

Article

A Comprehensive Update on Helminth Parasite Biodiversity and Richness in Peruvian Amphibians

Jhon D. Chero ^{1,*} , Celso L. Cruces ², Edson R. Cacique ¹ , Jodie A. Ponce ¹ , José Iannacone ^{3,4,5} , Lorena Alvarino ³, Lidia Sanchez ⁶, Gloria Sáez ⁷, Jorge Lopez ⁸ and Reinaldo José Da Silva ⁹ 

- ¹ Laboratorio de Zoología de Invertebrados, Departamento Académico de Zoología, Facultad de Ciencias Biológicas, Universidad Nacional Mayor de San Marcos (UNMSM), Avenida Universitaria Cruce Con Avenida Venezuela Cuadra 34, Lima 15081, Peru; edson.cacique@unmsm.edu.pe (E.R.C.); jodie.ponce.a@gmail.com (J.A.P.)
 - ² Facultad de Medicina Humana, Universidad Ricardo Palma (URP), Avenida Alfredo Benavides 5440 Santiago de Surco, Lima 15039, Peru; celso.cruces@urp.edu.pe
 - ³ Laboratorio de Ecología y Biodiversidad Animal, Facultad de Ciencias Naturales y Matemática, Universidad Nacional Federico Villarreal (UNFV), Lima 15001, Peru; jiannacone@unfv.edu.pe (J.I.); lalvarino@unfv.edu.pe (L.A.)
 - ⁴ Facultad de Ciencias Biológicas, Universidad Ricardo Palma (URP), Santiago de Surco, Lima 15039, Peru
 - ⁵ Laboratorio de Ingeniería Ambiental, Facultad de Ingeniería Ambiental, Universidad Científica del Sur, Lima 15067, Peru
 - ⁶ Departamento de Protozoología Helminología e Invertebrados Afines, Museo de Historia Natural, Universidad Nacional Mayor de San Marcos (UNMSM), Lima 15072, Peru; lsanchezp@unmsm.edu.pe
 - ⁷ Laboratorio de Parasitología General y Especializada, Facultad de Ciencias Naturales y Matemática, Universidad Nacional Federico Villarreal (UNFV), Lima 15007, Peru; gsaezf@unfv.edu.pe
 - ⁸ Departamento Académico de Ingeniería Ambiental, Facultad de Ingeniería Geológica Minera Metalúrgica y Geográfica, Universidad Nacional Mayor de San Marcos (UNMSM), Lima 15081, Peru; jlopezb@unmsm.edu.pe
 - ⁹ Laboratory of Wild Animals Parasitology, Department of Parasitology, Institute of Biosciences, São Paulo State University (UNESP), Botucatu 01419-901, SP, Brazil; reinaldo.silva@unesp.br
- * Correspondence: jcherod@unmsm.edu.pe



Citation: Chero, J.D.; Cruces, C.L.; Cacique, E.R.; Ponce, J.A.; Iannacone, J.; Alvarino, L.; Sanchez, L.; Sáez, G.; Lopez, J.; Da Silva, R.J. A Comprehensive Update on Helminth Parasite Biodiversity and Richness in Peruvian Amphibians. *Diversity* **2023**, *15*, 1169. <https://doi.org/10.3390/d15121169>

Academic Editors: Luc Legal, Alexander B. Ruchin and Igor V. Chikhlyaev

Received: 3 November 2023
Revised: 21 November 2023
Accepted: 21 November 2023
Published: 24 November 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: This study aimed to comprehensively update and expand the knowledge on the diversity and richness of helminth parasites found in Peruvian amphibians. A systematic search was conducted across primary databases, encompassing both indexed and non-indexed articles, to compile the most recent data. As of the present study, a total of 83 distinct helminth taxa have been documented in association with 78 anuran species of the order Anura, marking a 176.7% increase from previously recorded figures. Nematodes exhibited the highest species richness, totalling 52 taxa (62.65%), followed by trematodes (21 taxa, 25.3%), acanthocephalans and cestodes (4 taxa each, 4.8%), and monogeneans (2 taxa, 2.4%). The overwhelming majority (85.5%) of the collected parasites (71 taxa) were identified as mature helminths, with the remaining 14.5% (12 taxa) in their larval stages. Notably, *Cosmocerca brasiliense* Travassos, 1925 (Cosmocercidae), and *Physaloptera* sp. (Physalopteridae) were the most prevalent nematodes, having infected the broadest range of host species. *Rhinella marina* Linnaeus, 1758 (Bufonidae), emerged as the anuran host with the highest diversity, harboring 17 distinct helminth species. These findings underscore the crucial role of helminth parasites in shaping amphibian ecosystems and their significance as bioindicators of environmental health. Protecting both amphibian hosts and their associated helminth parasites is paramount, as it is intrinsically linked to the preservation of ecological equilibrium within these ecosystems.

Keywords: amphibians; helminth parasites; biodiversity; nematode parasites; neotropical region; richness; Peru

1. Introduction

South America represents 33.8% ($n = 2937$) of the total 8689 species of global amphibian diversity. Among South American countries, Peru ranks third in terms of amphibian diversity, with 670 recorded amphibian species (22.81%), following Brazil ($n = 1174$; 39.97%) and Colombia ($n = 832$; 28.33%) [1].

Campião et al. [2] published a list of helminth parasites found in South American amphibians, reporting a total of 30 helminth species in Peru, which positioned Peru fourth in terms of helminth biodiversity. However, this review did not consider data published in national journals, many of which are difficult to access and have since discontinued publication or exist only in printed form in Peruvian libraries.

