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Taxonomy and systematics

Digenea parasitizing snakes in Pampa Biome, southern Brazil

Digenea parasitando serpientes en el Bioma Pampa, sur de Brasil

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Abstract

The diversity of digenetic helminths of snakes from the Pampa Biome is poorly known, with few records in Brazil, Argentina, and Uruguay. The present study documents species of Digenea parasitizing snakes in the Pampa Biome, southern Brazil. Forty-two individuals belonging to 11 species of Dipsadidae and Viperidae were examined. A total of 178 specimens belonging to 9 taxa of digenetic trematodes were found in 50% of the snakes analyzed. Habitats and host behavior may influence the parasite fauna of snakes, since helminth diversity and abundance were greater in hosts present in semi-aquatic and grassland environments. Further, 89% of digenetic trematodes use anurans as second intermediate hosts; according to the literature, anurans are the most common food resource for these snakes. In this context, studies of diet and helminth fauna of snakes are complementary and contribute to the understanding of the biology of species and their role in ecosystems.

Keywords: Trematoda; Dipsadidae; Viperidae; *Opisthogonimus*; *Styphlodora*; *Travtrema*; *Catadiscus*; Infection indices

Resumen

La diversidad de helmintos digenéticos de serpientes del Bioma Pampa es poco conocida, con pocos registros en Brasil, Argentina y Uruguay. El presente estudio documenta especies de Digenea que parasitan serpientes en el Bioma Pampa, sur de Brasil. Se examinaron 42 individuos pertenecientes a 11 especies de Dipsadidae y Viperidae. En 50% de las serpientes analizadas se encontraron un total de 178 ejemplares pertenecientes a 9 taxones de digéneos. Los hábitats y el comportamiento del hospedador pueden influir en la fauna parasitaria de las serpientes, ya que la diversidad y abundancia de helmintos fueron mayores en los hospedadores presentes en ambientes semiacuáticos y de pastizales. Además, 89% de los tremátodos digenéticos utilizan anuros como segundos hospedadores intermediarios;

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según la literatura, los anuros son el recurso alimenticio más común para estas serpientes. En este contexto, los estudios de dieta y helmintofauna de serpientes son complementarios y contribuyen a la comprensión de la biología de las especies y su papel en los ecosistemas.

Palabras clave: Trematoda; Dipsadidae; Viperidae; *Opisthogonimus*; *Styphlodora*; *Travtrema*; *Catadiscus*; Índices de infección

Introduction

Knowing the parasitological fauna of wild animals, such as snakes, provides fundamental ecological information of both parasite and host. Digenea species have a heteroxenic life cycle, that is, they need 2 or more hosts to reach their adult form and reproduce, and their cycles can occur in aquatic, semi-aquatic or terrestrial environments (Marcogliese, 2004). Snakes are very important in food chains, since they are predators and prey for many different animals (Costa et al., 2014; Hartmann & Marques, 2005); in addition, they occupy diversified habitats (Bernarde, 2012; Marques et al., 2001). Such characteristics make these reptiles interesting hosts for digenetic trematodes, since they need to interact with the environment or other hosts to become infected and transport these helminths.

Brazil holds a total of 405 species of snakes (Costa & Bérnils, 2018); however, the diversity of Digenea is poorly known, with 41 species having been recorded parasitizing these reptiles in the country (Fernandes & Kohn, 2014; Quirino et al., 2018). In the extreme south of Brazil this number is even lower, with 4 Digenea species recorded in snakes of the Pampa Biome (Artigas et al., 1942; Ruiz & Leão, 1942a, b). However, parasitological studies with snakes in other countries that belong to this biome, such as Uruguay and Argentina, have reported 13 and 23 Digenea species, respectively (Fernandes & Kohn, 2014). The Pampa Biome is characterized by native grasslands with riparian forests, hillside forests, shrub formations, wetlands, and rocky outcrops (Overback et al., 2015), which provide a rich snake fauna.

Therefore, the objective of this study was to record Digenea species and their infection indices in 11 snake species in the Pampa Biome, extreme south of Brazil, and contribute to the knowledge of the parasitological fauna of these animals in Brazilian territory.

