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

BOTUCATU – SP
2009
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**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-hospeiro 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-hospeiro 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,
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.

REFERÊNCIAS BIBLIOGRÁFICAS


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), Espírito 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 Ríos (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 Paraguái (AP), Alto Paráná (AA), Amambay (AM), Distrito Capital (DC), Boquerón (BO), Caaguazú (CA), Caazapá (CZ), Canindeyú (CN), Central (CE), Concepción (CO), Cordillera (CR), Guaira (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), Chocó (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), Junín (JU), La Libertad (LL), Lambayeque (LA), Lima (LI), Loreto (LO), Madre de Dios (MD), Moquegua (MO), 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 Ríos (LR), Los Lagos (LL), Magallanes (MG), Maule (MA), O'Higgins (OH), Santiago (AS), Tarapacá (TA) and Valparaíso (VA).

Uruguay: Artigas (AR), Canelones (CA), Cerro Largo (CL), Colónia (CO), Durazno (DU), Flores (FL), Florida (FO), Lavalleja (LA), Maldonado (MA), Montevideo (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.

Archiacanthocephala
Oligacanthorhynchida
Oligacanthorhynchidae
Oligacanthorhynchus Travassos, 1915
*Oligacanthorhynchus* sp.
Hosts: *Ameiva ameiva* Linnaeus, 1758
Distribution: PARAGUAY: Rio Negro (Chaco), PH

Palaeacanthocephala
Echinorhynchida
Echinorhynchidae
Hosts: *Mabuya macrorhyncha* Hoge, 1946
Site of infection: Stomach wall
Distribution: BRAZIL: Trancoso (Restinga), BA
Comments: No indication of genus.

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

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

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

Polymorphida
Centrorhynchidae
Site of infection: Peritonium, liver; mesentery
Distribution: BRAZIL: Queimada Grande island (Atlantic forest) and Valinhos (Cerrado), SP; Grussaí (Restinga) and Nova Iguacu (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)  

NEMATODA  
Adenophorea  
Enoplida  
Capiliariidae  
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  
Ascarididae

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)  

*Freitasascaris* Sprent, 1983

*Freitasascaris alata* Baylis, 1947  
Hosts: *Tupinambis teguixin*  
Site of infection: intestine  
Distribution: SURINAM: PR (Amazon); BRAZIL: AM (Amazon); URUGUAY: MO  

*Hexametra* Travassos, 1919

*Hexametra boddartii* Baird, 1860  
Site of infection: Body cavity  
Distribution: BRAZIL: Jurubatiba, Grussaí and Marica (Restinga), RJ; Salvador and Trancoso (Restinga), BA; Valinhos (Cerrado), SP  
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


*Maracaya gracai* Díaz-Ungría, 1969

Hosts: *Amphisbaena alba*

Site of infection: intestine

Distribution: VENEZUELA: Maracay, AR


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

Hosts: *Amphisbaena* sp.

Site of infection: intestine
Distribution: BRAZIL: BA

Cosmocercidae

gen. sp.
Hosts: Cercosaura argulus Peters, 1863
Site of infection: small intestine
Distribution: PERU: Rio Nanay (Amazon), LO

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

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

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
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
**Paradollfusnema** Baker, 1982

*Paradollfusnema amphisbaenia* Baker, 1981

Hosts: *Leposternon microcephalum*

Site of infection: intestine

Distribution: BRAZIL: Recife, PE


**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 tequixin*

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

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 synonymized 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

**Falcaustra Lane, 1915**

*Falcaustra belemensis* Baker & Bain, 1981
Hosts: *Neusticurus bicaurinus* Linnaeus, 1758, *Potamites ecpleopus* Cope, 1876
Site of infection: intestine
Distribution: BRAZIL: Altamira and Belém (Amazon), PA

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

**Seuratidae**

*Skrjabinelazia Sypliakov, 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).


\textit{Skrjabinellazia intermedia} Freitas, 1940


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 \textit{Salobrella intermedia} from \textit{Tropidurus spinulosus} of Salobra, MS. See comments on host taxonomy at \textit{Strongylurus oscari}.