In recent years, there has been an increase in studies focusing on helminth parasites affecting amphibians in Peru [2–9]. Despite this increasing attention, the available information remains limited. It is necessary to continue these studies to document the diversity of helminths, which may face extinction if their hosts become threatened. Such research also contributes to the understanding of parasitic infection dynamics, aids in the use of these parasites as bioindicators of contamination in a specific area, and informs the development of conservation strategies [10–13].

Given the dispersed nature of information related to Peruvian amphibian parasites, this study aims to consolidate these data to facilitate future research. The objective of this research is to compile a comprehensive checklist of helminth parasites infecting amphibians in Peru and analyze their diversity and richness.

2. Materials and Methods

The database was compiled through an extensive bibliographical review of helminth parasites reported from amphibians in Peru. Searches were conducted using several keywords on various platforms, including Zoological Records (Web of Knowledge), Biological Abstracts, Helminthological Abstracts, Google Scholar, Aquatic Sciences and Fisheries Abstracts, Pubmed, ScienceDirect, and Scopus. In each database, search words included “anuran parasites Peru”, “amphibian parasites Peru”, and amphibian helminths Peru”. Additionally, articles published in Spanish that were not indexed in electronic databases were included. Dissertation, theses, and abstracts of scientific meetings do not constitute formal publications, and thus were not considered. The helminth parasite richness was quantified as the total number of parasite species observed in each host species.

This paper consists of two sections: The first section provides a list of helminth parasites, including information about their hosts, locality, site of infection, stage, and the corresponding references. The list of parasite–host associations is presented in phylogenetic order, beginning with the phylum Platyhelminthes (Monogenea, Trematoda, and Cestoda), followed by the phyla Nematoda and Rotifera. Helminth taxonomy follows specific reference for each group: Amin [14] for Acanthocephala, Anderson et al. [15] for Nematoda, Gibson et al. [16], Jones et al. [17], Bray et al. [18] for Trematoda, and Campião et al. [2], Cohen et al. [19] for monogenean, and Khalin et al. [20] for Cestoda. The second section presents a list of amphibian hosts, categorizing them based on their conservation status according to the IUCN (International Union for Conservation of Nature) and their associated parasites, organized by families and amphibian species in alphabetical order. Taxonomic information regarding amphibians is updated based on the AW database [1].

New records for Peru were also included in cases where helminth species were found in amphibian hosts at the Helminthological and Minor Invertebrates Collection at the Museum of Natural History, San Marcos University (MUSM), Peru, even if they had not been previously published in a scientific journal. The collection’s acronym is provided alongside the record. Parasite and amphibian names were updated in accordance with recent publications.

3. Results

The results obtained in this research reveal that in Peru, there is available information on parasites associated with 78 anuran hosts distributed across 10 families: Bufonidae (10 spp.), Dendrobatidae (4 spp.), Hemiphractidae (6 spp.), Hylidae (27 spp.), Leptodactylidae (11 spp.), Microhylidae (3 spp.), Pipidae (1 sp.), Ranidae (1 sp.), Strabomantidae (8 spp.), and Telmatobiidae (7 spp.). The Bufonidae and Telmatobiidae families exhibited the highest number of helminth parasites, with 49 and 29 taxa, respectively (Figure 1). Meanwhile, only one species of helminth parasite has been reported to infect Peruvian pipids and ranids so far.

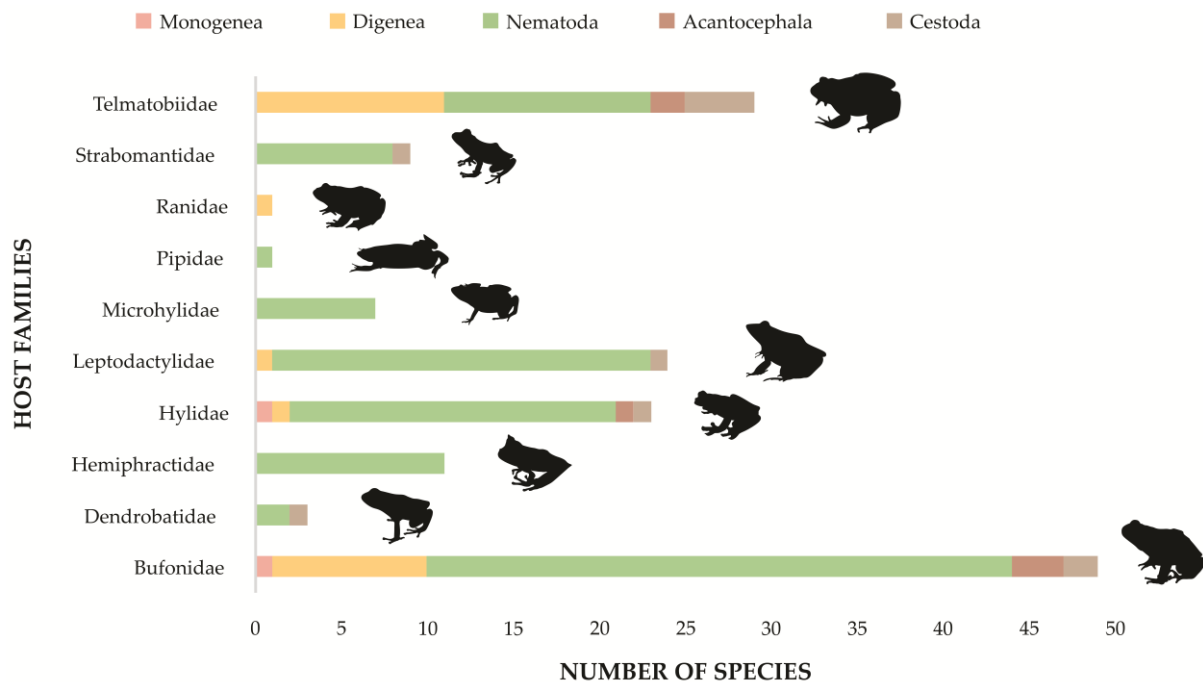


Figure 1. Helminth parasite species distribution among amphibian families in Peru.