Materials and methods

There were 42 specimens examined belonging to: *Atractus reticulatus* (Boulenger, 1885) (n = 1), *Phalotris lemniscatus* (Duméril, Bibron & Duméril, 1854) (n = 1), *Philodryas aestiva* (Duméril, Bibron & Duméril, 1854) (n = 1), *Erythrolamprus jaegeri* (Günther, 1858) (n = 2), *Thamnodynastes strigatus* (Günther, 1858) (n = 2), *Dipsas ventrimaculatus* (Boulenger, 1885) (n = 3), *Philodryas olfersii* (Lichtenstein, 1823) (n = 4), *Pseudablabes patagoniensis* (Girard, 1858) (n = 6), *Helicops infrataeniatus* Jan, 1865 (n = 6), *Erythrolamprus poecilogyrus* (Wied-Neuwied, 1825) (n = 10) (Dipsadidae) and *Bothrops alternatus* (Duméril, Bibron & Duméril, 1854) (n = 6) (Viperidae). The snakes came from the municipalities of Capão do Leão (31º45'48" S, 52º29'02" W), Pelotas (31º46'19" S, 52º20'33" W), Rio Grande (32º02'06" S, 52º05'55" W), Encruzilhada do Sul (30º32'38" S, 52º31'19" W) and Dom Pedrito (30º58'58" S, 54º40'23" W), Rio Grande do Sul, Brazil. Thirty-four were collected dead on roads from March 2017 to June 2019. The collections were licensed by Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio No. 38913). Four snakes were donated by the Núcleo de Reabilitação da Fauna Silvestre and Centro de Triagem de Animais Silvestres of the Federal University of Pelotas (NURFS-CETAS/UFPel), where they died after a rehabilitation attempt. Four *E. poecilogyrus* were donated by the Vertebrate Zoology Laboratory of the Federal University of Pelotas, where the specimens were fixed in formalin and conserved in 70°GL alcohol.

The hosts were necropsied for analysis of the infection sites. The helminths were compressed and fixed in AFA, conserved in 70% ethanol, stained with Langeron carmine or Delafield hematoxylin, cleared with creosote and mounted with Canada balsam (Amato et al., 1991). The systematic determination of the helminths was carried out following the approaches given by Artigas et al. (1942), Mañé-Garzón and Gortari (1965), Mañé-Garzón and Holcman-Spector (1967), Artigas and Perez (1969), Sey (1983), Jones (2005) and Tkach (2008a, b). The parasitological indices were calculated according to Bush et al. (1997). The specimens were deposited in the helminth collection of the Laboratory of Wild Animal Parasitology (CHLAPASIL-UFPel), and the helminthological collection at the Instituto Oswaldo Cruz (CHIOC). The photomicrographs were done in the Olympus® BX 41 microscope with attached camera system and the images were prepared in Adobe Photoshop®CS5.

Results

A total of 178 specimens belonging to 9 taxa of Digenea were found parasitizing 50% of the snakes analyzed. *Erythrolamprus jaegeri*, *D. ventrimaculatus*, *P. lemniscatus* and *A. reticulatus* showed no association with these helminths. A taxonomic summary of results is provided below.

Opisthogonimidae Travassos, 1928
Opisthogonimus Lühe, 1900
Opisthogonimus megabothrium Pereira, 1928 (Fig. 1A)

Hosts: *Erythrolamprus poecilogyrus* (Wied-Neuwied, 1825).

Developmental stage: adult.

Site of infection: oral cavity.

Prevalence, mean abundance and mean intensity of infection: 10% (1/10), 0.1 and 1.0 helminth/host.

Locality: Pelotas, Rio Grande do Sul, Brazil.

Specimens deposited: 858 (CHLAPASIL-UFPel).

Opisthogonimus lecithonotus Lühe, 1900 (Fig. 1B)

Hosts: *Thamnodynastes strigatus* (Günther, 1858), *Pseudablabes patagoniensis* (Girard, 1858), *Philodryas olfersii* (Lichtenstein, 1823) and *Helicops infrataeniatus* Jan, 1865.

Developmental stage: adult.

Site of infection: oral cavity and esophagus.

Prevalence, mean abundance and mean intensity of infection: *P. patagoniensis*: 83.33% (5/6), 6.16 and 7.4 helminths/host; *P. olfersii*: 75% (3/4), 3.0 and 4.0 helminths/host; *T. strigatus*: 50% (1/2), 1.5 and 3.0 helminths/host; *H. infrataeniatus*: 16.66% (1/6), 0.66 and 4.0 helminths/host.

Locality: Capão do Leão, Pelotas and Dom Pedrito, Rio Grande do Sul, Brazil.

Specimens deposited: 859-866 (CHLAPASIL-UFPel); 39732a-b, 39733 (CHIOC).

Opisthogonimus sulina (Artigas, Ruiz & Leão, 1942) (Fig. 1C)

Hosts: *Philodryas aestiva* (Duméril, Bibron & Duméril, 1854).

