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Systematic review of the helminth community in opossums of the genus *Didelphis* (Family: Didelphidae)

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Abstract: Opossums are essential for public health because of their versatility and adaptability to environments. Their dietary diversity exposes these animals to many gastrointestinal parasites, including zoonotic ones. However, technical-scientific literature is limited, with few studies addressing the diversity of parasitic helminths found in opossums, especially when considering polyparasitism. Given the limited number of reports, it is crucial to update the existing findings, particularly regarding the location and species of *Didelphis*, to encourage further research. This paper is a systematic review of qualitative and quantitative literature focusing on the description of helminths reported in opossums of the genus *Didelphis* in the time frame from 1948 to September 2024. The active search was conducted by searching for articles in all languages across the SciELO, PubMed, and VHL platforms, using a combination of English descriptors registered in the VHL, specifically "Helminths" and *"Didelphis"*, with the Boolean operator "AND". After applying the inclusion and exclusion criteria over nearly 77 years, 111 articles were identified by combining the three databases within the stipulated period. After applying the inclusion and exclusion criteria, 68 works were included in the present study. Based on the review, four species of opossums of the genus *Didelphis* have the most published data. In this group, parasite diversity is excellent, with classes and species adequately identified. However, few studies have been conducted in Brazil, and these have primarily focused on specimens from the North region. Due to the region's significant presence of species and unique environment, further study is warranted, given the richness of families and species reported.
Keywords: Opossums, Helminths, Diversity, Identification.

1. Introduction

Opossums are marsupials belonging to the Didelphidae family, comprising 95 of the more than 125 existing species. Widely distributed in the Americas and representing the oldest marsupials, dating back to the Upper Cretaceous period, they probably originated in South America. The genus *Didelphis* is common from southeastern Canada to southeastern Argentina (Boullosa et al., 2021). The genus *Didelphis* comprises six species known as “New World Marsupials.” In addition to *Didelphis virginiana*, which occurs in North America, five other species are common in South America. They are divided into two groups: the Marsupialis or black-eared opossums (*Didelphis marsupialis* and *Didelphis aurita*) and the Albiventris or white-eared opossums (*Didelphis albiventris*, *Didelphis pernigra,* and *Didelphis imperfecta*) (Gardner 2008; Faria and De Melo 2017).

The diet of opossums is usually quite diverse and reflects their omnivorous behavior. These marsupials feed on various items, such as fruits, insects, small vertebrates, and even food scraps left by humans. In urban areas, they are often seen searching for food in the garbage, while in wild environments, their diet includes amphibians, birds, and eggs. It is worth mentioning that they also contribute to the ecological control of insects and small mammal populations (Freitas et al., 2022). Because opossums' diets are quite diverse (opportunistic feeding behavior), they are exposed to many gastrointestinal parasites, including those of zoonotic concern, such as the genera *Ancylostoma*, *Toxocara*, *Trichuris*, *Ascaris*, *Capillaria*, *Cruzia*, *Strongyloides*, *Turgida*, *Didelphostrongylus*, *Giardia,* and *Cryptosporidium* (Bezerra-Santos et al., 2020).

Despite the versatile habits and characteristics of these marsupials, the technical-scientific literature on them is limited, and few studies address the diversity of parasitic helminths found in opossums, especially when considering the polyparasitism observed in these animals, since the interactions between infectious agents are possibly linked to host susceptibility (Costa-Neto, Cardoso and Boullosa, 2019). Given the limited number of reports, it is essential to update the existing findings, particularly concerning the location and species of *Didelphis*, to encourage further research.

2. Development

2.1. Type of Study

This is a qualitative systematic review that focuses on describing helminths reported in opossums of the genus *Didelphis* from 1948 to September 2024. For the study design, the recommendations of the PRISMA 2020 guidelines were adopted and adapted, as described by Page et al. (2021), to ensure greater transparency in the methodology employed and the results obtained.

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2.2. Descriptors and Databases

The active search was performed by searching for articles in all languages on the Scientific Electronic Library Online (SciELO), National Library of Medicine (PubMed), and Virtual Health Library (VHL) platforms, adopting the combination of English descriptors registered in the VHL: Helminths (Helminthe) (ID: D006376) and *Didelphis* (ID: D016848). The English terms were combined using the Boolean operator "AND", which limits the search results to documents containing all the specified descriptors, thereby optimizing the search.

2.3. Inclusion and Exclusion Criteria

Primary studies reporting helminths identified from eggs in collected feces or adult worms recovered from necropsies of *Didelphis* specimens published between 1948 and September 2024 were included. Studies outside the study topic, duplicates, and studies that could not identify the family or group of the helminth were excluded, as were review articles, notes, comments, or incomplete results.

2.4. Search Strategy

Data were collected from October to November 2024. During this period, the initial evaluation of the bibliographic material was conducted by reviewing the titles and abstracts to select those aligned with the study objectives. This was followed by a thorough reading and classification of the selected articles based on the previously mentioned inclusion and exclusion criteria. Data were recorded in Excel 365 program spreadsheets and used to construct figures, charts, and tables of interest. Two independent reviewers reviewed all data.

2.5. Summary of Results

The search results from the databases were organized into a flowchart. After being reviewed by two independent researchers, the articles deemed suitable for inclusion in the research were categorized by reported forms, including eggs and adult worms. The following details were documented: Year of Publication, Authors, Host Country, Host, and Reported Parasites. Additionally, figures were created to illustrate the distribution of annual scientific productions at both global and national levels, offering a clearer understanding of the interest in this topic. The final text was compiled by critically comparing the main results from each study and incorporating all relevant articles for discussion and analysis. The information was organized according to the form identified (Eggs or Adult Worms) and the number of studies conducted on each host species and its country of origin.