\textbf{Subuluridae}

\textit{Subulura} Molin, 1860

\textit{Subulura lacertilia} Vicente, Van-Sluys, Fontes & Kiefer, 2000

Hosts: \textit{Eurolophosaurus nanuzae}, \textit{Cnemidophorus nativo}

Site of infection: intestine

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


\textit{Subulura} sp.

Hosts: \textit{Tropidurus torquatus}

Site of infection: small intestine

Distribution: BRAZIL: Jurubatiba (Restinga), RJ


\textbf{Oxyurida}

\textbf{Oxyuridae}

\textit{Gynaecometra} Araújo, 1976

\textit{Gynaecometra bahiensis} Araujo, 1976

Hosts: \textit{Polychrus acutirostris} Spix, 1825

Site of infection: intestine

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

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

Alaeuris galapagensis Cuckler, 1938
Hosts: Conolophus subcristatus Gray, 1831
Site of infection: intestine
Distribution: ECUADOR: Galapagos Islands

Alaeuris labicula Cuckler, 1938
Hosts: Conolophus subcristatus
Site of infection: intestine
Distribution: ECUADOR: Galapagos Islands
*Alaeuris longispicula* Cuckler, 1938  
Hosts: *Conolophus subcristatus*  
Site of infection: intestine  
Distribution: ECUADOR: Galapagos Islands  

*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

**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

*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*

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

*Parapharyngodon sceleratus* Travassos, 1923


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, Umbuzeiro 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 sensifaciecaudus* 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)

*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.

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

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

*Pharyngodon* sp.
Hosts: *Tropidurus torquatus, Tropidurus hispidus* Spix, 1825
Site of infection: intestine
Distribution: BRAZIL: Salvador, BA; CE

*Pseudostrongyluris* Guerrero, 1971
*Pseudostrongyluris polychrus* Guerrero, 1971
Hosts: *Polychrus marmoratus*
Site of infection: not informed
Distribution: VENEZUELA: Federal District

*Skrjabinodon* Inglis, 1968
*Skrjabinodon dixoni* Bursey & Goldberg, 2007
Hosts: *Uracentron flaviceps* (Guichenot, 1855)
Site of infection: large intestine
Distribution: PERU: LO (Amazon); ECUADOR: SU
*Skrjabinodon* heliocostai Vicente, Vrcibradic, Muniz-Pereira & Pinto, 2000
Hosts: *Mabuya frenata*
Site of infection: large intestine
Distribution: BRAZIL: Valinhos (Cerrado), SP

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

*Spauligodon* Skrjabin, Schikhobalova & Lagodovsk., 1960

*Spauligodon lobo* Ramallo, Bursey & Goldberg (2002)
Site of infection: large intestine
Distribution: ARGENTINA: Tafí del 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

*Spauligodon maytacapaci* Vicente & Ibañez (1968)
Site of infection: intestine
Distribution: PERU: Pumarongo, CA; ARGENTINA; CHILE

*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.

*Spauligodon viracochai* Freitas, Vicente & Ibañez, 1968
Site of infection: intestine
Distribution: PERU: Trujilo, LL and IC

*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

*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


**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).

**Filaridae**

*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.


**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

**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)

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

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


**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”.


**Physaloptera** Rudolphi, 1819

*Physaloptera lutzi* Cristofaro, Guimarães & Rodrigues, 1976


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


Physaloptera retusa Rudolphi, 1819


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 Itiparina (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, Cumúná (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 ocellifer* 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 & Vogelsang (1947); Roca (1997); Vrcibradic et al. (2007).
Physaloptera sp.
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. meriana (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
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  

**Spiruridae**

*Spirurinae*

Hosts: *Hemidactylus mabouia*  
Site of infection: stomach, lungs, and small intestine  
Distribution: BRAZIL: Rio de Janeiro, RJ  

**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).

**Diaphanoccephalidae**

*Diaphanoccephalus Diesing, 1851*

*Diaphanoccephalus diesingi* Freitas & Lent, 1938  
Hosts: *Tupinambis teguixin*  
Site of infection: small intestine  
Distribution: BRAZIL: Belém (Amazon), PA  

