diversity index (bold) and similarity coefficients (Jaccard) for lizard community at Chapada dos Guimarães, Mato Grosso, Brazil. Aa = *Ameiva ameiva*, Af = *Anolis fuscoauratus*, Am = *Anolis meridionalis*, Bb = *Bachia bresslaui*, Co = *Cercosaura ocellata*, Cs = *Cercosaura schreibersii*, Cp = *Cnemidophorus* cf. *parecis*, Cc = *Cnemidophorus ocellifer*, Cm = *Colobosaura modesta*, Ii = *Iguana iguana*, Kp = *Kentropyx paulensis*, Mg = *Mabuya guaporicola*, Mn = *Mabuya nigropunctata*, Ma = *Micrablepharus atticolus*, Mm = *Micrablepharus maximiliani*, Os = *Ophiodes striatus*, Pa = *Polychrus acutirostris*, Ss = *Stenocercus sinesaccus*, Tg = *Tropidurus guarani*, To = *Tropidurus oreadicus*, Tt = *Tropidurus torquatus*, Tm = *Tupinambis merianae*, Tq = *Tupinambis quadrilineatus*, Te = *Tupinambis teguixin*.

										I					M						T			
	Aa	Af	Am	Bb	Co	Cs	Cp	Cc	Cm	i	Kp	Mg	Mn	Ma	m	Os	Pa	Ss	Tg	To	t	Tm	Tq	Te
	0.16 ±																							
Aa	**0.32**																							
		0.12 ±																						
Af	0	**0.21**																						
A																								
m	0	0	**0**																					
Bb	0	0	0	**0**																				
					0.33 ±																			
Co	0.17	0	0	0	**0.47**																			
Cs	0	0.25	0	0	0	**0**																		
Cp	0	0	0	0	0	0	**0**																	
								0.07 ±																
Cc	0.20	0	0	0	0.17	0	0	**0.13**																
						0.3																		
Cm	0	0	0	0	0.20	3	0	0	**0**															
Ii	0	0	0	0	0	0	0	0	0	**0**														
Kp	0.25	0	0	0	0.20	0	0	0	0	0	**0**													
			0.2				0.1				0.2	**0.01 ±**												
Mg	0.17	0	0	0	0.14	0	7	0	0	0	0	**0.02**												

			0.1			0.1					0.1		**0.53 ±**															
Mn	0.14	0.14	7	0	0.12	7	0	0	0	0	7	0.29	**0.37**															
						0.3			1.0																			
Ma	0	0	0	0	0.20	3	0	0	0	0	0	0	0	**0**														
M						0.3			0.3					0.3	**0.3**													
m	0	0	0	0	0	3	0	0	3	0	0	0	0	3	**5**													
				0.2							0.1					**0.56 ±**												
Os	0.14	0	0	0	0.12	0	0	0	0	0	7	0.12	0.25	0	0	**0.05**												
											0.2						**0.01 ±**											
Pa	0.20	0.20	0	0	0.17	0	0	0	0	0	5	0.17	0.14	0	0	0.14	**0.01**											
						0.2			0.2					0.2				**0.06 ±**										
Ss	0	0.50	0	0	0.17	5	0	0	5	0	0	0	0.14	5	0	0	0.20	**0.11**										
											0.1								**0.11 ±**								
Tg	0.14	0.14	0	0	0.12	0	0	0	0	0	7	0.12	0.11	0	0	0.11	0.33	0.14	**0.14**								
																				0.45 ±							
To	0.17	0	0	0	0	0	0	0.17	0	0	0	0.14	0	0	0	0	0	0	0.29	**0.12**							
							0.3																				
Tt	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**						
											0.2											**0.57 ±**					
Tm	0.40	0	0	0	0.14	0	0	0	0	0	0	0.14	0.12	0	0	0.12	0.17	0	0.12	0	0	**0.28**					
											0.2												**0.49 ±**				
Tq	0.50	0.20	0	0	0.17	0	0	0	0	0	5	0.17	0.14	0	0	0.14	0.50	0.20	0.33	0	0	0.40	**0.20**				
											0.2																**0.7**
Te	0.20	0	0	0	0.17	0	0	0	0	0	5	0.17	0.14	0	0	0.33	0.20	0	0.14	0	0	0.40	0.20	**1**			

ARTIGO 9

HELMINTHS OF TWO LIZARD COMMUNITY AT TRANSITION ZONES CERRADO-AMAZON, WESTERN MATO GROSSO, BRAZIL

HELMINTHS OF TWO LIZARD COMMUNITY AT TRANSITION ZONES CERRADO-AMAZON, WESTERN MATO GROSSO, BRAZIL

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ABSTRACT

One hundred-sixty eight lizards from 17 species captured in two areas of transition zone Cerrado-Amazon in the western Brazil were analyzed for helminths. Lizards hosts were collected during Environmental Impact studies of two Hydroelectric Water Dams, from the municipalities of Araputanga and Vale de São Domingos, both from the Mato Grosso State, Brazil. A total of 20 helminth species were recovered, including 1 acanthocephalan, 1 cestoda, 1 trematoda and 17 nematode species were recovered. The overall prevalence was 33.3%, and the two areas have different prevalence, but no differences of diversity between areas were noted. There are also relationships between lizard body size and both diversity and abundance of helminths, and where similarities were observed, lizard species are grouped by phylogenetic resemblances. One new country record, 8 new hosts, and 10 new State records are reported for helminth species.