2.6. Active Search Flowchart

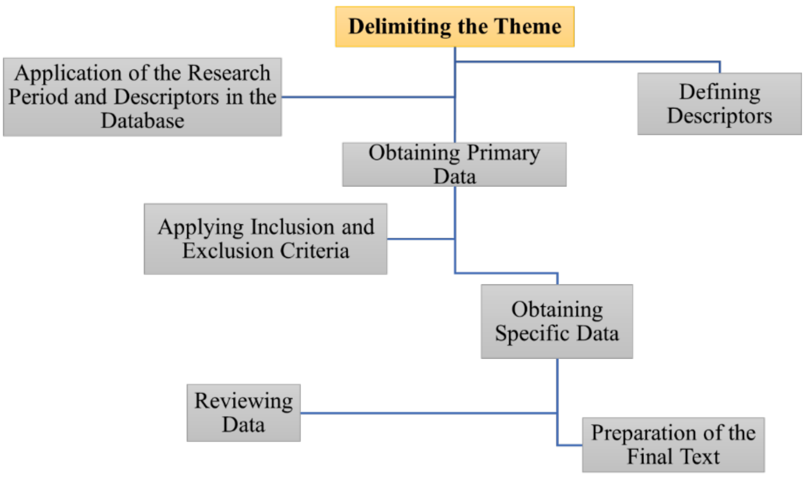

Figure 1 – Flowchart of the research, determining the main steps that were taken.

2.7. Active Search Results

The active search, conducted over nearly 77 years, yielded 111 articles in the three databases within the stipulated period. Among these, 85 were found in PubMed, 25 in VHL, and 1 in SciELO. With the application of inclusion and exclusion criteria, 87 studies were approved for the study. Excluding duplicates, 68 studies formed the present study, as shown in Figure 2.

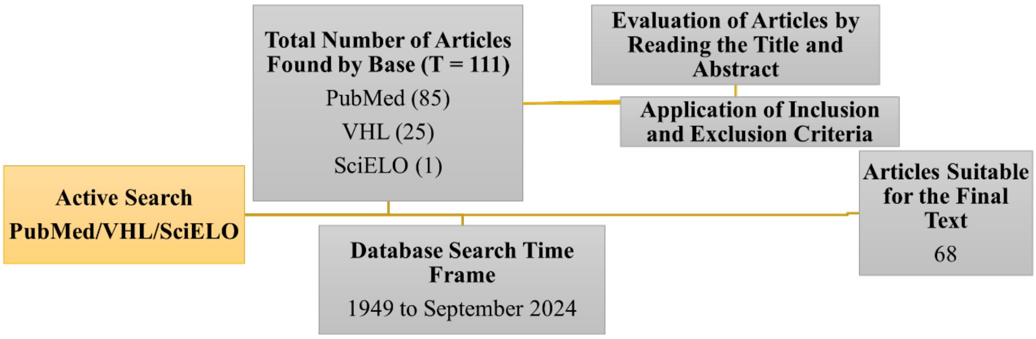

Figure 2 – Flowchart for obtaining suitable articles from the databases: PubMed, VHL, and SciELO.

The defined species and the number of citations in the works, when divided by host reported in each study, were *Didelphis* sp (Dsp) 2, *D. aurita* (Da) 11, *D. albiventris* (Dal) 12, *D. marsupialis* (Dm) 17, and *D. virginiana* (Dv) 31. It is worth mentioning that some works analyzed more than one species; therefore, the species was recorded in multiple topics.

An analysis of the 68 published studies on *Didelphis* species worldwide reveals that the distribution of studies and research appears to be skewed, as shown in Figure 3.

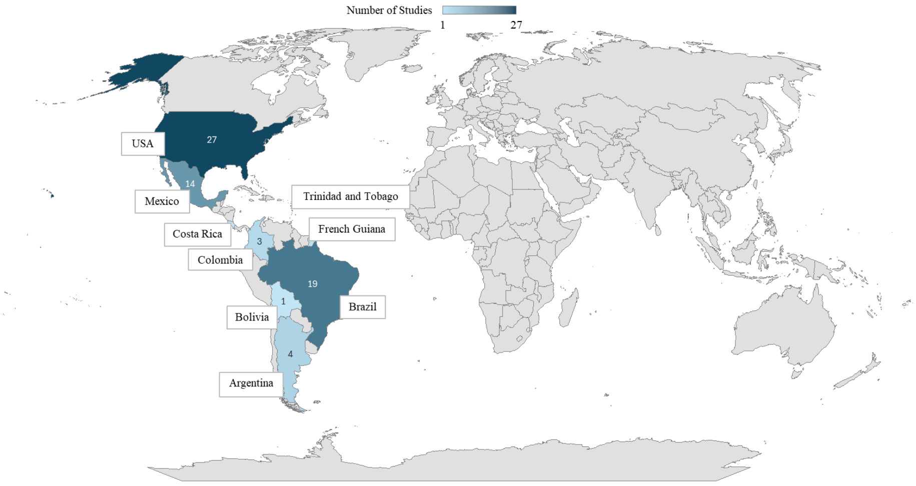

Figure 3 – Worldwide distribution of the number of studies and origin of the hosts studied, based on PubMed, VHL, and SciELO articles.

The 28 studies performed with species found in Brazil can be distributed as shown in Figure 4, with the majority of reports concentrated in the southeast and southern regions of Brazil.