*Diaphanoccephalus 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

*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

*Oswaldocruzia benslimanei* Durette-Desset, Anjos & Vrcibradic, 2006
Hosts: *Enyalius bilineatus* Duméril & Bibron, 1837
Site of infection: small intestine
Distribution: BRAZIL: Marechal Floriano, ES

*Oswaldocruzia brasiliensis* Lent & Freitas, 1935
Hosts: *Hemidactylus mabouia*
Site of infection: small intestine
Distribution: BRASIL: Rio de Janeiro, RJ

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

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

*Oswaldocruzia peruensis* Ben-Slimane, Verhaag & Durette-Desset, 1995
Hosts: *Stenocercus roseiventris*, *Cercosaera 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, Chasmophorus 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 Führmann, 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).

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

Oochoristica insulamargaritae López-Neyra and Diaz-Ungría, 1957
Hosts: Ameiva ameiva
Site of infection: small intestine
Distribution: VENEZUELA: Isla Margarita

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 vanzolini* Rego & Oliveira-Rodrigues, 1965
Hosts: *Hemidactylus mabouia, Eurolophosaurus nanuzea*
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

**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  

**Ophiotaenia La Rue, 1911**  
*Ophiotaenia flava* Rudin, 1917  
Hosts: *Kentropyx pelviceps*  
Site of infection: not informed  
Distribution: PERU: CU (Amazon)  

*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.  

*Ophiotaenia sp.*  
Hosts: *Anolis fuscoauratus*  
Site of infection: small intestine  
Distribution: BRAZIL: Santarém (Amazon), PA  

**Tejidotaenia Freze, 1965**  
*Tejidotaenia appendiculata* (Baylis, 1947)  
Hosts: *Tupinambis tejuixin*  
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 Echinostomoidea Looss, 1899

Cathaemasiidae
*Pulchrossomoides* Freitas & Lent, 1937
_Pulchrosomoides elegans_ Freitas & Lent, 1937
Hosts: *Tupinambis tequixin*, *Iguana iguana*, *Mabuya macrorhyncha*
Site of infection: stomach
Distribution: BRAZIL: Porto Esperança (Pantanal), MS; Praia das Neves (Restinga), ES

Plagiorchiida
Dicrocoeliidae
*Brachycoelium* (Dujardin, 1845)
*Brachycoelium salamandrae* (Frolich, 1789) Dujardin, 1845
Site of infection: small intestine
Distribution: BRAZIL: Novo Progresso (Amazon), PA

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

*Helicotrema spirale* (Diesing, 1850) Odhner, 1912
Hosts: *Iguana iguana*
Site of infection: intestine
Distribution: BRAZIL

**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 lutzei, Mabuya macrorhyncha, M. agilis, Tropidurus torquatus, Tupinambis teguixin
Site of infection: gall blader, liver, small intestine
Distribution: Brazil: Arraial do Cabo, Grussaí, Nova Iguacu, 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).

Macrodideridae

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  

**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 graciae*

*Aplectana albae*

*Aplectana raillieti*

*Physaloptera retusa*

*Semenoviella amphisbaenae*

*Pneumotrema travassosi*

*Amphisbaena bolivica*

*Aplectana tucumanensis*

*Amphisbaena fuliginosa*

*Semenoviella amphisbaenae*

*Amphisbaena sp.*

*Maracaya pusilla*

*Mesocoelium monas*
Lepistemnon 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 asymmetricum
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 salamandrace*

**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  
Strongylurus oscari  
Mesocestoides sp.

**Polychrus acutirostris**  
Gynaecometra bahiensis  
Physaloptera sp.

**Polychrus marmoratus**  
Pseudostrongylurus polyulus  
Oswaldofilaria azevedoi  
Piratuba lainsoni

**FAMILY LEIOSAURIDAE**

**Enyalius bilineatus**  
Centrorhynchidae  
Rhabdias sp.  
Acuariidae  
Physaloptera lutzi  
Physaloptera retusa  
Oswaldocruzia benslimanei

**Enyalius catenatus**  
Oswaldocruzia sp

**Enyalius iheringii**  
Strongylurus 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 lobo

**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 lacertilia*  
*Parapharyngodon sceleratus*  
*Physaloptera lutzi*  
*Oochoristica vanzolinii*

**Leiocephalus sp.**  
*Spauligodon mayacapaci*  
*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
*Theilandros* sp
*Physaloptera* sp.