Developmental stage: adult.

Site of infection: oral cavity.

Prevalence, mean abundance and mean intensity of infection: 100% (1/1), 6.0 and 6.0 helminths/host.

Locality: Capão do Leão, Rio Grande do Sul, Brazil.

Specimens deposited:856-857 (CHLAPASIL-UFPel).

Opisthogonimus sp.

Hosts: *Erythrolamprus poecilogyrus* (Wied-Neuwied, 1825), *Helicops infrataeniatus* Jan, 1865 and *Bothrops alternatus* (Duméril, Bibron & Duméril, 1854).

Developmental stage: adult.

Site of infection: oral cavity and esophagus.

Prevalence, mean abundance and mean intensity of infection: *E. poecilogyrus*: 20% (2/10), 0.2 and 1.0 helminth/host; *H. infrataeniatus*: 16.66% (1/6), 0.16 and 1.0 helminth/host; *B. alternatus:* 16.66% (1/6), 0.16 and 1.0 helminth/host.

Locality: Capão do Leão and Pelotas, Rio Grande do Sul, Brazil.

Specimens deposited: 961-963 (CHLAPASIL-UFPel).

Remarks

Opisthogonimus parasites the oral cavity and esophagus of snakes, with 12 species recorded in Brazil (Fernandes & Kohn, 2014). Metacercariae of *Opisthogonimus* have been recorded in several species of anurans in Argentina (Hamann & González, 2009; Hamann et al., 2012), indicating these vertebrates as secondary intermediate hosts in the helminth cycle. The specimens of *Opisthogonimus* sp. found in this study presented a large quantity of eggs, making it difficult to visualize the diagnostic structures. *Opisthogonimus megabothrium* (Fig. 1A) differs from the other species found because it has an acetabulum twice as large as its oral sucker. *Opisthogonimus lecithonotus* (Fig. 1B) and *O. sulina* (Fig. 1C) differ in the size of the caeca, being long and short, respectively, and position of the vitellaria, arranged in the same field and in 2 distinct fields, respectively (Artigas, 1942; Artigas & Perez, 1969). Despite some records for snakes in Brazil (Fernandes & Kohn, 2014), the association between *O. sulina* with *P. aestiva*, *O. megabothrium* with *E. poecilogyrus* and *O. lecithonotus* with *T. strigatus*, *P. patagoniensis*, *P. olfersii* and *H. infrataeniatus* are reported for the first time in the country.

Plagiorchiidae Lühe, 1901
Styphlodora Looss, 1899
Styphlodora gili Mañé-Garzón & Holcman-Spector, 1967 (Fig. 1D)

Hosts: *Bothrops alternatus* (Duméril, Bibron & Duméril, 1854).

Developmental stage: adult.

Site of infection: kidney.

Prevalence, mean abundance and mean intensity of infection: 33.33% (2/6), 2.16 and 6.5 helminths/host.