Key-words: Parasitism, Nematoda, Cestoda, Trematoda, Acanthocephala, Squamata

INTRODUCTION

Lizards are considered model organisms for ecological studies (Pianka and Vitt, 2003), especially for parasitological investigations (Aho, 1990). Studies of parasitological features from lizards have evolved in temperate zones, and since then many interesting patterns of parasite community composition and structure have been described (see Aho, 1990 and references therein).

From Neotropical areas, studies concerning parasitic ecology from lizards are relatively recent (Vrcibradic *et al*., 1999; Fontes *et al*., 2003), and many of them corroborate the general predictions, except those regarding the influence of foraging modes (Ribas *et al*., 1998). However, almost all deals with a single or few lizard species from a given community (Rocha, 1995; Rocha *et al*., 2003; Vrcibradic *et al*., 2000).

In the present study, we present a helminthological survey of two lizard communities from transition zones between Cerrado-Amazon from western Brazil, linking the ecological features of parasites with aspects of hosts biology.

MATERIALS AND METHODS

Fieldwork was taken in two localities of western Mato Grosso State located at transition zones Cerrado-Amazon Biomes: Araputanga municipality (15°08’ S 58°54’ W) and Vale de São Domingos municipality (15°00’ S 58°58’ W). Lizards of Araputanga municipality (N = 65) were captured June 2005 to April 2007 by hand in both the faunal rescue programs and herpetofaunal monitoring program of the Ombreras Hydroelectric Power Plant (PCH Ombreras) and from Vale de São Domingos municipality (N = 103) were captured from January 2002 to May 2003 by hand also during Environmental Impact studies of the Guaporé Hydroelectric Power Plant (UHE Guaporé). Lizard host were euthanized, fixed in formalin 10%, and preserved in 70% ethanol. Voucher hosts were housed at the Coleção Zoológica de Vertebrados do Instituto de Biociências da Universidade Federal de Mato Grosso (UFMT).

Parasitological studies consists of a longitudinal incision in hosts, being examined for endoparasites the body cavity, lungs, gall bladder and the gastrointestinal tract. Helminths found were placed in vials of 70 % ethanol for latter identification. For species identification, nematodes were cleared in phenol, and acanthocephalans, trematodes and cestodes were stained in carmine cleared with creosote, and were examined under a light microscope. Voucher specimens were deposited in the Coleção Helmintológica do Instituto de Biociências da Unesp de Botucatu (CHIBB).

Ecological terms used throughout the text follows Bush *et al*. (1997). The diversity of the nematode fauna associated with each host species was estimated using the Brillouin's Diversity Index (Magurran, 1988), considering only parasitized individuals. Classification of helminths follows Roca (1993): prevalence greater than 30% are considered core species and between 10-30% are considered secondary species. Generalists (not restricted to a single host species) and specialists (in single host species) helminths classification follows Bursey *et al*. (2005a).

For evaluate the effect of lizards body size, a Pearson correlation between lizard snout-vent length (SVL) and both the total number of parasites and number of helminth species for each lizard host were used. Differences in overall prevalence between areas were tested using the Z-test for proportions and for differences in diversity between areas we performed an ANOVA (Zar, 1984). For avoid comparisons between specimens collected in different areas and seasons, we performed between-species similarities in nematode community composition using Jaccard index for qualitative data only. To evaluate the similarity between areas qualitative data were subjected to UPGMA cluster analysis, using the Sorensen's coefficient of MVSP version 3.1 (Kovach Computing Services 2006).

RESULTS

A total of 300 individuals from 20 helminth species were recovered, including 1 acanthocephalan, 1 cestoda, 1 trematoda and 17 nematode species. Five of these infect more than one lizard species and 13 helminth species attained core status (Table 1). *Strongyluris oscari* and *Spauligodon oxkutzcabiensis* were the only core species in both areas.

The maximum number of helminth species per individuals host was 2; whereas the maximum number per lizard species was 5 (in the scincid lizard *Mabuya nigropunctata* from Vale de São Domingos). However, the higher diversity were attained by the anguid lizard *Ophiodes striatus* (Brillouin index = 0.26) from Araputanga, followed by the gymnophthalmid *Alopoglossus angulatus* (table 2).

The overall prevalence was 33.3%. A significant difference (Z=2.46, P=0.01) was observed between the prevalence of Vale de São Domingos (39.8%) and Araputanga (21.9%). The diversity between areas were not different ($F_{1, 17} = 2.27$, P = 0.15).

Heavy bodied lizard have more helminth species ($R = 0.30$, $P < 0.001$) and total number of parasites ($R = 0.32$, $P < 0.001$) than smaller ones; however, this occurred only at Araputanga ($R = 0.64$, $P < 0.001$ and $R = 0.45$, $P < 0.001$, respectively). At Vale de São Domingos, it is true for total number of parasites and lizard SVL ($R = 0.28$, $P = 0.004$), while number of helminth species were not correlated with lizard SVL ($R = 0.16$, $P = 0.12$).