**Tropidurus guarani**
*Strongyluris oscari*
*Skrjabinellazia intermedia*
*Typhlonema* sp.
*Parapharyngodon sceleratus*
*Spauligodon oaxtzcabiensis*
*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 semitaenius**
- Parapharyngodon sceleratus

**Tropidurus spinulosus**
- Strongyluris oscari

**Tropidurus torquatus**
- Acanthocephala
- Echinorhynchus sp.
- Centrorhynchus tumidulus
- Capillaria (=Amphibiocapillaria) freitaslenti
- Hexametra boddaertii
- Strongyluris oscari
- Skrabinellazia 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

Phyllocaustylus angustidigitus
Spauligodon viracochai

Phyllocaustylus 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 lacertilia
Parapharyngodon sp
Physaloptera retusa
Physalopteroides venancioi
Oochoristica ameivae

Cnemidophorus ocellifer
Hexametra boddaerti
Physaloptera retusa
Physaloptera sp.

Cnemidophorus sp.
Pharyngodon cesarpintoi

Dicrodon heterolepis
Pharyngodon micrurus
Thubunaea parkeri
Oochoristica freitasi

Dicrodon holmbergi
Thelandros capacypanquii

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 meriana**

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 GYMNOPTHALMIDAE
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 salamandrace

**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
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
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 Helminológica 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. meriana* (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.


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.


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 meriana*e 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.
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.
Site of infection: small intestine.
Type host: *Tupinambis teguixin*
Other reported hosts: *T. meriana*e 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.

*Skrijabinellazia intermedia* Freitas, 1940 (CHIBB 3278)

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


Site of infection: small and large intestine

Type host: *Tropidurus* sp.


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 synonymized 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, 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 Km², 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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LITERATURE CITED


ARTIGO 3

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

Seventy specimens representing nineteen species of lizards (Ameiva ameiva, Anolis nitens brasiliensis, A. meridionalis, Bachia bresslaii, Cercosaura schreibersii, Cnemidophorus cf. parecis, Colobosaura modesta, Hemidactylus mabouia, Kentropyx paulensis, Mabuya dorsivittata, M. frenata, M. nigropunctata, Micrablepharus atticus, Ophiodes striatus, P. acutirostris, Tropidurus itambere, T. oedicus, 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. bresslaii, C. schreibersii, Colobosaura modesta, K. paulensis, M. frenata, Micrablepharus atticus, and T. torquatus) were uninfected. Thirteen species of nematodes (Cruzia travassosi, Gynaeometra 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
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 & Williams, 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.


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.

**Polychrus acutirostris Spi**, 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.


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*


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 below:

*Oochoristica* sp. (CHIBB 4011)

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


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.
Site of infection: stomach.
Type host: *Tupinambis teguixin*.

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.


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.


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.
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**

*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.
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.
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.
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 them 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 Gymnophthalmidae 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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LITERATURE CITED


ARTIGO 4

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

Sixty-three specimens from 17 lizard species (Ameiva ameiva, Bachia bresslaui, B. scoleoides, 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 Km², 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 bresslauri* (N = 2; SVL = 78.8 ± 6.7 mm); *B. scoleoides* (N = 15; SVL = 67.4 ± 5.2 mm); *Cercosaura ocellata* (N = 1; SVL = 47.7 mm); *C. schreibersii* (N = 1; SVL = 67.4 ± 5.2 mm); *Gonatodes eladioi* (N = 2; SVL = 32.2 ± 1.7 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.


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*. 

**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.
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*.

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


*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).
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*.

*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).
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);

**Gekkonidae**

*Hemidactylus mabouia* Moreau de Jonnés, 1818
Five specimens from two municipalities (Cuiabá and Rondonópolis), both located at 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.
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.