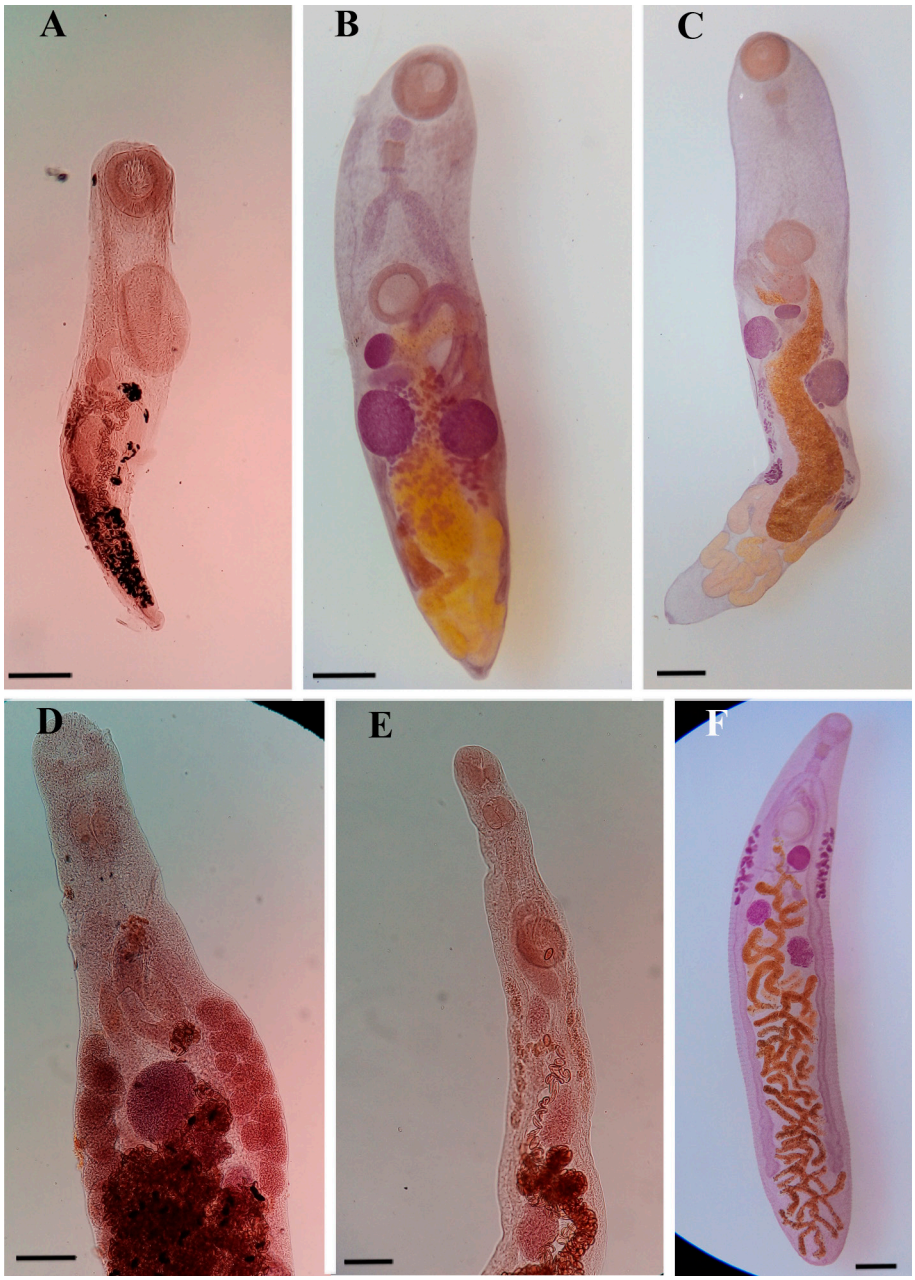

Figure 1. Digenea associated to snakes in the Pampa Biome, southern Brazil. A. *Opisthogonimus megabothrium* Pereira, 1928 (Opisthogonimidae) found in *Erythrolamprus poecilogyrus* (Wied-Neuwied, 1825) (Dipsadidae) (scale bar = 310 µm). B. *Opisthogonimus lecithonothus* Lühe, 1900 found in *Pseudablabes patagoniensis* (Girard, 1858) (Dipsadidae) (scale bar = 520 µm). C. *Opisthogonimus sulina* (Artigas, Ruiz & Leão, 1942) found in *Philodryas aestiva* (Duméril, Bibron & Duméril, 1854) (Dipsadidae) (scale bar = 650µm). D. *Styphlodora gili* Mañé-Garzon & Holcman-Spector, 1967 (Plagiorchiidae) found in *Bothrops alternatus* (Duméril, Bibron & Duméril, 1854) (Viperidae) (scale bar = 230 µm). E. *Styphlodora* sp. 1 found in *P. patagoniensis* (scale bar = 130 µm). F. *Styphlodora* sp. 2 found in *B. alternatus* (scale bar = 490 µm).