No similarities were observed between lizard species from Araputanga municipality. At Vale de São Domingos, lizard species of the same family (as *Alopoglossus angulatus* and *Cercosaura eigenmanni*; *Anolis fuscoauratus* and *Polychrus liogaster*) showed higher similarities (Table 2). Besides, when helminth community composition was compared between areas, lizards were grouped both by family and by the same species of the different areas (Figure 1).

DISCUSSION

In this paper, 18 new hosts, 10 new State and one new country are reported for the recoverd helminths. Moreover, *Aplectana meridionalis* and *Cosmocerca parva* are reported for the first time in a reptilian host.

The higher number of core species and the lower number of generalist helminths found in the present study are unusual for reptiles, in which tend to harbor an isolationist helminth community, less diverse and dominated by generalist and secondary species (Aho, 1990). Several studies have corroborated these predictions, even in Neotropical areas (Bursey *et al*., 2005b; Bursey *et al*., 2007; Vrcibradic *et al*., 2000). However, our small sample size may be responsible for the pattern found.

Foraging mode has an impact on the establishment of helminth communities in lizard hosts (Aho, 1990). This has been controversial, especially in Neotropical region, where sit-and-wait foragers tend to harbor higher diversities (Ribas *et al.*, 1998). However, many authors have pointed that habitat and diet plasticity of sit-and-wait tropidurids may be related with the observed patterns (Van Sluys *et al*., 1994; Van Sluys *et al*., 1997; Vrcibradic *et al*., 2000). In the present study, active foragers showed higher diversity (*Ophiodes striatus* and *Alopoglossus angulatus*), but tropidurids are less represent in the sample, with only two species with few specimens.

Relationship between host body size and diversity and abundance of helminths are well known, and are explained by the availability of habitats provided by larger

hosts, which increases habitat segregation and niche differentiation opportunities (Kuris *et al*., 1980; Kehr *et al.*, 2000).

Aside from the absence of helminth community similarity between lizards in Araputanga, closeness relationships between phylogenetic lizards intra and inter areas are also found worldwide (see Aho, 1990).

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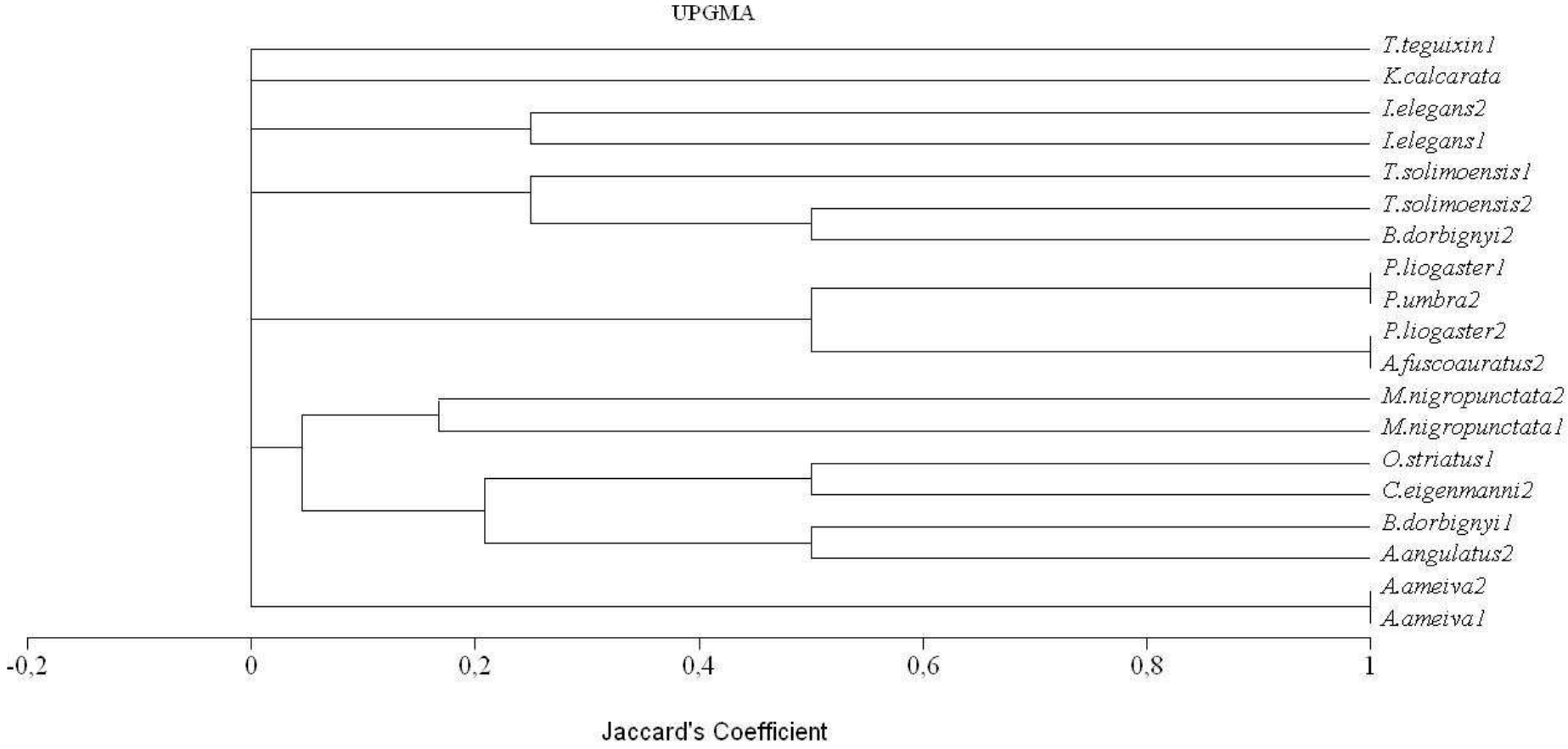