To date, a total of 83 taxa of helminth parasites from 28 families infecting amphibians have been recorded in Peru. Among the different types of parasites, nematodes exhibited the highest species richness ($n = 52$, 62.65%), followed by trematodes ($n = 21$; 25.3%), acanthocephalans ($n = 4$; 4.8%), cestodes ($n = 4$; 4.8%), and monogeneans ($n = 2$, 2.4%). These helminth parasites were associated with 60 nominal species and 23 undetermined species (Table 1) within the context of 78 species of anuran host. The overwhelming majority (85.5%) of the registered parasites (71 taxa) were identified as mature helminths, with the remaining 14.5% (12 taxa) in their larval stages. Sixty-eight percent ($n = 53$) of the amphibian hosts were found to harbor two or more parasites per host (Figure 2).

Table 1. Total of nominal and undetermined parasite species of amphibia from Peru according to the taxonomic group.

Taxonomic Group	Nominal sp.	Undetermined sp.	Total
Monogenea	2	0	2
Trematoda	17	4	21
Cestoda	1	3	4
Nematoda	39	13	52
Acanthocephala	1	3	4

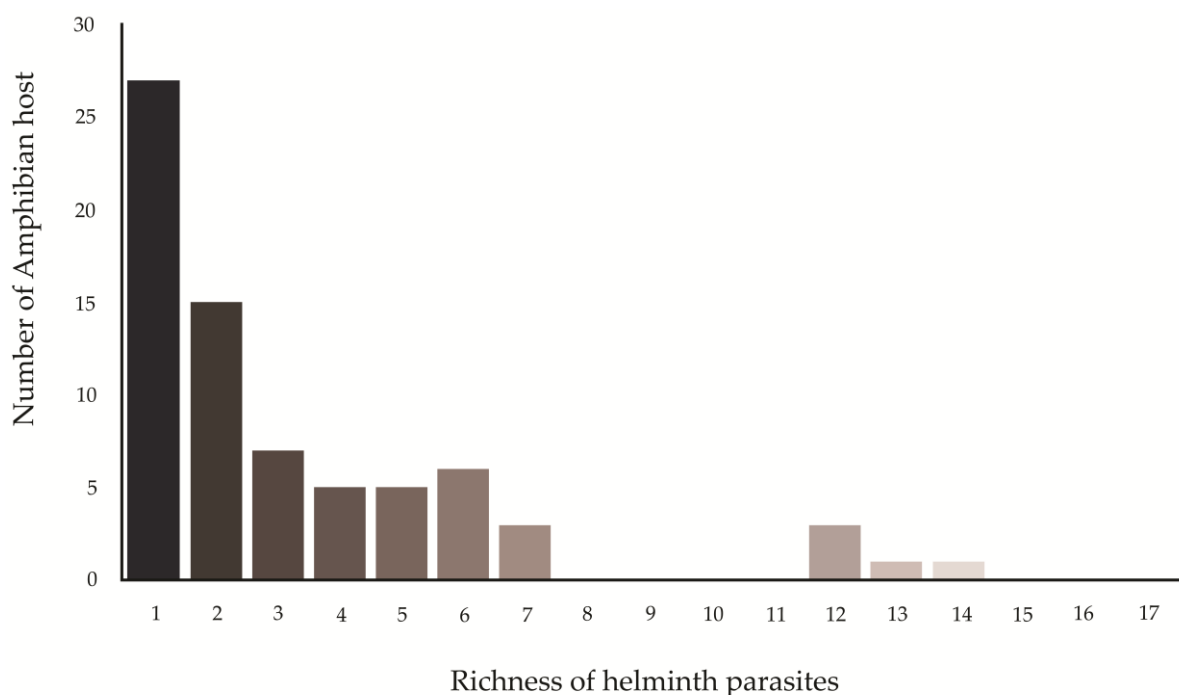


Figure 2. Current known richness of helminth parasites in amphibian hosts from Peru.

Table 2 displays information on the Anura hosts in Peru, including the mean richness of helminths, the maximum richness, the number and percentage of Anura families with larval parasites, and the percentage of amphibians listed in the IUCN conservation database. Of all the collected parasites, 85.5% ($n = 71$) were identified as mature forms of helminths, while 14.5% ($n = 12$) were in larval stages. Nematodes such as *Cosmocerca brasiliense* Travassos, 1925; *Physaloptera* sp. Rud, 1819; and *Aplectana hylambatis* (Baylis, 1927) exhibited a broad range of host species. Anurans such as *Rhinella marina* Linnaeus, 1758 (17 spp.); *Rhinella margaritifera* (Laurenti, 1768) (16 spp.); and *Telmatobius jelskii* (Peters, 1863) (16 spp.) were found to host the highest diversity of helminth parasites.