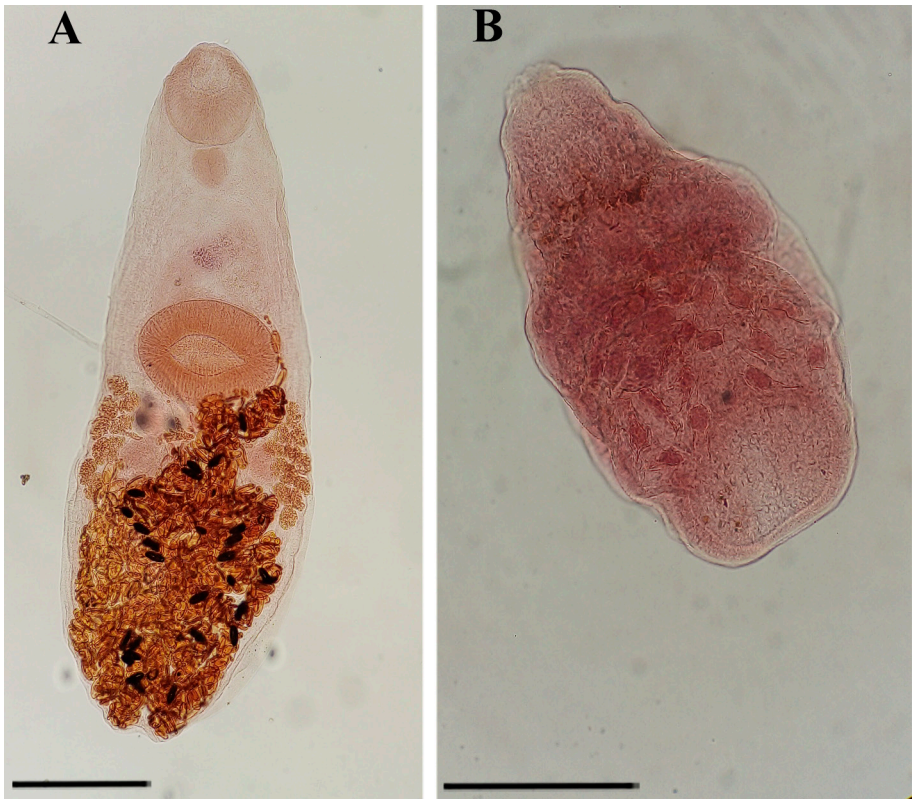

Figure 2. Digenea associated to *Erythrolamprus poecilogyrus* (Wied-Neuwied, 1825) (Dipsadidae) in the Pampa Biome, southern Brazil. A. *Travtrema stenocotyle* (Cohn, 1902) (Plagiorchiidae) (scale bar = 340 µm). B. *Catadiscus* sp. (Diplodiscidae) (scale bar = 200 µm).

Locality: Rio Grande and Capão do Leão, Rio Grande do Sul, Brazil.

Specimens deposited:848-849 (CHLAPASIL-UFPel); 39734a-b (CHIOC).

Styphlodora sp. 1 (Fig. 1E)

Hosts: *Pseudablabes patagoniensis* (Girard, 1858) and *Erythrolamprus poecilogyrus* (Wied-Neuwied, 1825).

Developmental stage: adult.

Site of infection: stomach, large intestine and coelomic cavity.

Prevalence, mean abundance and mean intensity of infection: *P. patagoniensis*: 16.66% (1/6), 12.0 and 72.0 helminths/host; *E. poecilogyrus:* 10% (1/10), 0.1 and 1.0 helminth/host.

Locality: Capão do Leão and Pelotas, Rio Grande do Sul, Brazil.

Specimens deposited: 850-851(CHLAPASIL-UFPel).

Styphlodora sp. 2 (Fig. 1F)

Hosts: *Bothrops alternatus* (Duméril, Bibron & Duméril, 1854).

Developmental stage: adult.

Site of infection: large intestine.

Prevalence, mean abundance and mean intensity of infection: 16.66% (1/6), 0.33 and 2.0 helminths/host.

Locality: Dom Pedrito, Rio Grande do Sul, Brazil.

Specimens deposited:852 (CHLAPASIL-UFPel).

Remarks

Styphlodora comprises species that can be found in the gastrointestinal and excretory systems of reptiles. Little is known about the biology of the species of this genus, the vast majority of papers are about taxonomy (Byrd et al., 1940), however, in general, life cycles of the species of Plagiorchidae include 3 hosts (Bowman, 2014). Hamann and Gonzales (2009) recorded larval forms of *Styphlodora* in tadpole, indicating amphibians as second intermediate hosts. The morphotypes collected in this study differed mainly by the shape, position and extension of the vitellariae in the body, as well as site of infection. *Styphlodora gili* was described in *B. alternatus* in Uruguay (Mañé-Garzón & Holcman-Spector, 1967), and in the present study we also reported parasitizing this

snake species, characterizing then the first record of this trematode in *B. alternatus* in Brazil. We also recorded *Styphlodora* spp. in *P. patagoniensis* and *E. poecilogyrus* and *B. alternatus* in Brazil.

Plagiorchiidae Lühe, 1901
Travtrema Pereira, 1929
Travtrema stenocotyle (Cohn, 1902) (Fig. 2A)

Hosts: *Erythrolamprus poecilogyrus* (Wied-Neuwied, 1825).

Developmental stage: adult.

Site of infection: stomach, small intestine, large intestine and coelomic cavity.

Prevalence, mean abundance and mean intensity of infection: 40% (4/10), 2.2 and 5.5 helminths/host.