Figure 1 – Cluster analyses of similarities in helminth communities of lizards from two transition zones areas of western Brasil.

Table 1 - Epidemiological data from lizards (N = number of lizards examined) and their respectives parasites of two sites in transition zones Cerrado-Amazon, western Mato Grosso state, Brazil. For each host species the prevalence (P), mean intensitiy of infection (MII; mean ± sd) and sites of infection of each nematode are given. Abbreviations for sites of infection are: BC = Body cavity, S = Stomach, LI = Large intestine, SI = Small intestine, L = Lungs. The symbols capitalized are: [a]=new host record, [b]=new state record.

Host	**Parasite**	**Araputanga**			**Vale de São Domingos**			**SITE**
		N	**P**	**MII**	**N**	**P**	**MII**	
Ameiva ameiva	*Spinicauda spinicauda*[b]	10	40	5 ± 5.5	9	22.2	1	LI
Alopoglossus angulatus	*Cosmocerca* sp.	-	-	-	3	66.7	2.5 ± 2.1	LI
	Oswaldocruzia sp.[a]	-	-	-		33.3	2	SI
Anolis fuscoauratus	*Rhabdias* sp.	-	-	-	6	16.7	5	L
	Strongyluris oscari [b]	-	-	-		16.7	1	LI
Anolis punctatus	Not parasitized	-	-	-	1	-	-	-
Bachia dorbignyi	Centrorhynchidae larvae [a]	19	5.3	1	8	-	-	BC
	Oswaldocruzia sp. [a]		-	-		25	2	LI
Cercosaura eigenmanni	*Cosmocerca* sp.	1	-	-	9	55.5	2.4 ± 0.9	LI

Gonatodes hasemani	Not parasitized	8	-	-	8	-	-	-
Iphisa elegans	*Aplectana meridionalis* [a,b]	5	20	1	11	27.3	3 ± 2.6	SI, LI
	Cosmocerca parva [a,b]		-	-		9.1	1	LI
	Cosmocercoides sp. [a,b]		-	-		36.4	2.2 ± 1.5	SI, LI
	Parapharyngodon sp. [a]		-	-		9.1	2	LI
Kentropyx altamazonica	Not parasitized	7	-	-	1	-	-	-
Kentropyx calcarata	*Physaloptera* sp.	-	-	-	7	14.3	5	S
Mabuya nigropunctata	*Oochoristica travassosi* [a,b,c]	5	-	-	15	33.3	3 ± 1.9	SI
	Oswaldocruzia sp. [a]		-	-		13.3	1	SI, LI
	Parapharyngodon largitor [a,b]		40			26.7	2.3 ± 1.9	LI
	Parapharyngodon sceleratus [a]		20			-	-	LI
	Plagiorchis sp. [a,b]		-	-		6.7	1	S
	Skrjabinodon spinulosus [a,b]		-	-		6.7	21	SI, LI
Ophiodes striatus	Cosmocercidae larvae [a,b]	1	100	1	-	-	-	LI

	Physaloptera retusa		100	7		-	-	S
Plica umbra	*Strongyluris oscari*	-	-	-	3	33.3	1	LI
Polychrus liogaster	*Rhabdias* sp. [a]	2	-	-	6	16.7	1	L
	Strongyluris oscari [a]		50	1		66.7	7.5 ± 10.9	
Stenocercus sp.	Not parasitized	4	-	-	8	-	-	-
Thecadactylus solimoensis	Centrorhynchidae larvae [a]	3	-	-	7	14.3	-	BC
	Spauligodon oxkutzcabiensis [a]		100	16 ± 6.1		57.1	15.3 ± 18.8	LI
Tupinambis teguixin	*Diaphanocephalus diesingi* [b]	-	-	-	1	100	4	SI, LI

Table 2 – Brillouin diversity index (bold) and similarity coefficients (Jaccard) for lizard community at Vale de São Domingos municipality, western Mato Grosso Brazil.