Table 2. Number of anuran hosts of Peru, richness of helminths average, maximum richness, number and percentage of anuran families with larvae, and the percentage found in conservation lists of IUCN.

	Hosts	Average Richness	Maximum Richness	Number of Anuran Families with Larvae	Percentage Larvae	Percentage Conservation IUCN
Bufonidae	10	7.80	17	5	50	40
Dendrobatidae	4	1.25	2	0	0	0
Hempractidae	6	2.7	6	0	0	33.3
Hylidae	27	2.44	5	17	62.96	0
Leptodactylidae	11	3.45	6	6	54.55	9
Microhylidae	3	2.33	3	2	66.67	0
Pipidae	1	1	1	1	1	0

We compiled a total of 47 articles published over a 60-year period (1963 to 2023) on helminth parasites in amphibian hosts from Peru. The highest number of articles published on amphibian hosts falls within the period from 2000 to 2023, with 22 articles, representing 46.81% of the total. The second-highest period for article publication spans from 1980 to 1999, with 15 articles, accounting for 31.9% of the total. The earliest period, from 1963 to 1979, saw the publication of 10 papers, representing 21.27% of the total number of articles. Figure 3 displays the curve representing the total accumulated records of

helminth taxa between 1963 and 2023 in Peruvian amphibians, while Figure 4 illustrates the curve depicting the accumulated number of new helminth taxa during the same period in Peruvian amphibians.

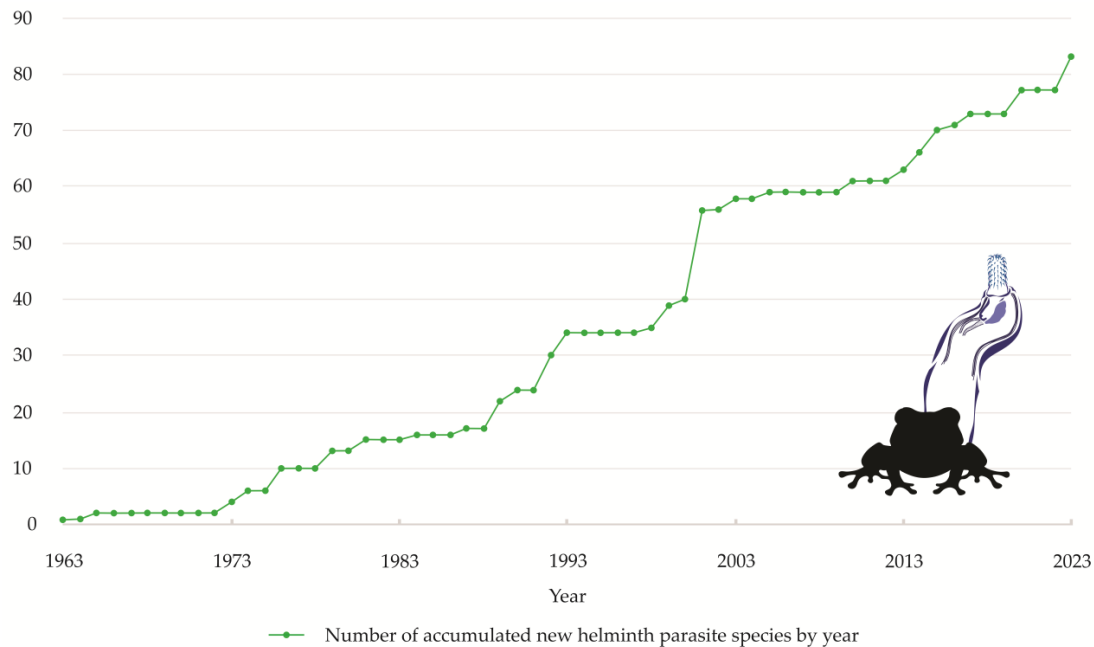


Figure 3. Curve of the number of accumulated total records of helminth parasite taxa between 1963 and 2023 in amphibians of Peru.