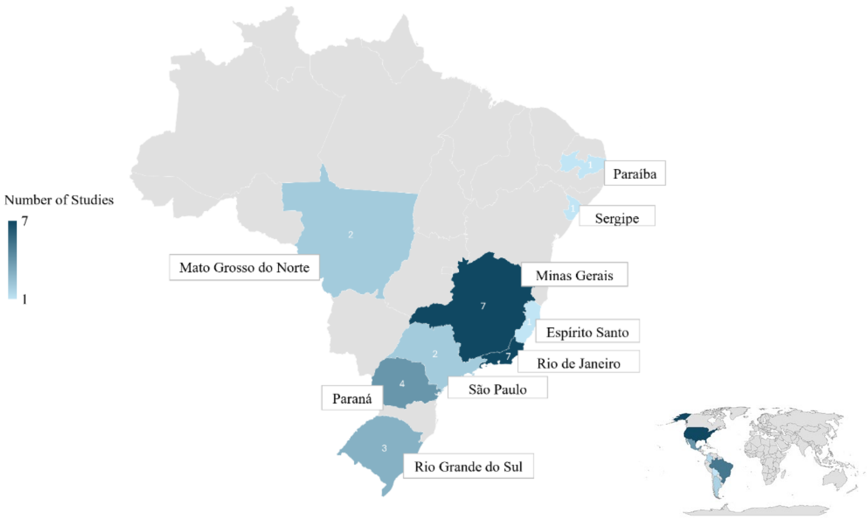

Figure 4 – Distribution of the number of studies and origin of the hosts studied in Brazil, based on PubMed, VHL, and SciELO articles.

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After being screened, the studies were organized by year of publication and reported species of *Didelphis*, as seen in Figure 5, considering the species mentioned.

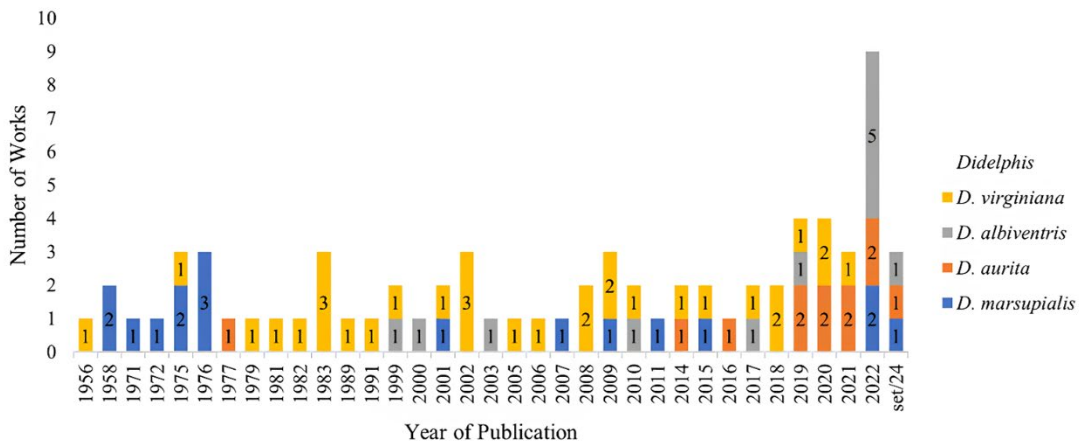

Figure 5 – Number of works published by *Didelphis* species between 1949 and September 2024 found in the PubMed, VHL, and SciELO databases.

Approximately 11 articles identified helminths from eggs in feces collected after host capture and are presented in Frame 1, which presents the following information: Year of Publication (Ascending Order); Authors; Species; Reported Parasites.

Nº	Year/Author(s)	Country	Species	Reported Parasite
01	Bowman, Smith and Little*[a], 1983	USA	Dv	*Lagochilascaris sprenti*
02	Nichelason et al.* 2008	USA	Dv	*Physaloptera* sp./ *Cruzia* sp./ *Didelphostrongylus* sp.
03	Torres-Montoya et al.* 2014	Mexico	Dv	*Gnathostoma turgidum*
04	Pinto, Mati and Melo 2014	Brazil	Dv	*Toxocara catis*
05	Aragón-Pech et al., 2018	Mexico	Dv	*Trichuris* sp./ *Capillaria* sp./ *Ancylostoma* sp./ *Cruzia* sp./ *Ascaris* sp./ *Toxocara* sp./ *Turgida* sp./ Acanthocephalans/ *Oligacanthorhvnchus* sp.
06	Gerhold et al., 2018	USA	Dv	*Baylisascaris* spp.
07	Teodoro et al., 2019	Brazil	Dv/Dal	*Cruzia tentaculata* (Dal/Da)/ Trichuridae (Dal/Da)/ Trichostrongylidae (Dal/Da)/ Singamidae (Dal)/ Spiruroidea (Dal)/ Acylostomatidae (Dal/Da)
08	Bezerra-Santos et al. 2020	Brazil	Da	*Ancylostoma caninum*
09	Bezerra-Santos et al. 2020	Brazil	Da	*Ancylostoma* spp./ Ascarididae/ Spiruroidea/ Trematoda/ *Cruzia tentaculata*/ *Strongyloides* spp./ *Trichuris* spp.
10	Boulossa et al. 2021	Brazil	Da	*Aspidodera raillieti*/ *Cruzia tentaculata*/ *Globocephalus marsupialis*/ *Turgida turgida*/ Trichuridae/ Viannaiidae/ *Brachylaima advena*/ *Duboisiella proloba*/ *Oligacanthorhynchus microcephalus*
11	Chagas et al. 2024	Brazil	Da	Strongylida/ *Cruzia* sp./ Trematoda/ Trichuridae/ Strongyloididae/ Acanthocephala/ Ascarididae/ Oxyuroidea

[a] Experimental Infection.
*Study that identified both eggs and adult worms.

Table 1. Number of papers published by *Didelphis* species between 1949 and September 2024 found in the PubMed, HVL, and SciELO databases.