Locality: Pelotas and Capão do Leão, Rio Grande do Sul, Brazil.

Specimens deposited: 853-854 (CHLAPASIL-UFPel).

Remarks

Travtrema stenocotyle is a parasite of the gastrointestinal system of snakes. This species uses mollusks as intermediate hosts and amphibians as secondary intermediate hosts (Ostrowski-De Núñez, 1979, in Pinto et al., 2012). *Travtrema stenocotyle* is common in snakes, existing several records in Brazil, including in *E. poecilogyrus* (Fernandes & Kohn, 2014), and some in Rio Grande do Sul (RS) in *Xenodon merremi* (Wagler, 1824), *Thamnodynastes pallidus* (Linnaeus, 1758) and *P. patagoniensis* (Ruiz & Leão, 1942b); however, it is reported for the first time in *E. poecilogyrus* in RS.

Diplodiscidae Cohn, 1904
Catadiscus Cohn, 1904
Catadiscus sp. (Fig. 2B)

Hosts: *Erythrolamprus poecilogyrus* (Wied-Neuwied, 1825).

Developmental stage: adult.

Site of infection: stomach.

Prevalence, mean abundance and mean intensity of infection: 10% (1/10), 0.9 and 9.0 helminths/host.

Locality: Pelotas, Rio Grande do Sul, Brazil.

Specimens deposited: 855 (CHLAPASIL-UFPel).

Remarks

Catadiscus Cohn, 1904 comprises species that parasitize the intestines of amphibians and rarely reptiles (Hamann, 1992). Biology of *Catadiscus* species that parasitize snakes is little known, but the species of this genus in general are transmitted through the ingestion of metacercariae and have mollusks as first intermediate hosts (Kehr & Hamann, 2003). Five species of *Catadiscus* have been recorded in snakes in South America (Fernandes & Kohn, 2014). *Catadiscus uruguayensis* Freitas & Lent, 1939 has already been recorded in *E. poecilogyrus* in Argentina (Lunaschi & Drago, 2002), therefore this trematode is reported for the first time in Brazil for this snake species.

Discussion

All snakes analyzed in this study have a restricted distribution to the South American continent (Uetz et al., 2021). However, most records of Digenea in these hosts are in Argentina and the southeastern and central-western regions of Brazil (Table 1), which highlights the importance of studies in this area.

Even with only 1 individual of *P. aestiva* sampled, it was possible to report, for the first time, digenetic helminths in this species. On the other hand, there is still a large gap on the parasitic fauna of *P. lemniscatus* and *A. reticulatus*, which may be related to the fossorial habit of these species that implies difficulties for their sampling (Balestrin et al., 2007; Quintela & Loebmann, 2009); therefore, in the present study only 1 individual of each species was sampled.

Habitats and host behavior may influence the parasite fauna of snakes, since those hosts that had higher abundance and richness of parasites are related to semi-aquatic and grassland environments, like *E. poecilogyrus*, *P. patagoniensis*, and *B. alternatus*. These environments are favorable for the development and maintenance of digenetic helminths and their networks of interactions, since parasites of this group use aquatic and semi-aquatic organisms as intermediate and paratenic hosts.

Many digeneans found in the snakes analyzed, such as *Opisthogonimus* spp., *Styphlodora* spp. and *Travtrema stenocotyle*, have as intermediate hosts amphibian anurans (Hamann & González, 2009; Hamann et al., 2012; Ostrowski-De Núñez, 1979 in Pinto et al., 2012), which are food resources for several snake species (Thaler et al., 2018; Vasconcelos-Filho et al., 2015). Some of these parasites were present in *B. alternatus*, corroborating diet studies of the species, which, besides mammals, can also feed on amphibians, even if sporadically (Bellini et al., 2015). Although the diet of *D. ventrimaculatus* is specialized in mollusks (Quintela & Loebmann, 2009), which are intermediate hosts of digenetic trematodes, the 3 individuals of this snake analyzed did not present digeneans, what may be related to the low number of hosts sampled, since there are records in Argentina (Lunaschi & Sutton, 1985; Poumarau, 1968 in Fernandes & Kohn, 2014).

Table 1

Records of Digenea parasitizing the snake species analyzed in the study, geographic distribution of these snakes according to Uetz et al. (2021) and locality of the helminthological records. ARG = Argentina; BOL = Bolivia; BRA = Brazil; COL = Colombia; GUF = French Guiana; GUY = Guyana; PRY = Paraguay; PER = Peru; URY = Uruguay; VEN = Venezuela.