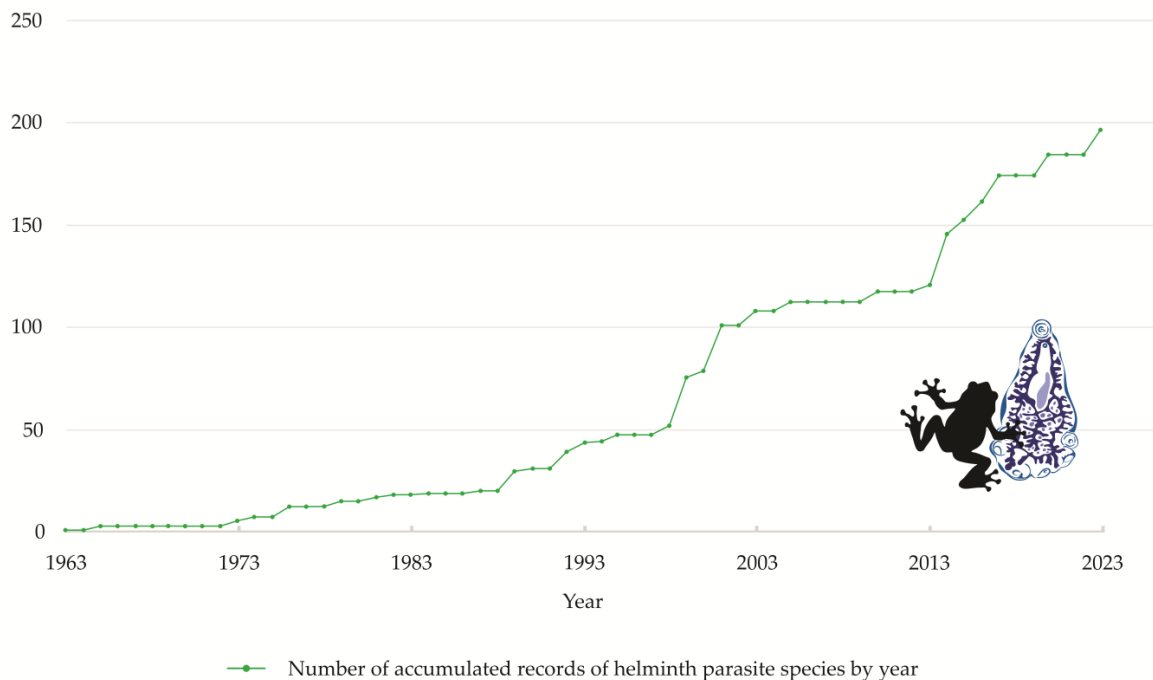


Figure 4. Curve of the number of accumulated new helminth parasite taxa between 1963 and 2023 in amphibians of Peru.

The regions in Peru where amphibian parasites were most frequently recorded included Cuzco (39.75%), Lima (32.53%), Junín (16.87%), Arequipa (15.66%), and Pasco (13.25%) (Figures 5 and 6). The most commonly infected organs were the intestine, small

intestine, and urinary bladder, accounting for 28%, 19%, and 16% of recorded infections, respectively, across 11 different sites within the host amphibians.

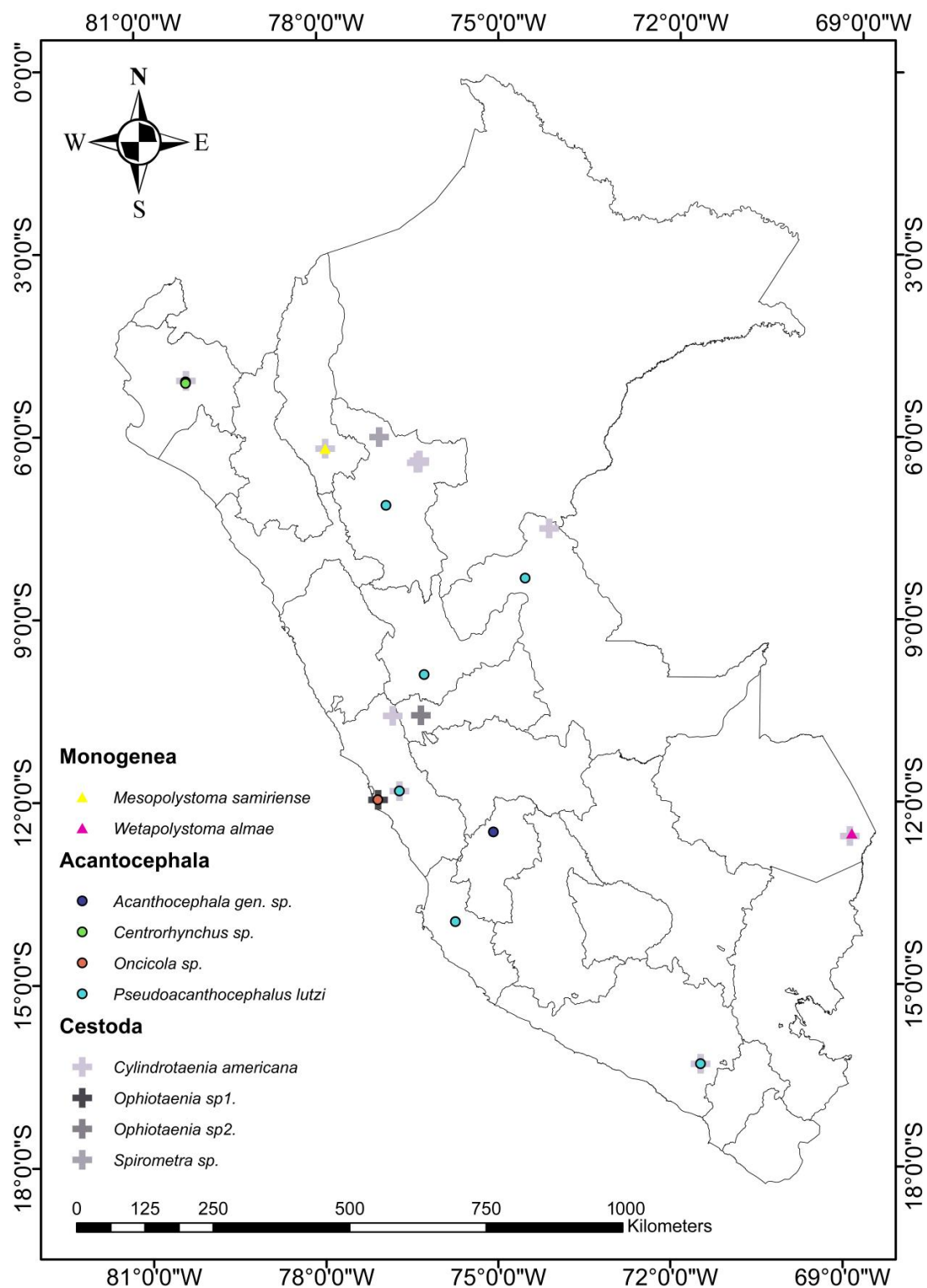


Figure 5. Areas with records of monogeneans, acanthocephalans, and cestodes in amphibian hosts from Peru.