Identifying parasites by their eggs alone is challenging, especially when a host has a wide variety of possible parasites. Many studies have been able to define the genus and, in some cases, the family, but not the species, due to the limitations of morphological analyses. Among the studies that reported using adult worms, 60 articles performed identification after necropsy of hosts that had

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been recovered, found, or euthanized. These articles are presented in Table 2, which includes the following information: Year of Publication (Ascending Order), Authors, Species, and Reported Parasites.

Nº	Year/ Author(s)	Country	Species	Reported Parasite
01	Crites, 1956	USA	Dv	*Cruzia americana*
02	Sandars, 1958	Trindad and Tobago	Dm	*Achillurbainia recôndita/ Metadelphis evandroi/ Rhopalias coronatus*
03	Barbero, 1958	USA	Dm	*Capillaria longicauda/ Dipetalonema* sp./ *Dirofilaria* sp./ *Gongylonema longispiculum/ Gnathostoma didelphis/ Gnathostoma* sp./ *Trichuris minuta/ Trichuris didelphis/ Mesocestoides variabilis/ Hamanniella tortuosa*
04	Stewart and Dean, 1971	USA	Dm	*Didelphonema longispiculata*
05	Pence and Little 1972	USA/Costa Rica/ Colombia	Dm	*Anatrichosoma buccalis*
06	Kuntz et al.[a] 1975	USA	Dm	*Schistosoma haematobium*
07	Nettles, Prestwood and Davidson, 1975	USA	Dm	*Physaloptena turgida/ Brachylaima virginianum/ Cruzia americana/ Capillania aerophila*
08	Kinsella and Winegarner, 1975	USA	Dv	Anatrichosoma bucalis
09	Prestwood, 1976	USA	Dm	*Didelphostrongylus hayesi*
10	Dubois, 1976	Argentina	*D. azarae* (= Da)	*Bursotrema tetracotyloides*
11	Diaw, 1976	French Guiana	Dm	Trichostrongyloidea
12	Prestwood, Nettles and Farrek, 1977	-	Dm	*Didelphostrongylus hayesi/ Capillaria* sp.
13	Coelho et al., 1979	Brazil	Dsp	*Schistosoma mansoni*
14	Esslinger and Smith, 1979	USA	Dv	*Dipetalonema didelphis*
15	Dunagan and Miller, 1981	USA	Dv	*Oligacanthorhynchus tortuosa*
16	Gray and Anderson, 1982	USA	Dv	*Turgida turgida*
17	Bowman, Smith and Little*, 1983	USA	Dv	*Lagochilascaris sprenti*
18	Smith, Bowman and Little, 1983	USA	Dv	*Lagochilascaris sprenti*
19	Ducan Júnior, Reinemeyer and Funk, 1989	USA	Dv	*Didelphostrongylus hayesi*
20	Snyder et al., 1991	USA	Dv	*Capillaria didelphis/ Cruzia americana/ Turgida turgida*
21	Ellis and Richardson 1999	USA	Dv	*Centrorhynchus spinosus/Oligacanthorhynchus tortuosa/ Mesocestoides variabilis/ Cruzia americana/ Gnathostoma didelphis/ Longistriata didelphis/ Physaloptera turgida/ Trichuris didelphis/ Viannaia hamata/ Trematoda Brachylaima virginiana/ Diplostomum variabile/ Rhopalias macracanthus*
22	Silva and Costa, 1999	Brazil	Dal	*Rhopalias coronatus/ Brachylaema migrans/ Aspidodera raillieti/ Cruzia tentaculata/ Viannaia hamata/ Travassostrongylus orllofi/ Trugida turgida/ Gongylonema* sp./ *Trichuris didelphis/ Capillaria* sp.
23	Cruz et al., 2000	Argentina	Dal	*Duboisiella proloba*
24	Cañeda-Guzmán, Chambrier and Scholz, 2001	Mexico	Dm	*Thaumasioscolex didelphidis*
25	Matey, Kuperman and Kinsella, 2001	USA	Dv	*Turgida turgida*
26	Salgado-Maldonado and Cruz-Reyes 2002	Mexico	Dv	*Porrorchis nickoli*
27	Lamberski et al.	USA	Dv	*Didelphostrongylus hayesi*