	A.ameiva	*A.angulatus*	*A.fuscoauratus*	*B.dorbignyi*	*C.eigenmanni*	*I.elegans*	*K.calcarata*	*M.nigropunctata*	*P.umbra*	*P.liogaster*	*T.solimoensis*
A.ameiva	**0**										
A.angulatus	0	**0.15 ± 0.26**									
A.fuscoauratus	0	0	**0**								
B.dorbignyi	0	0	0	**0**							
C.eigenmanni	0	0.5	0	0	**0**						
I.elegans	0	0	0	0	0	**0.03 ± 0.11**					
K.calcarata	0	0	0	0	0	0	**0**				
M.nigropunctata	0	0.17	0	0	0	0	0	**0.07 ± 0.15**			
P.umbra	0	0	0.5	0	0	0	0	0	**0**		
P.liogaster	0	0	1	0	0	0	0	0	0.5	**0.02 ± 0.05**	
T.solimoensis	0	0	0	0.5	0	0	0	0	0	0	**0.01 ± 0.03**

ARTIGO 10

HELMINTHS OF LIZARDS FROM ARIPUANÃ, AN AMAZONIAN SITE AT WESTERN BRAZIL

HELMINTHS OF LIZARDS FROM ARIPUANÃ, AN AMAZONIAN SITE AT WESTERN BRAZIL

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ABSTRACT

Ninety-five specimens from 13 lizard species captured during the herpetofaunal monitoring program at the Faxinal II Power plant, Aripuanã municipality, Mato Grosso State, in the southern Amazon were surveyed for helminths. A total of 21 helminth species, including 16 nematodes, 1 cestode and 4 trematodes, were recovered, with an overall prevalence of 67.37%. Eighteen new host records and sixteen new locality records were reported. A lower number of specialists and core helminth species were found. There is a positive correlation with lizard body size and both total number of helminth species and individuals. Active foragers attain the higher helminth diversity, however, sit-and-wait foragers, especially *Plica plica*, showed diversities closer to active foragers and harbor more helminth species. Similarities between helminth fauna were higher between phylogenetic closest host species.

Key-words: Parasitism, Squamata, Cestoda, Trematoda, Nematoda

INTRODUCTION

The Brazilian Amazon harbors more than 100 species of lizards (Ávila-Pires, 1995). Despite this great diversity, studies dealing with helminths of Amazonian lizards are scarce basically consisting in species descriptions (see Alho, 1965; Bain, 1974; Freitas & Lent, 1938). Recently, there are an increase of studies, and many species, such as *Allopharynx daileyi* from *Uranoscodon superciliosus* (Bursey *et al*. 2005a); *Cosmocerca vrcibradici* in *Cercosaura eigenmanni* and *C. oshaughnessyi* (Bursey & Goldberg, 2004) are described.

At the same manner, autoecological studies have also increased, and many species were investigated, such as the *Anolis fuscoauratus* (Goldberg *et al*. 2006a), *Anolis punctatus* and *K. transversalis* (Goldberg *et al*. 2006b), *Alopoglossus angulatus* and *A. atriventris* (Goldberg *et al*. 2007a), *Kentropyx calcarata, Leposoma osvaldoi* and *Potamites ecpleopus* (Goldberg *et al*. 2007b).

However, those studies are restricted to the north portion of Brazilian Amazon, while the southern part has no investigation. In this study, we conducted an analysis of the helminth fauna of a lizard community at Aripuanã municipality, Mato Grosso State, Brazil in the southern Amazon.

MATERIALS AND METHODS

Lizards (N = 95) were captured during the herpetofaunal monitoring program of the Faxinal II hydroelectric power plant (10º 9' 0"S, 59º 27' 0"W) at Aripuanã municipality, Mato Grosso State, Brazil. Captures were made by pitfall traps with drift fences and by hand from September 2006 to July 2008. Lizard host were euthanized, fixed in formalin 10%, and preserved in 70% ethanol. Voucher hosts were housed at the Coleção Zoológica da Universidade Federal de Mato Grosso (UFMT).

At laboratory, longitudinal incisions were made in hosts, and body cavity, lungs, gall bladder and the gastrointestinal tract were examined for endoparasites. Helminths found were placed in vials of 70% ethanol for latter identification. For species identification, nematodes were cleared in phenol, trematodes and cestodes were stained in carmine cleared with creosote. All helminths were examined under a light microscope. Voucher specimens were deposited in the Coleção Helmintológica do Instituto de Biociências da Unesp de Botucatu (CHIBB).

Ecological terms used throughout the text follows Bush *et al*. (1997). The diversity of the nematode fauna associated with each host species was estimated using the Brillouin's Diversity Index (Magurran, 1988), considering only parasitized individuals. Classification of

helminths follows Roca (1993): prevalences greater than 30% are considered core species and between 10-30% are considered secondary species. Generalists (not restricted to a single host species) and specialists (in single host species) helminths classification follows Bursey *et al.* (2005b). For evaluate the effect of lizards body size, we made a Pearson correlation between lizard snout-vent length (SVL) and both the total number of parasites and number of helminth species for each lizard host. For avoid comparisons between specimens collected in different areas and seasons, we performed between-species similarities in nematode community composition using Jaccard index for qualitative data only. To evaluate the similarity between species, the qualitative data were subjected to UPGMA cluster analysis, using the Sorensen's coefficient of MVSP version 3.1 (Kovach Computing Services 2006).