Snake and distribution	Digenea	Locality of the helminthological records (Reference)
Pseudablabes patagoniensis ARG; BOL; BRA; PRY; URY	*Opisthogonimus afranioi*	Precise location not available, BRA (Pereira, 1929 *apud* Fernandes & Kohn, 2014); Colonia, URY (Mañé-Garzón & Gortari, 1965)
	Opisthogonimus lecithonotus	Tucumán, ARG (Poumarau, 1968 *apud* Fernandes & Kohn, 2014 and Lunaschi & Drago, 2007); Canelones, URY (Mañé-Garzón & Gortari, 1965); Capão do Leão, Rio Grande do Sul, BRA (present study)
	Opisthogonimus sulina	Tuparaí, Itaqui, Rio Grande do Sul, BRA (Artigas et al., 1942); Precise location not available, BRA (Freitas, 1956 *apud* Fernandes & Kohn, 2014); Nico Pérez, Lavalleja, URY (Mañé-Garzón & Gortari, 1965)
	Opisthogonimus fonsecai	Precise location not available, BRA (Pinto et al., 2012)
	Opisthogonimus interrogativus	Precise location not available, BRA (Pereira, 1929 *apud* Fernandes & Kohn, 2014)
	Styphlodora condita	Precise location not available, ARG (Poumarau, 1968 *apud* Fernandes & Kohn, 2014; Lunaschi & Sutton, 1985)
	Travtrema stenocotyle	Villa Elisa, La Plata, Buenos Aires, ARG (Lunaschi & Sutton, 1985); Tuparaí, Itaqui, Rio Grande do Sul, BRA; Boa Esperança do Sul, São Paulo, BRA; Pitangueiras, São Paulo, BRA (Ruiz & Leão, 1942b); Precise location not available, BRA (Freitas & Dobbin Jr., 1957 *apud* Fernandes & Kohn, 2014 and Ostrowski de Núñez, 1979)
	Paradistomum parvissimum	Precise location not available, BRA (Travassos, 1944 *apud* Fernandes & Kohn, 2014)
	Renifer heterocoelium	Precise location not available, BRA (Corrêa et al., 1990; Pinto et al., 2012)
	Styphlodora sp. 1	Capão do Leão, Rio Grande do Sul, BRA (present study)
Philodryas olfersii ARG; BOL; BRA; COL; GUF; GUY; PRY; PER; URY; VEN	*Infidum similis*	Precise location not available, ARG (Poumarau, 1968 *apud* Fernandes & Kohn, 2014)
	Catadiscus longicoecalis	Precise location not available, ARG (Poumarau, 1968 *apud* Fernandes & Kohn, 2014)
	Opisthogonimus lecithonotus	Capão do Leão, Rio Grande do Sul, BRA (present study)
Philodryas aestiva ARG; BOL; BRA; PRY; URY	*Opisthogonimus sulina*	Capão do Leão, Rio Grande do Sul, BRA (present study)
Erythrolamprus poecilogyrus ARG; BOL; BRA; GUY; PRY; PER; URY; VEN	*Opisthogonimus fonsecai*	Precise location not available, BRA (Pinto et al., 2012)
	Opisthogonimus serpentis	Cornélio Procópio, Paraná, BRA (Artigas et al., 1943)