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Nº	Year/ Author(s)	Country	Species	Reported Parasite
	2002			
28	Kim et al., 2002	USA	Dv	*Parastrongylus costaricensis*
29	Campbell, Gardner and Navone, 2003	Argentina	Dal	*Mathevotaenia argentinensis*
30	Mont-Mendoza and García-Prieto, 2005	Mexico	Dv	*Brachylaima virginiana*/ *Brachylaima* sp./ *Paragonimus mexicanus*/ *Rhopalias coronatus*/ *Rhopalias macracanthus*/ *Mathevotaenia* sp./ *Oligacanthorhynchus tortuosa*/ *Oncicola luehei*/ *Didelphostrongylus hayesi*/ *Cruzia* sp./ *Cruzia americana*/ *Cruzia tentaculata*/ *Gnathostoma turgidum*/ *Turgida turgida*/ *Didelphonema longispiculata*/ *Trichuris* sp./ *Viannaia* sp./ *Viannaia didelphis*/ *Viannaia viannai*
31	Miller et al., 2006	USA	Dv	*Parastrongylus costaricensis*
32	Chagas-Moutinho et al., 2007	Colombia	Dm	*Aspidodera raillieti*
33	Nichelason et al.* 2008	USA	Dv	*Cruzia americana*/ *Turgida turgida*/ *Didelphostrongylus hayesi*
34	Díaz-Camacho et al., 2009	Mexico	Dv	*Gnathostoma turgidum*
35	Adnet et al., 2009	Colombia	Dm	*Cruzia tentaculata*
36	Nawa et al., 2009	México	Dv	*Gnathostoma turgidum*
37	Ribicich et al., 2010	Argentina	Dal	*Trichinella spiralis*
38	Díaz-Camacho et al., 2010	Mexico	Dv	*Gnathostoma turgidum*
39	Jiménez, Catzeflis and Gardner, 2011	French Guiana	Dm	*Mathevotaenia bivittata*/ *Aspidodera raillieti*/*Capillaria eberthi*/ *Spirura guianensis*/ *Travassostrongylus paraquintus*/ *Trichuris reesali*/ *Viannaia viannai*/ *Oncicola campanulata*
40	Chagas-Moutinho et al., 2014	Brazil	Da	*Aspidodera Lanfredi*
41	Torres-Montoya et al.*, 2014	Mexico	Dv	*Gnathostoma turgidum*
42	Acosta-Virgen et al. 2015	Mexico	Dv/Dm/Dsp	*Amphimerus caudalitestis* (Dm/Dv)/ *Brachylaima didelphus* (Dv)/ *Philandrophilus magnacirrus* (Dm)/ *Rhopalias coronatus* (Dm/Dv/Dsp)/ *Rhopalias macracanthus* (Dm/Dv/Dsp)/ *Mathevotaenia* sp. (Dv)/ *Thaumasioscolex didelphidis* (Dv/Dm)/ *Oligacanthorhynchus microcephalus* (Dv)/ *Oncicola luehei* (Dm)/ *Porrorchis nickoli* (Dv)/ *Didelphostrongylus hayesi* (Dv)/ *Aspidodera raillieti* (Dv)/ *Cruzia tentaculata* (Dm/Dv/Dsp)/ *Gnathostoma turgidum* (Dsp/Dv/Dm)/ *Gongylonema* sp. (Dv)/ *Turgida turgida* (Dm/Dv/Dsp)/ *Trichuris didelphis* (Dv/Dsp/Dm)/ Capillariinae (Dm/Dv)/ *Viannaia viannai* (Dv/Dm)
43	Costa-Neto et al., 2016	Brazil	Da	*Heterostrongylus heterostrongylus*
44	Lópes-Crespo et al., 2017	Mexico	Dv	*Didelphostrongylus hayesi*
45	Zabott et al., 2017	Brazil	Dal	*Turgida turgida*/ *Cruzia tentaculata*/ *Aspidodera* sp./ *Trichuris* sp./ *Hamanniella microcephala*/ *Rhopalias coronatus*
46	Torres-Montoya, 2018	Mexico	Dv	*Gnathostoma turgidum*
47	Costa-Neto et al., 2019	Brazil	Da	*Aspidodera raillieti*/ *Cruzia tentaculata*/ *Trichuris minuta*/ *Trichuris didelphis*/ *Travassostrongylus orloffi*/ *Viannaia hamata*/ *Globocephalus marsupialis*/ *Heterostrongylus heterostrongylus*/ *Turgida turgida*/ *Duboisiella proloba*/ *Brachylaima advena*/ *Rhopalias coronatus*/ Cestoda/ *Oligacanthorhynchus microcephalus*
48	Li, 2019	USA	Dv	*Cruzia americana*

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Nº	Year/ Author(s)	Country	Species	Reported Parasite
49	Gárcia-Varela et al., 2020	Mexico	Dv	*Porrorchis nickoli*
50	Cleveland et al., 2020	USA	Dv	*Dracunculus insignis*
51	Cardoso et al., 2021	Brazil	Da	*Cruzia tentaculata*/ *Viannaia* sp./ *Turgida turgida*/ *Heterostrongylus heterostrongylus*/*Mathevotaenia* sp./ *Viannaia hamata*/ *Travassostrongylus orloffi*/ *Rhopalias coronatus*/ *Globocephalus marsupialis*/ *Trichuris minuta*/ *Trichuris didelphis*/ *Oligacanthorhynchus microcephalus*
52	Ramírez-Cañas, López-Caballero and Mata-López 2021	Mexico	Dv	*Viannaia angelae*
53	Cirino et al., 2022	Brazil	Dal	*Aspidodera raillieti*/ *Cruzia tentaculata*/ *Trichuris didelphis*/ *Trichuris minuta*/ *Turgida turgida*/ *Travassostrongylus orloffi*/ *Viannaia hamata*/ *Brachylaima advena*/ *Rhopalias coronatus*/ *Hoineffia* sp./ *Viannaia* sp./ Cestoda
54	Vielmo et al., 2022	Brazil	Dal	*Angiostrongylus cantonensis*
55	Freitas et al., 2022	Brazil	Dm	*Aspidodera raillieti*/ *Cruzia tentaculata*/ *Didelphonema longispiculata*/ *Travassostrongylus orloffi*/ *Trichuris minuta*/ *Turgida turgida*/ *Viannaia hamata*/ *Oligacanthorhynchus microcephalus*/ Cestoda
56	Varella et al., 2022	Brazil	Da/Dal	*Aspidodera raillieti*
57	Souza et al., 2022	Brazil	Da/Dal	*Cruzia tentaculata*
58	Jukervicz et al. 2022	Brazil	Dal	*Trichinella spiralis*
59	Freitas et al., 2022	Brazil	Dm	*Didelphonema longispiculata*
60	Jiménes et al., 2024	Bolivia	Dm Dal	*Aspidodera raillieti* (Dal/Dm)/ *Turgida túrgida* (Dal/Dm)/ *Cruzia tentaculata* (Dal)/ *Viannaia hamata* (Dm)/ *Viannaia simplicispicula* (Dm)/ *Viannaia skrjabini* (Dm)/ *Viannaia viannai* (Dm)/ *Oligacanthorhynchus microcephala* (Dm)

[a] Experimental Infection.

* Study that identified both eggs and adult worms.