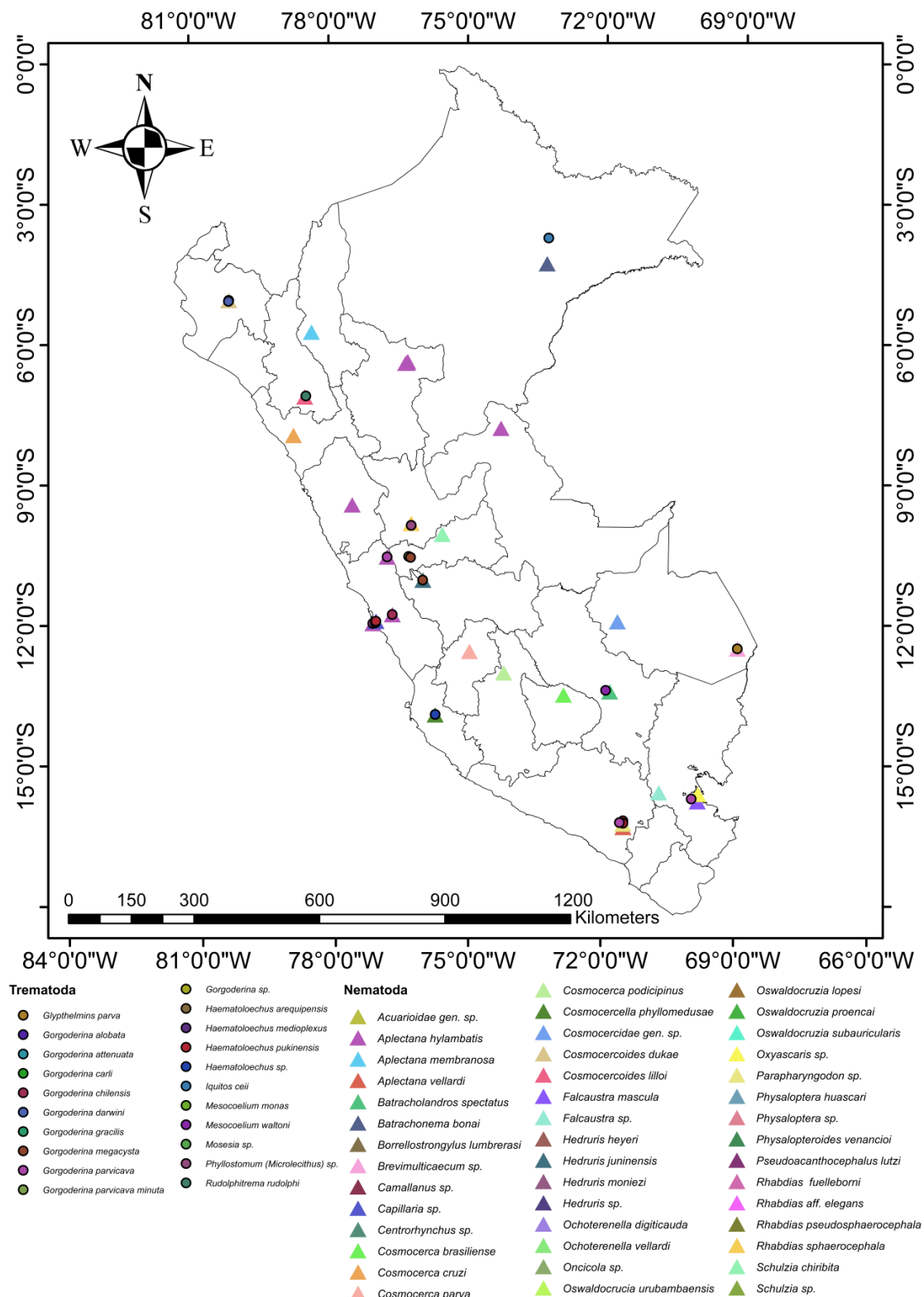


Figure 6. Areas with records of digeneans and nematodes in amphibian hosts from Peru.

Regarding the conservation status of the host amphibians, as per the IUCN, 63 anuran species are classified as ‘Least Concern’ (LC), two as ‘Near Threatened’ (NT), three are ‘Vulnerable’ (VU), six are ‘Endangered’ (EN), three are ‘Critically Endangered’ (CR), and the status of two species remains undetermined.

PARASITE–HOST LIST

Phylum Platyhelminthes Gegenbaur, 1959
Class Monogenea Van Beneden, 1858
Family Polystomatidae (Carus, 1863) Gamble, 1896
Mesopolystoma samiriense Vaucher, 1981
 Host: *Osteocephalus taurinus* Steindachner, 1862
 Locality: Amazonas
 Site of infection: urinary bladder
 Stage: adult
 References: [19,21]

Wetapolystoma almae Gray, 1993
 Host: *Rhinella margaritifera* (Laurenti, 1768)
 Locality: Cuzco, Madre de Dios
 Site of infection: urinary bladder
 Stage: adult
 References: [2,19,22]

Class Trematoda Rudolphi, 1808
Subclass Digenea Carus, 1863
Superfamily Gorgoderioidea Looss, 1899
Family Brachycoellidae Johnston, 1912
Iquitos ceii Mañe-Garzon & Gil, 1963
 Host: *Lithobates palmipes* Spix, 1824
 Locality: Loreto
 Site of infection: intestine
 Stage: adult
 References: [7,23]