RESULTS

We recovered 74,167 helminths from 21 species, including 16 nematodes, 1 cestode and 4 trematodes. The overall prevalence was 67.37%. The nematodes *Physaloptera retusa* and *Parapharyngodon sceleratus*, found in stomach and large intestine, respectively, were found infecting more lizard species (n = 6), followed by the trematode *Mesocoelium monas*, which infect three lizard species (Table 1). Of the 41 records, few helminths (36.6%) can be considered as core species, and the majority is considered as secondary species. *Physaloptera retusa* attained the status of core species in more lizard species (Table 1).

The overall prevalence was 67.4 %.. Two (2.1%) individual lizards belonging to sit-and-wait foraging mode harbors more helminth species (n = 4): one *Iguana iguana* and one *Plica plica*. Eleven (11.6%) individual lizards were found to harbor three helminth species (active foragers: 6 *Ameiva ameiva* and 2 *Kentropyx calcarata*; sit-and-wait foragers: 2 *Plica plica* and 1 *Anolis fuscoauratus*). Another 20% harbor two helminth species and the majority (33.7%) were infected by one helminth species.

The higher diversity were found in the teiid *Ameiva ameiva* (0.46 ± 0.32), followed by the tropidurid *Plica plica* (0.36 ± 0.28) and the polychrotid *Anolis fuscoauratus* (0.27 ± 0.36; Table 2). However, *P. plica* was found to harbor more helminth species (7; Table 1).

Both the total number of helminth species ($R = 0.53$, $P < 0.001$) and total number of parasites ($R = 0.66$, $P < 0.001$) were correlated with lizard SVL. The similarities of helminth fauna were higher between phyllogenetic closest lizard species, such as two pairs of gekkotans (*T. solimoensis* - *H. mabouia* and *G. humeralis* - *C. amazonicus* and the tropidurids *P. plica* and *U. superciliosum* (Figure 1). Three species (*I. iguana*, *H. spinosus* and *A. phyllorhynus*) showed no similarity between helminth fauna with any lizard species.

DISCUSSION

Aside from our small sample size for many lizard species, eighteen new host records and sixteen new locality records were reported in the present paper, what is considered a substantial contribution for the Amazon region.

Aho (1990) stated that helminth fauna of reptiles are depauperate when comparing with other vertebrates and, moreover, are dominated by generalist species. Likewise, many studies from Neotropical region (e.g. Vrcibradic *et al*. 2000; Bursey *et al*. 2005c) and our results corroborate Aho's depictions.

An interesting pattern of helminth richness between lizards that exhibited different foraging modes was observed in the present study. The higher diversity was attained by the active forager *Ameiva ameiva*, which were followed by the sit-and-wait forager *Plica plica*. However, when the total number of helminth species per individuals and species were analyzed, sit-and-wait foragers tend to harbor more than active foragers. Although Aho (1990) suggested that active foragers tend to harbor a richer and complex helminth fauna, many studies from Brazilian lizards showed an opposite trend, with tropidurids having the richest fauna (see Ribas *et al*. 1998; Vrcibradic *et al*. 2000). A diversified diet, with higher values of niche breadth, including plant material and higher percentages of ants may be responsible by this pattern (Vrcibradic *et al*. 2000). Like populations of *Tropidurus*, lizards of the genus *Plica* have a diversified diet, with greater proportions of ants (Vitt, 1991).

Lizard body size has an effect on diversity and abundance of helminths, and this relationship were tested in many lizard species (Fontes *et al*, 2003; Rocha *et al*, 2003; Anjos *et al*, 2005). According to Kuris *et al*. (1980), this relationship is compared to the MacArthur and Wilson Island Biogeography Theory, in that hosts may act as islands. Besides provides larger sites, body size has a deep impact in other ecological features of lizards, such as diets and habitat use (see Pianka and Vitt, 2003), thus influencing associated helminth fauna.

Similarities in helminth fauna tend to be higher between closely related sympatric lizards (see Aho, 1990, Vrcibradic *et al*. 2000). Phylogeny has a deep impact on lizard ecology (Pianka and Vitt, 2003), and this reflects in establishment of helminth communities (Poulin 1997). This may be explain the similarities found in our study, and partly may be related with differences found in *I. iguana* and *H. spinosus*, but not the difference in *A. phyllorhynus*. In this latter, the small sample size should be related with lower similarity, as well as the poorest helminth fauna.

In short, the patterns found in the present study agree with those found from reptiles, i. e., a depauperate fauna characterized by many generalist species and a higher similarity probably due to host phylogeny.