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.


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.


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.
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.
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).
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.
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).
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.
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.
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.
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.
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*.

**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.
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.
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*.

**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.
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.
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 Gymnophthalmidae 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 meriana show 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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LITERATURE CITED


ARTIGO 5

HELMINTHS OF THE TEIID LIZARD KENTROPYY 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 *Kentropyx*
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.

ACKNOWLEDGEMENTS

We would like to thank the Instituto de Biociências da Universidade Federal de Mato Grosso, specially Ricardo A. K. Ribeiro and Marcos A. Carvalho for provided lizards for this parasitological study. This study had financial support by FAPESP (process 06/59692-5). RWA thanks CAPES for a grant.

REFERENCES


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.

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<th>Intensity of Infection</th>
<th>Mean Abundance</th>
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<td><em>Piratuba shawi</em>&lt;br&gt;<em>Kentropyxia sauria</em></td>
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<td><em>Baker 1982, Baker 1987</em></td>
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PARTE 3

RELACOES ECOLÓGICAS EM COMUNIDADES DE LAGARTOS DO
BRASIL CENTRAL
ARTIGO 6

HELMINTHS OF LIZARDS FROM PANTANAL, BRAZIL
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.
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/parasite 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 km² 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 Nhcolândia and 41.82% in Poconé. The highest prevalence noted in the Miranda region were different from Corumbá (Z = 3.12, P = 0.02) and Nhcolândia (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. meriana* 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.

ACKNOWLEDGMENTS

This study had financial support by FAPESP (process 06/59692-5). RWA thanks CAPES for a grant. We would like to thank Marcos André de Carvalho, for gently provided lizards for dissection.

LITERATURE CITED


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 respective parasites in four regions of the Pantanal, Brazil. For each host species the prevalence (P), intensity 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: =new host record, =new state record, =new country record

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**PHYLLODACTYLIDAE**

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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*.

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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.

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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.

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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*.

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ARTIGO 7

HELMINTHS OF A LIZARD COMMUNITY AT A CERRADO SITE
FROM CENTRAL BRAZIL
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 Oochristica 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 significant 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. Forty-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 Aquidauna municipality (Table 2), whereas Ameiva ameiva presented the highest diversity in Dois Irmãos do Buriti municipality (Table 3).

Overall diversity of helminths in Aquidauna municipaliy were higher than the Dois Irmãos do Buriti municipality (F1,24 = 11.47, P = 0.002). Mean number of helminth species/host species (infected ones) in Aquidauna municipality was 2.75 ± 1.71 and in
Dois Irmãos do Buriti was $1.60 \pm 0.89$. *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 phylogenetically closer (Table 2-3; Figure 1). Beyond similarities 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.

**ACKNOWLEDGMENTS**

This study had financial support by FAPESP (process 06/59692-5). RWA thanks CAPES for a grant.

**LITERATURE CITED**


Figure 1 – Cluster analysis of helminth communities of lizards at two Cerrad 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 respective parasites in Cerrado at two municipalities of the Mato Grosso do Sul State, Brazil. For each host species the 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.

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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*.

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<th>O.s</th>
<th>P.p</th>
<th>P.a</th>
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<th>T.o</th>
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Table 3 – Brillouin diversity index (bold) and similarity coefficients (Jaccard) for lizard community at Dois Irmãos do Buriti municipality.

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ARTIGO 8

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

One hundred-seventy specimens from 26 lizard 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 phylogenetic 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 recovered. Some individuals, such as Filariididae and Cosmobecercidae 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 al., 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).

ACKNOWLEDGMENTS

This study had financial support by FAPESP (process 06/59692-5). RWA thanks CAPES for a grant. We would like to thank Marcos André de Carvalho for gently provided lizards for dissection.
LITERATURE CITED


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 respective parasites in Cerrado at Chapada dos Guimarães, Mato Grosso state, Brazil. For each host species the 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, "c"= new country record.