Table 2 – Number of works published by *Didelphis* species between 1949 and September 2024 found in the PubMed, VHL, and SciELO databases.

Over the years, species identification through necropsies has proven to be the most effective taxonomic approach. However, as is the case with other analyses, its success depends on the taxonomic criteria applied, the quantity of parasites recovered, and the state of preservation of the parasites. The latter is a determining factor in some instances, as poorly preserved characteristics can result in ambiguity or inability to identify the family or even the genus of the parasite.

2.8. Limitations of Morphological Identification

The morphological identification of eggs recovered from the feces of hosts is a crucial step in helminth identification. However, relying on this type of analysis has become increasingly complex, particularly at an ecological level, due to hosts' versatility in harboring different parasites. Relying on an analysis closely related to a stage of resistance or transmission to the environment is highly questionable, as multiple genera may exhibit similar characteristics in their eggs within various parasites.

Nonetheless, in situations where experimental infection can be carried out to obtain adult forms, this serves as an essential countermeasure to ensure the robustness of the results, as demonstrated by Bowman, Smith, and Little (1983) in identifying *Lagochilascaris sprenti* in *D. virginiana*. The authors also combined both identifications (coproparasitological and necroscopic) in the same way Nichelason et al. (2008) did for *Physaloptera* sp., *Cruzia* sp., and *Didelphostrongylus* sp., while Torres-Montoya et al. (2014) performed this measure for *Gnathostoma turgidum*.

Relying on the description of eggs can be particularly challenging in certain cases, especially considering the possibility of pseudo-parasitism. For instance, when an opossum consumes other animals or contaminated remains, as reported by Pinto, Mati, and Melo (2014), who identified *Toxocara cati* eggs in a specimen of *D. marsupialis*. The review of the case and context confirmed that the findings were ingested during feeding and subsequently released in the animal's feces.

Aragón-Pech et al. (2018) described specimens of *D. virginiana* eggs with morphological characteristics grouped into the genera *Trichuris*, *Capillaria*, *Ancylostoma*, *Cruzia*, *Ascaris*, *Toxocara*, *Turgida,* and *Oligacanthorhynchus*. They defined others only as

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belonging to the Acanthocephala. In the same year, Gerhol et al. reported one of the few cases of *Baylisascaris* spp. in *D. virginiana*, a genus of great interest given the documented cases of visceral, ocular, and neural *larva migrans* in several hosts, including humans. The zoonotic risk has been well known since the 1970s, with a total of more than 2,400 cases of encephalitis associated with *B. procyonis* in animals and approximately 25 human instances documented in the USA and Canada. In 2019, Teodoro and collaborators identified *Cruzia tentaculata* in *D. aurita* and *D. albiventris*. Still, they only managed to define the family in others, such as Trichuridae, Trichostrongylidae, and Acylostomatidae. Two other families, Sigmanidae and Spiruroidea, were also associated, but only with findings of *D. albiventris*.

The study by Bezerra-Santos et al. (2020) reported the presence of *Ancylostoma caninum* in *D. aurita* captured in an urban environment in Southeastern Brazil, which emphasizes the potential impact of these findings on public health, mainly due to the circulation and adaptation of this host in cities and metropolitan areas. However, it is crucial to perform additional studies on the involvement of *D. aurita* in disseminating *Ancylostoma caninum* in these environments. In the same year, the authors also reported the presence of *Ancylostoma* spp., *Cruzia tentaculata*, *Strongyloides* spp., *Trichuris* spp., and eggs from the families Ascarididae, Spiruroidea, and Trematoda.

In terms of diversity, Boulossa et al. (2021) managed to identify the species only by characterizing the eggs recovered from *D. aurita*, defining the findings as *Aspidodera raillieti*, *Cruzia tentaculata*, *Globocephalus marsupialis*, *Turgida turgida*, *Brachylaima advena*, *Duboisiella proloba,* and *Oligacanthorhynchus microcephalus*. As well as some family members of Trichuridae and Viannaiidae. On the other hand, Chagas et al. (2024) reported only the genus *Cruzia*, with greater accuracy, while the other findings were allocated in order (Strongylida or Ascaridida), family (Trichuridae or Strongyloididae), superfamily (Oxyuroidea), or class (Trematoda or Acanthocephala).

2.8.1. Community of Parasitic Helminths

- *Didelphis* sp.

In 1979, in Brazil, Coelho et al. reported the presence of *Schistosoma mansoni* eggs in specimens of *Didelphis* sp. The lack of definition of the host species often limits correct identification, especially with food variability, but does not make it impossible. Given that, in Mexico, Acosta-Virgen et al. (2015) were able to record the presence of *Trichuris didelphis*, *Turgida turgida*, *Rhopalias macracanthus*, *Cruzia tentaculata*, *Rhopalias coronatus,* and *Rhopalias macracanthus*.

- *Didelphis aurita*

Most studies involving the species *D. aurita* are records made in Brazil; however, Dubois (1976) characterized the first adults of *Bursotrema tetracotyloides* in *D. azarae* (*D. aurita*) in Argentina. In Brazil, Chagas-Moutinho et al. (2014) reported *Aspidodera lanfredi*, while in 2016 Costa-Neto et al. described the presence of *Heterostrongylus heterostrongylus* and later in 2019, *Aspidodera raillieti*, *Cruzia tentaculata*, *Trichuris minuta*, *Trichuris didelphis*, *Travassostrongylus orloffi*, *Viannaia hamata*, *Globocephalus marsupialis*, *Heterostrongylus heterostrongylus*, *Turgida turgida*, *Duboisiella proloba*, *Brachylaima advena*, *Rhopalias coronatus*, *Oligacanthorhynchus microcephalus* and a Cestoda, which, due to the quality of the sample, was not correctly identified.