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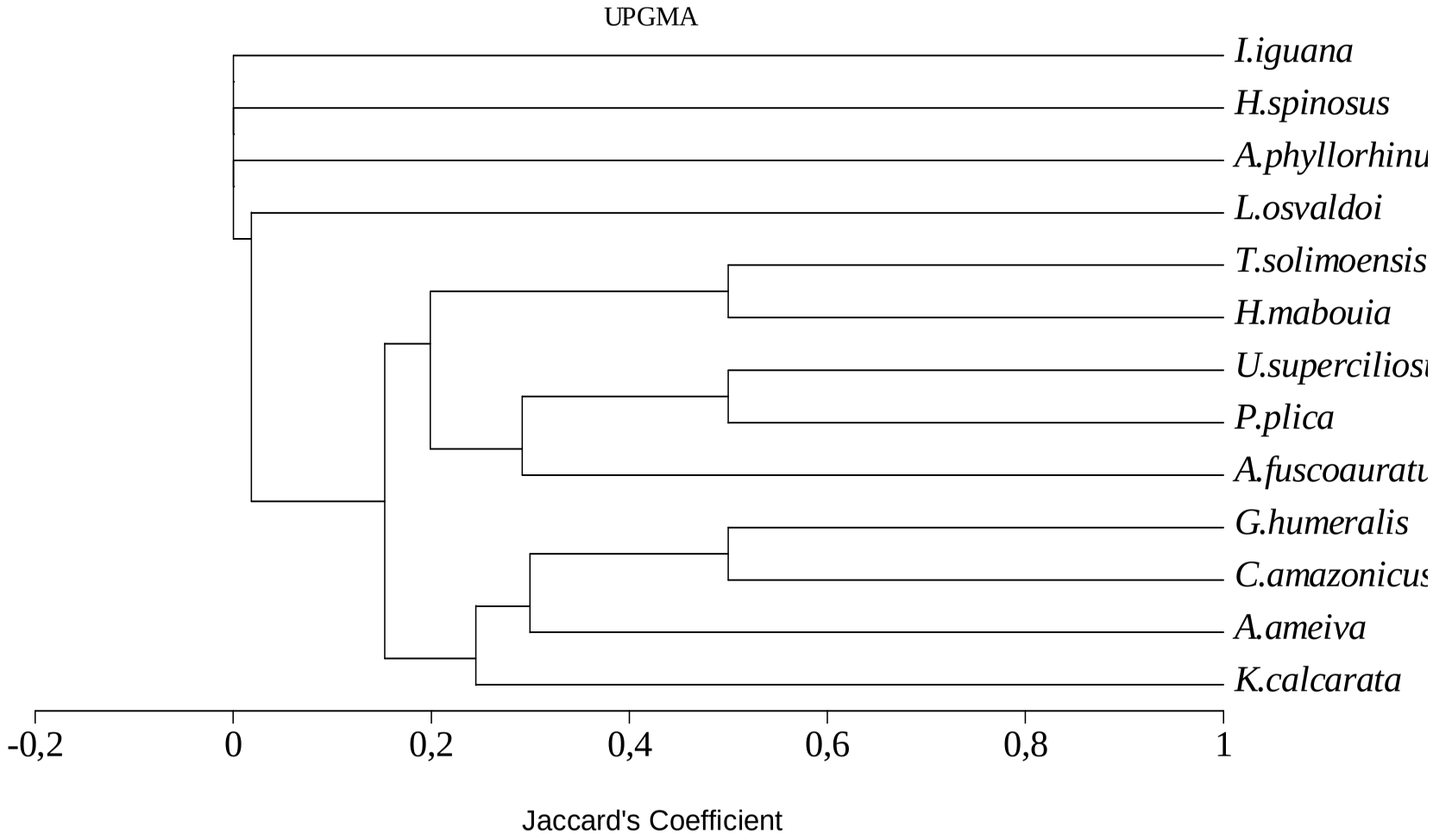

FIGURE 1 – Cluster analysis of similarity of helminth community from lizards at Aripuanã municipality, southern Amazon, Mato Grosso State, Brazil.

Table 1 – Epidemiological data from lizards (N = number of lizards examined) and their respectives parasites in Aripuanã municipality, Mato Grosso State, Brazil. For each host species the number of specimens examined (N), mean snout-vent length (SVL), prevalence (P), mean intensity of infection (MII; mean ± sd) and sites of infection of each nematode are given. Abbreviations for sites of infection are: BC = Body cavity, S = Stomach, LI = Large intestine, SI = Small intestine, L = Lungs. The symbols capitalized are: [a] = new host record, [b] = new state record.

Host	N	SVL	Parasite	P	MII	SITE
IGUANIDAE						
Iguana iguana	7	154.7 ± 104.8	*Alaeuris vogelsangi*[b]	14.3	34400	LI
			Cosmocercidae larvae	14.3	1	L
			Helicotrema magniovatum[b]	28.6	11 ± 8.5	SI
			Ozolaimus cirratus[b]	14.3	12241	SI, LI
			Ozolaimus megatyphlon[b]		6585 ± 7786.7	LI
HOPLOCERCIDAE						
Hoplocercus spinosus	3	89.8 ± 8.6	*Africana dardanelosi* sp. nov.	100	7 ± 8.7	
POLYCHROTIDAE						
Anolis fuscoauratus	4	42.9 ± 3.3	*Mesocoelium monas*[a, b]	25	8	SI
			Oswaldocruzia vitti[b]	25	4	LI
			Physaloptera retusa[b]	50	3 ± 1.4	S
			Skrjabinellazia galliardi[a, b]	25	2	LI
			Strongyluris oscari[b]	50	1	LI
Anolis ortonii	1	42.7	Not parasitized	-	-	-