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<th>Parasite</th>
<th>P</th>
<th>MII</th>
<th>SITE</th>
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ARTIGO 9

HELMINTHS OF TWO LIZARD COMMUNITY AT TRANSITION
ZONES CERRADO-AMAZON, WESTERN MATO GROSSO, BRAZIL
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 (F1, 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 recovered 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).

ACKNOWLEDGMENTS
This study had financial support by FAPESP (process 06/59692-5). RWA thanks CAPES for a grant. We would like to thank Marcos André de Carvalho for gently provided lizards for dissection.

LITERATURE CITED


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 respective parasites of two sites in transition zones Cerrado-Amazon, western Mato Grosso state, Brazil. For each host species the 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.

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<th>Parasite</th>
<th>Araputanga</th>
<th>Vale de São Domingos</th>
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<td></td>
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<td>N  P  MII</td>
<td>N  P  MII</td>
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<td>Ameiva ameiva</td>
<td><em>Spinicauda spinicauda</em> (^b)</td>
<td>10 40 5 ± 5.5</td>
<td>9 22.2 1</td>
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<tr>
<td>Alopoglossus angulatus</td>
<td><em>Cosmocerca</em> sp.</td>
<td>- - -</td>
<td>3 66.7 2.5 ± 2.1</td>
<td>LI</td>
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<td><em>Oswaldocruzia</em> sp.(^a)</td>
<td>- - -</td>
<td>33.3 2</td>
<td>SI</td>
</tr>
<tr>
<td>Anolis fuscoauratus</td>
<td><em>Rhabdias</em> sp.</td>
<td>- - -</td>
<td>6 16.7 5</td>
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<td><em>Strongyluris oscari</em> (^b)</td>
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<td>16.7 1</td>
<td>LI</td>
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<td>Anolis punctatus</td>
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<td>1 -</td>
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<tr>
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<td><em>Centrorhynchidae larvae</em> (^a)</td>
<td>19 5.3 1</td>
<td>8 -</td>
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<td>- - -</td>
<td>25 2</td>
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<td>Cercosaura eigenmanni</td>
<td><em>Cosmocerca</em> sp.</td>
<td>1 - -</td>
<td>9 55.5 2.4 ± 0.9</td>
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<tr>
<td>Species</td>
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<td><em>Iphisa elegans</em></td>
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<td><em>Cosmocercoides</em>&lt;sup&gt;a,b&lt;/sup&gt; sp.</td>
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<td><em>Mabuya nigropunctata</em></td>
<td><em>Oochoristica travassosi</em>&lt;sup&gt;a,b,c&lt;/sup&gt;</td>
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<td><em>Physaloptera retusa</em></td>
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<td><em>Strongyluris oscari</em></td>
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<td><em>Polychrus liogaster</em></td>
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<td><em>Tupinambis teguixin</em></td>
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Table 2 – Brillouin diversity index (bold) and similarity coefficients (Jaccard) for lizard community at Vale de São Domingos municipality, western Mato Grosso Brazil.

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<th>A.ameiva</th>
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<th>B.dorbignyi</th>
<th>C.eigenmanni</th>
<th>I.elegans</th>
<th>K.calcarata</th>
<th>M.nigropunctata</th>
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ARTIGO 10

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

ACKNOWLEDGMENTS

This study had financial support by FAPESP (process 06/59692-5). RWA thanks CAPES for a grant. We would like to thank Marcos André de Carvalho and Ricardo Alexandre Kawashita Ribeiro, for gently provided lizards for dissection.

LITERATURE CITED


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 respective 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.

<table>
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<th>SVL</th>
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<th>P</th>
<th>MII</th>
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<td>6</td>
<td>LI</td>
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<td>2.5 ± 2.1</td>
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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 fuscauratus*, 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*.

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<th>Kc</th>
<th>Aa</th>
<th>Af</th>
<th>Ap</th>
<th>Ca</th>
<th>Gh</th>
<th>Hm</th>
<th>Hs</th>
<th>Ii</th>
<th>Lo</th>
<th>Pp</th>
<th>Ts</th>
<th>Us</th>
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<td>0.27±0.36</td>
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