Family Gorgoderidae Looss, 1899
Gorgoderina alobata Lees & Mitchell, 1965
 Host: *Telmatobius* sp. Wiegmann, 1834
 Locality: not indicated
 Site of infection: urinary bladder
 Stage: adult
 Reference: Present study (MUSM 2185)

Gorgoderina attenuata (Stafford, 1902)
 Host: *Telmatobius jelskii* (Peters, 1863)
 Locality: Lima
 Site of infection: urinary bladder
 Stage: adult
 Reference: [24]

Gorgoderina carli Baer, 1930
 Host: *Telmatobius brachydactylus* (Peters, 1873)
 Locality: Pasco
 Site of infection: urinary bladder
 Stage: adult
 Reference: Present study (MUSM 1420a)

Gorgoderina chilensis Dioni, 1947
 Hosts: *Telmatobius brachydactylus*, *Telmatobius macrostomus* Peters, 1873, *Rhinella spinulosa* Wiegmann, 1834
 Locality: Lima, Pasco
 Site of infection: urinary bladder
 Stage: adult
 References: [6,7,25], Present study (MUSM 1420b)

Gorgoderina darwini Mane-Garzon & Gonzalez, 1978

Host: *Atelopus* aff. *bomolochus* Peters 1973

Locality: Piura

Site of infection: urinary bladder

Stage: adult

Reference: Present study (MUSM 1764a,b)

***Gorgoderina gracilis* Wongsawad, Sey, Rojanapaibul, Wongsawad, Marayong, Rojtin-nakorn, Suwattanacoupt & Pachananwan, 2000**

Host: *Telmatobius jelskii*

Locality: Lima

Site of infection: urinary bladder

Stage: adult

Reference: present study: MUSM 1762.

***Gorgoderina parvicava* Travassos, 1922**

Hosts: *Atelopus* aff. *bomolochos*, *Telmatobius macrostomus*, *Leptodactylus rhodonotus* (Gunther, 1868), *Rhinella arequipensis* (Vellard, 1959), *Rhinella limensis* (Werner, 1901), *Rhinella spinulosa* Wiegmann, 1834, *Telmatobius culeus* (Garman, 1876), *Telmatobius jelskii*, *Telmatobius peruvianus* Wiegmann, 1834

Locality: Arequipa, Cuzco, Ica, Junín, Lima, Piura, Puno

Site of infection: urinary bladder

Stage: adult

References: [2,3,5,7,25–30], present study (MUSM 114)

***Gorgoderina parvicava minuta* Tantaleán & García, 1993**

Hosts: *Telmatobius macrostomus*

Locality: Pasco

Site of infection: urinary bladder

Stage: adult

References: [7,25,31]

***Gorgoderina megacysta* Mane-Garzon & Gonzalez, 1978**

Hosts: *Telmatobius brachydactylus*, *Telmatobius culeus*, *Leptodactylus rhodonotus*

Locality: Junín, Pasco

Site of infection: urinary bladder

Stage: adult

Reference: present study (MUSM 110, 261 and 1315)

***Gorgoderina* sp.**

Host: *Telmatobius macrostomus*, *Telmatobius jelskii*

Locality: Lima, Pasco

Site of infection: urinary bladder

Stage: adult

References: [7,24,25]

***Phyllostomum* (*Microlecithus*) sp.**

Host: *Rhinella spinulosa*

Locality: Huánuco

Site of infection: urinary bladder

Stage: adult

Reference: [27]

Family Mesocoeliidae Dollfus, 1933

***Mesocoelium monas* (Rudolphi, 1819) Freitas, 1958**

Host: *Rhinella marina* Linnaeus, 1758

Locality: Cuzco

Site of infection: small intestine

Stage: adult

References: [7,27]

***Mesocoelium waltoni* Brunetti, 1912**Host: *Rhinella marina*

Locality: Cuzco

Site of infection: small intestine

Stage: adult

References: [7,27]

Family lecithodendriidae Odhner, 1911***Mosesia* sp.**Host: *Rhinella limensis*

Locality: Lima

Site of infection: small intestine

Stage: adult

References: [27,32]

Superfamily Plagiorchioidae Lühe, 1901**Family Plagiorchiidae Lühe, 1901*****Rudolphitrema rudolphi* (Travassos, 1924) Travassos, 1926**Host: *Atelopus ignescens* (Cornalia, 1849)

Locality: Cajamarca

Site of infection: small intestine

Stage: adult

References: [7,27,28]

Family Glypthelminthidae Cheng, 1959***Glypthelmins parva* Travassos, 1924**Hosts: *Dendropsophus sarayacuensis* (Shreve, 1935), *Trachycephalus coriaceus* (Peters, 1867), *Scinax pedromedinae* (Henle, 1991)

Locality: Cuzco

Site of infection: small intestine

Stage: adult

References: [2,7,33]

Family Haematoloechidae Freitas & Lent, 1939***Haematoloechus arequipensis* Ibañez & Cordova, 1979**Host: *Telmatobius peruvianus*

Locality: Arequipa

Site of infection: lungs

Stage: adult

References: [7,26–28]

***Haematoloechus medioplexus* Looss, 1899**Host: *Rhinella limensis*

Locality: Lima

Site of infection: lungs

Stage: adult

Reference: present study: MUSM 246

***Haematoloechus pukinensis* Ibañez & Cordova, 1979**Hosts: *Telmatobius peruvianus*, *Telmatobius jelskii*

Locality: Arequipa, Lima

Site of infection: urinary bladder

Stage: adult

References: [3,7,26–28]