Anolis phyllorhinus	1	82.3	*Oswaldofilaria* sp. [a]	100	1	BC
TROPIDURIDAE						
Plica plica	13	105 ± 29.4	*Mesocoelium monas*[a, b]	15.4	6.5 ± 7.8	SI
			Paradistomum parvissimum[a, b]	7.7	1	BV
			Parapharyngodon sceleratus[a, b]	23.1	2.7 ± 1.5	LI
			Piratuba sp. [a]	7.7	1	LI
			Physaloptera lutzi[a]	7.7	70	S
			Physaloptera retusa	84.6	36.7 ± 38.9	S, SI
			Strongyluris oscari	69.2	18.8 ± 19.1	SI, LI
Uranoscodon superciliosum	10	101.2 ± 31.6	*Allopharynx daileyi*[b]	40	6.5 ± 6.4	SI
			Mesocoelium monas	10	2	SI
			Paradistomum parvissimum[a]	10	18	BV
			Parapharyngodon sceleratus[a]	10	1	LI
			Strongyluris oscari[a]	20	3 ± 1.4	LI
GEKKONIDAE						
Hemidactylus mabouia	6	56.5 ± 11.3	*Parapharyngodon sceleratus*	16.7	6	LI
PHYLLODACTYLIDAE						
Thecadactylus solimoensis	3	115.5 ± 26.7	*Mesocoelium monas*[a]	33.3	8	SI
			Parapharyngodon sceleratus[a]	33.3	11	SI, LI
SPHAERODACTYLIDAE						

Coleodactylus amazonicus	4	21.9 ± 0.6	*Physaloptera retusa*[a]	75	3 ± 1.7	S
Gonatodes hasemani	3	33.1 ± 4.2	Not infected	-	-	-
Gonatodes humeralis	8	34.4 ± 3.4	*Parapharyngodon sceleratus*[a]	37.5	1.3 ± 0.6	LI
			Physaloptera retusa[a]	25	10 ± 12.7	S
TEIIDAE						
Ameiva ameiva	12	113.4 ± 23.2	*Oochoristica ameivae*[b]	41.67	9.2 ± 10.8	SI
			Parapharyngodon sceleratus	25	1	LI
			Physaloptera retusa	75	7.2 ± 11.9	S
			Physalopteroides venancioi	8.3	1	S
			Spinicauda spinicauda	83.3	14.9 ± 32.5	LI, SI
Kentropyx calcarata	10	79.3 ± 16.5	*Kentropyxia sauria*[b]	30	11 ± 14.1	SI
			Oochoristica ameivae[a]	20	1	SI
			Paradistomum parvissimum[a]	10	25	BV
			Physaloptera retusa	60	3.7 ± 4.4	S
GYMNOPHTHALMIDAE						
Cercosaura eigenmanni	2	41.1 ± 0.5	Not parasitized	-	-	-
Leposoma osvaldoi	8	29.7 ± 4.5	*Cosmocerca* sp.	12.5	6	LI
			Oswaldocruzia vitti[a, b]	25	2.5 ± 2.1	SI

Table 2 – Similarity (Jaccard index) and Brillouin diversity index (bold type in diagonal) of helminth for lizards at Aripuanã municipality, Mato Grosso, Brazil. Kc = *Kentropyx calcarata*, Aa = *Ameiva ameiva*, Af = *Anolis fuscoauratus*, Ap = *Anolis phyllorhynus*, Ca = *Coleodactylus amazonicus*, Gh = *Gonatodes humeralis*, Hm = *Hemidactylus mabouia*, Hs = *Hoplocercus spinosus*, Ii = *Iguana iguana*, Lo = *Leposoma osvaldoi*, Pp = *Plica plica*, Ts = *Thecadactylus solimoensis*, Us = *Uranoscodon superciliosus*.

	Kc	Aa	Af	Ap	Ca	Gh	Hm	Hs	Ii	Lo	Pp	Ts	Us
Kc	**0.15±0.38**												
Aa	0.29	**0.46±0.32**											
Af	0.13	0.11	**0.27±0.36**										
Ap	0	0	0	**0**									
Ca	0.25	0.20	0.20	0	**0**								
Gh	0.20	0.40	0.17	0	0.50	**0**							
Hm	0	0.20	0	0	0	0.50	**0**						
Hs	0	0	0	0	0	0	0	**0**					
Ii	0	0	0	0	0	0	0	0	**0.13±0.29**				
Lo	0	0	0.17	0	0	0	0	0	0,00	**0**			
Pp	0.22	0.20	0.33	0	0.14	0.29	0.14	0	0	0	**0.36±0.28**		
Ts	0	0.17	0.17	0	0	0.33	0.50	0	0	0	0.29	**0.20±0.34**	
Us	0.13	0.11	0.25	0	0	0.17	0.20	0	0	0	0.50	0.40	**0.07±0.15**