In 2021, Cardoso et al. reported two genera (Viannaia sp. and Mathevotaenia sp.) and the species Turgida turgida, *Heterostrongylus heterostrongylus*, *Viannaia hamata*, *Travassostrongylus orloffi*, *Rhopalias coronatus*, *Globocephalus marsupialis*, *Trichuris minuta*, *Trichuris didelphis*, *Oligacanthorhynchus microcephalus*, and *Cruzia tentaculata*, the latter also seen by Souza et al. in 2022. On the other hand, Varella et al. (2022) also described the presence of Aspidodera raillieti in the same year.

- *Didelphis albiventris*

Similar to the case of reports on *D. aurita*, most of the work was carried out in Brazil. However, other studies carried out in South American countries, including Cruz et al. (2000) in Argentina, found *Duboisiella proloba*. On the other hand, the study by Campbell, Gardner, and Navone (2003) reports only *Mathevotaenia argentinensis* in the same locality. In 2024, Jiménez et al. in Bolivia described findings of *Aspidodera raillieti*, *Turgida turgida,* and *Cruzia tentaculata*.

Regarding Brazil, Silva and Costa (1999) reported the presence of two genera (*Gongylonema* sp. and *Capillaria* sp.) and the following species: *Rhopalias coronatus*, *Brachylaema migrans*, *Aspidodera raillieti*, *Cruzia tentaculata*, *Viannaia hamata*, *Travassostrongylus orllofi*, *Turgida turgida,* and *Trichuris didelphis*. Zabott et al. (2017) *Turgida turgida*, *Cruzia tentaculata*, *Hamanniella microcephala,* and *Rhopalias coronatus*, in addition to two findings characterized only by the genus *Aspidodera* sp. And *Trichuris* sp., as early as 2022, Cirino et al. describe the presence of the species *Aspidodera raillieti*, *Cruzia tentaculata*, *Trichuris didelphis*, *Trichuris minuta*, *Turgida turgida, Travassostrongylus orloffi*, *Viannaia hamata*, *Brachylaima advena,* and *Rhopalias coronatus*. Some specimens were characterized only at the genus level (*Hoineffia* sp. and *Viannaia* sp.) and an unidentified Cestoda. Later in the year, there were reports by Jukervicz et al. (2022) for *Trichinella spiralis*, in addition to Souza et al. for *Cruzia tentaculata*, Varella et al. with *Aspidodera raillieti,* and Vielmo et al. with *Angiostrongylus cantonensis*.

- *Didelphis marsupialis*

In 1958, Sandars reported *Achillurbainia recondita*, *Metadelphis evandroi,* and *Rhopalias coronatus* found in Trinidad and Tobago (formerly the West Indies) material. In the USA, Barbero (1958) described the presence of *Capillaria longicauda*, *Gongylonema longispiculum*, *Gnathostoma didelphis*, *Trichuris minuta*, *Trichuris didelphis*, *Mesocestoides variabilis,* and *Hamanniella tortuosa*. In addition to three specimens characterized as belonging to the genus (*Gnathostoma* sp., *Dipetalonema* sp.,

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and *Dirofilaria* sp.), Stewart and Dean reported *Didelphonema longispiculata* in 1971. Previously, Pence and Little (1972) had found *Anatrichosoma buccalis* in specimens from the USA, Costa Rica, and Colombia.

During the research by Kuntz et al. (1975), *Schistosoma haematobium* was identified, and it was one of the first reported cases of the genus. Still, in the same year, Nettles, Prestwood, and Davidson found *Physaloptena turgida*, *Brachylaima virginianum*, *Cruzia americana,* and *Capillania aerophila*. As early as 1976, Prestwood found *Didelphostrongylus hayesi*, while Diaw in French Guiana managed to recover specimens of Trichostrongyloidea. Although there is no exact definition of the location of the samples, in 1977, Prestwood, Nettles, and Farrek found worms of the species *Didelphostrongylus hayesi* and some associated with the genus *Capillaria* sp..

In the 21st century, Cañeda-Guzmán, Chambrier, and Scholz (2001) in Mexico detail *Thaumasioscolex didelphidis*, while after ten years in French Guiana, Jiménez, Catzeflis, and Gardner (2011) report the finds of the species *Mathevotaenia bivittata*, *Aspidodera raillieti*, *Capillaria eberthi*, *Spirura guianensis*, *Travassostrongylus paraquintus*, *Trichuris reesali*, *Viannaia viannai,* and *Oncicola campanulata*.

Acosta-Virgen et al. (2015) in Mexico describe *Amphimerus caudalitestis*, *Philandrophilus magnacirrus*, *Rhopalias coronatus*, *Rhopalias macracanthus*, *Thaumasioscolex didelphidis*, *Oncicola luehei*, *Cruzia tentaculata*, *Gnathostoma turgidum*, *Turgida turgida*, *Trichuris didelphis,* and *Viannaia viannai*, in addition to structures associated with the Capillariinae family. In Brazil, Freitas et al. (2022) have published the following findings: *Aspidodera raillieti*, *Cruzia tentaculata*, *Didelphonema longispiculata*, *Travassostrongylus orloffi*, *Trichuris minuta*, *Turgida turgida*, *Viannaia hamata,* and *Oligacanthorhynchus microcephalus*. As with other authors, some cestodes could not be identified due to the state of the morphological characters. In the same year, Freitas and collaborators also described *Didelphonema longispiculata*. In 2024, Jiménes et al. reported the findings of *Aspidodera raillieti*, *Turgida turgida*, *Viannaia hamata*, *Viannaia simplicispicula*, *Viannaia skrjabini*, *Viannaia viannai,* and *Oligacanthorhynchus microcephala* from specimens from Bolivia.