Table 1. Continued

Snake and distribution	Digenea	Locality of the helminthological records (Reference)
	Opisthogonimus megabothrium	Pelotas, Rio Grande do Sul, BRA (present study)
	Opisthogonimus sp.	Capão do Leão, Rio Grande do Sul, BRA (present study); Pelotas, Rio Grande do Sul, BRA (present study)
	Travtrema stenocotyle	Zelaya, Buenos Aires, ARG (Ostrowski de Núñez, 1979); Araçatuba, São Paulo, BRA (Ruiz & Leão, 1942b); Capão do Leão, Rio Grande do Sul, BRA (present study); Pelotas, Rio Grande do Sul, BRA (present study)
	Renifer heterocoelium	Precise location not available, BRA (Corrêa et al., 1990; Pinto et al., 2012)
	Ophiodiplostomum spectabile	Precise location not available, BRA (Pinto et al., 2012); Paraná, BRA; São Paulo, BRA (Ruiz & Rangel, 1954)
	Infidum similis	Precise location not available, BRA (Ruiz & Leão, 1943 and Travassos, 1944 *apud* Fernandes & Kohn, 2014)
	Mesocoelium monas	Rio de Janeiro, Rio de Janeiro, BRA (Freitas, 1963)
	Heterodiplostomum lanceolatum	Ruta Transchaco, Presidente Hayes, PRY (Dubois, 1988)
	Catadiscus uruguayensis	Laguna Salada Grande, General Lavalle, Buenos Aires, ARG (Lunaschi & Drago, 2002)
	Catadiscus sp.	Pelotas, Rio Grande do Sul, BRA (present study)
	Styphlodora sp. 1	Pelotas, Rio Grande do Sul, BRA (present study)
Erythrolamprus jaegeri ARG; BRA; PRY; URY	*Opisthogonimus megabothrium*	Punta Lara, Ensenada, Buenos Aires, ARG (Lunaschi & Sutton, 1985)
	Travtrema stenocotyle	Punta Lara, Ensenada, Buenos Aires, ARG (Lunaschi & Sutton, 1985)
Helicops infrataeniatus ARG; BRA; PRY; URY	*Opisthogonimus lecithonotus*	Corrientes, ARG (Lunaschi & Drago, 2007); Capão do Leão, Rio Grande do Sul, BRA (present study)
	Opisthogonimus serpentis	Precise location not available, BRA (Rodrigues & Santos, 1974 *apud* Fernandes & Kohn, 2014)
	Opisthogonimus sp.	Capão do Leão, Rio Grande do Sul, BRA (present study)
	Heterodiplostomum helicopsis	Precise location not available, URY (Mañé-Garzón & Alonso, 1976 *apud* Fernandes & Kohn, 2014)
Thamnodynastes strigatus ARG; BRA; PRY; URY	*Opisthogonimus lecithonotus*	Juan Jose Castelli, Chaco, ARG; Ituzaingo, Corrientes, ARG; Posadas, Misiones, ARG (Martínez et al., 1996); Chaco, ARG; Corrientes, ARG; Misiones, ARG (Lunaschi & Drago, 2007); Capão do Leão, Rio Grande do Sul, BRA (present study)
	Styphlodora condita	Precise location not available, ARG (Poumarau, 1968 *apud* Fernandes & Kohn, 2014)
	Liophistrema buccalis	Artilleros, Colonia, URY (Holcman-Spector & Mañé-Garzón, 1973)
Dipsas ventrimaculatus ARG; BRA; PRY	*Mesocoelium monas*	Precise location not available, ARG (Poumarau, 1968 *apud* Fernandes & Kohn, 2014)
	Travtrema stenocotyle	Precise location not available, ARG (Lunaschi & Sutton, 1985; Poumarau, 1968 *apud* Fernandes & Kohn, 2014)

Table 1. Continued

Snake and distribution	Digenea	Locality of the helminthological records (Reference)
Bothrops alternatus ARG; BRA; PRY; URY	*Opisthogonimus lecithonotus*	Precise location not available, ARG (Poumarau, 1968 *apud* Fernandes & Kohn, 2014); Machagai, Chaco, ARG; Ituzaingo, Corrientes, ARG (Martínez et al., 1996); Buenos Aires, ARG; Chaco, ARG; Corrientes, ARG; Santa Fé, ARG (Lunaschi & Drago, 2007);
	Opisthogonimus fonsecai	Precise location not available, BRA (Pinto et al., 2012)
	Opisthogonimus sp.	Capão do Leão, Rio Grande do Sul, BRA (present study)
	Styphlodora gili	Precise location not available, URY (Mañé-Garzón & Holcman-Spector, 1967); Capão do Leão, Rio Grande do Sul, BRA; Rio Grande, Rio Grande do Sul, BRA (present study)
	Styphlodora condita	Precise location not available, ARG (Lunaschi & Sutton, 1985; Poumarau, 1968 *apud* Fernandes & Kohn, 2014)
	Styphlodora sp. 2	Dom Pedrito, Rio Grande do Sul, BRA (present study)
	Heterodiplostomum lanceolatum	Precise location not available, ARG (Lunaschi & Sutton, 1985; Poumarau, 1968 *apud* Fernandes & Kohn, 2014)
	Catadiscus freitaslenti	Precise location not available, ARG (Lunaschi & Sutton, 1985; Poumarau, 1968 *apud* Fernandes & Kohn, 2014)
	Travtrema stenocotyle	Precise location not available, ARG (Lunaschi & Sutton, 1985; Poumarau, 1968 *apud* Fernandes & Kohn, 2014)

In this context, studies of diet and helminth fauna of snakes are complementary and contribute to the understanding of the biology of species and their role in ecosystems. Such studies generate important information that can be used in conservation programmes for the species and their habitats.

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