- Didelphis virginiana

Due to the limited distribution of opossums of the species *D. virginiana* in terms of countries, most published studies focused on specimens from the USA and Mexico. Therefore, they were organized in order of location and chronological order for better identification.

Studies from species in the USA

The species *D. virginiana* is well-distributed and present in North America, primarily in the United States. Parasites such as *Cruzia americana* were reported by Crites in 1956 and even in 2019 by Li. On the other hand, Kinsella and Winegamer (1975) were the only ones to identify *Anatrichosoma bucalis*, a common nematode in non-human primates that poses a zoonotic risk, albeit rarely reported, for humans.

In 1979, Esslinger and Smith characterized *Dipetalonema didelphis*, while Dunagan and Miller (1981) characterized *Oligacanthorhynchus tortuosa*, one of the most frequent acanthocephalans in marsupials, which has some species of great zoonotic interest. Gray and Anderson (1982) and Matey, Kuperman, and Kinsella (2001) identified *Turgida turgida*, a common Physalopteridae species found in opossums of the genus *Didelphis,* which is present in both North and South America.

Bowman, Smith, and Little's (1983) study found *Lagochilascaris sprenti*, a nematode of significant health relevance due to its accidental occurrence in humans and the versatility of the genus in infecting hosts. The authors confirmed the presence and viability of the host by conducting an experimental infection using eggs obtained from *D. virginiana*.

The study by Ducan Júnior, Reinemeyer, and Funk (1989), as well as that of Lamberski (2002), demonstrated the presence of *Didelphostrongylus hayesi*, while Snyder et al. (1991) found *Capillaria didelphis* in addition to *Cruzia americana* and *Turgida turgida*. At the turn of the millennium, Ellis and Richardson (1999) produced one of the most significant reports for the species to date when they identified *Centrorhynchus spinosus*, *Oligacanthorhynchus tortuosa*, *Mesocestoides variabilis*, *Cruzia americana*, *Gnathostoma didelphis*, *Longistriata didelphis*, *Physaloptera turgida*, *Trichuris didelphis*, *Viannaia hamata*, *Brachylaima virginiana*, *Diplostomum variabile,* and *Rhopalias macracanthus*.

Kim et al. (2002) and Miller et al. (2006) were able to recover specimens of *Parastrongylus costaricensis*, while Nichelason et al. (2008) found the trio of *Cruzia americana*, *Turgida turgida,* and *Didelphostrongylus hayesi* previously seen in isolation, after almost a decade. However, it was only in 2020 that Cleveland et al. reported the presence of *Dracunculus insignis*, which, despite not being considered zoonotic, is sporadically found in opossums of the genus *Didelphis*. Notably, the species *Dracunculus medinensis* is responsible for human infection and is known as the Guinea worm.

Studies with Specimens from Mexico

There is also a significant presence of *D. virginiana* in Mexico, where Salgado-Maldonado and Cruz-Reyes (2002), for the first time in the Western Hemisphere, identified specimens of *Porrorchis nickoli* present in the Virginia opossum, which were subsequently found in 2015 and 2020, respectively, by Acosta-Virgen et al. and Gárcia-Varela et al.. In the 21st century, Mont-Mendoza and García-Prieto (2005) managed to carry out another central identification of several species, such as *Brachylaima virginiana*, *Paragonimus mexicanus*, *Rhopalias coronatus*, *Rhopalias macracanthus*, *Oligacanthorhynchus tortuosa*, *Oncicola luehei*, *Didelphostrongylus hayesi*, *Cruzia americana*, *Cruzia tentaculata*, *Gnathostoma turgidum*, *Turgida turgida*, *Didelphonema*

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longispiculata, *Viannaia didelphis,* and *Viannaia viannai*. Once again, some species could not be identified to the species level; these specimens were classified only to the genus level (*Brachylaima*, *Mathevotaenia*, *Cruzia*, *Trichuris,* and *Viannaia*).

Despite the many distinct helminths present, one of the few species that are recurrent in the region is *Gnathostoma turgidum*, also reported by Díaz-Camacho et al. (2009), Nawa et al. (2009), Díaz-Camacho et al. (2010), Torres-Montoya et al. (2014), and Torres-Montoya et al. (2018). It should be noted that the genus *Gnathostoma* contains several well-established zoonotic species. In 2015, another extensive survey was carried out by Acosta-Virgen et al. with records of *Amphimerus caudalitestis*, *Brachylaima didelphus*, *Rhopalias coronatus*, *Rhopalias macracanthus*, *Thaumasioscolex didelphidis*, *Oligacanthorhynchus microcephalus*, *Porrorchis nickoli*, *Didelphostrongylus hayesi*, *Aspidodera raillieti*, *Cruzia tentaculata*, *Gnathostoma turgidum*, *Turgida turgida*, *Trichuris didelphis,* and *Viannaia viannai*. Some findings have been recorded only at the genus level (*Mathevotaenia* and *Gongylonema*) and at the family level (Capillariinae).

In 2017, Lópes-Crespo et al. rediscovered *Didelphostrongylus hayesi* in the lung region, detailing the lung lesions caused by the parasite. Meanwhile, in 2021, Ramírez-Cañas, Lópes-Caballero, and Mata-López described morphologically and phylogenetically the new species *Viannaia angelae* found in *D. virginiana*.

3. Final Considerations

Based on the historical context of helminth records in opossums of the genus *Didelphis*, it is possible to observe the wide variety of helminths in the species. However, there is also a notable lack of more detailed and technical investigations in areas where this host can be found. Additionally, the zoonotic potential of some genera and species of helminths identified has not been adequately analyzed. This is especially relevant, considering these animals are highly versatile and adaptable to different environments and diets. Therefore, future detailed research on helminth communities in these animals should be conducted, especially in regions where historical scientific studies are lacking.

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