***Haematoloechus* sp. Looss, 1899**Host: *Rhinella spinulosa*

Locality: Ica

Site of infection: urinary bladder

Stage: adult

References: [7,27]

Class Cestoda Rudolphi, 1808

Order Cyclophyllidea Van Deneden in Braum, 1990

Family Nematotaeniidae Lühe, 1910

***Cylindrotaenia americana* Jewell, 1916**

Hosts: *Allobates marchesianus* (Melin, 1941), *Atelopus* aff. *bomolochos*, *Lithodytes lineatus* (Schneider, 1799), *Rhinella marina*, *Rhinella margaritifera*, *Rhinella poeppigii* (Tschudi, 1845), *Rhinella spinulosa*, *Scinax pedromedinae*, *Telmatobius jelskii*, *Telmatobius marmoratus* (Duméril & Bibron, 1841)

Locality: Amazonas, Arequipa, Cuzco, Lima, Piura, San Martin, Ucayali

Site of infection: small intestine

Stage: adult

References: [2–4,6,9,25–29,33,34]

Family Proteocephalidae La Rue, 1911

***Ophiotaenia* sp1.**

Host: *Telmatobius jelskii*

Locality: Lima

Site of infection: small intestine

Stage: adult

Reference: [3]

***Ophiotaenia* sp2.**

Host: *Telmatobius macrostomus*

Locality: Pasco

Site of infection: small intestine

Stage: adult

Reference: [35]

Order Diphyllbothriidea Lühe, 1910

Family Diphyllbothriidae Lühe, 1910

***Spirometra* sp. Faust, Campbell et Kellogg, 1929**

Hosts: *Pristimantis nephophilus* Duellman & Pramuk, 1999, *Pristimantis rhodostichus* (Duellman & Pramuk, 1999)

Locality: San Martín

Site of infection: subcutaneous level

Stage: larvae

References: [36,37]

Phylum Nematoda Rudolphi, 1808

Order Ascaridida Skrjabin & Shulz, 1940

Superfamily Ascaridoidea Chabaud, 1965

Family Ascarididae Baird, 1853

***Brevimulticaecum* sp. Mozgovoi, 1951**

Hosts: *Boana fasciata* (Günther, 1858), *Boana cinerascens* (Spix, 1824), *Leptodactylus bolivianus* Boulenger, 1898, *Leptodactylus pentadactylus* (Laurenti, 1768), *Scarthyla goinorum* (Bokermann, 1962), *Sphaenorhynchus lacteus* (Daudin, 1800), *Trachycephalus coriaceus*

Locality: Cuzco

Site of infection: cysts in gastrointestinal wall

Stage: larvae

References: [2,33]

***Ophidascaris* sp. Baylis, 1921**

Host: *Callimedusa tomopterna* (Cope, 1868)

Locality: Cuzco

Site of infection: mesentery and serous stomach

Stage: larvae

References: [2,33]

***Porrocaecum* sp. Railliet & Henry, 1912**

Host: *Pipa pipa* (Linnaeus, 1758)

Locality: Cuzco

Site of infection: mesentery and serous stomach

Stage: larvae

References: [2,33]

Superfamily Cosmoceroidea Skrjabin & Schikhobalova, 1951

Family Atractidae (Railliet, 1917) Travassos, 1919

***Schrankiana inconspicata* Freitas, 1959**

Host: *Leptodactylus rhodonotus*

Locality: Cuzco

Site of infection: intestine

Stage: adult

References: [2,33]

***Schrankiana larvata* (Vaz, 1933) Fahel, 1952**

Hosts: *Leptodactylus mystaceus* (Spix, 1824), *Leptodactylus pentadactylus*

Locality: Cuzco

Site of infection: intestine

Stage: adult

References: [2,33]

***Schrankiana schrankai* (Travassos, 1925)**

Host: *Leptodactylus mystaceus*

Locality: Cuzco

Site of infection: intestine

Stage: adult

References: [2,33]

***Schrankianella brasili* (Travassos, 1927)**

Host: *Leptodactylus pentadactylus*

Locality: Cuzco

Site of infection: intestine

Stage: adult

References: [2,33]

Family Cosmocercidae Travassos, 1925

***Aplectana hylambatis* (Baylis, 1927)**

Hosts: *Atelopus* aff. *bomolochos*, *Elachistocleis ovalis* (Schneider, 1799), *Gastrotheca marsupiata* (Duméril & Bibron, 1841), *Gastrotheca griswoldi*, *Gastrotheca peruana*, *Pleurodema marmoratum*, *Leptodactylus bolivianus*, *Leptodactylus leptodactyloides* (Andersson, 1945), *Leptodactylus pentadactylus*, *Leptodactylus rhodonotus*, *Lithodytes lineatus*, *Rhinella arequipensis*, *Rhinella spinulosa*, *Rhinella margaritifera*, *Rhinella marina*, *Rhinella poeppigii*, *Telmatobius jelskii*, *Telmatobius marmoratus*

Locality: Amazonas, Ancash, Apurimac, Arequipa, Cajamarca, Cuzco, Huánuco, Junín, La Libertad, Lima, Pasco, Piura, San Martín, Ucayali

Site of infection: large intestine, small intestine

Stage: adult

References: [2–6,8,9,29,30,33,34,38–40]

***Aplectana membranosa* Schneider, 1866**

Hosts: *Gastrotheca marsupiata*

Locality: Abancay, Cajamarca, Huánuco, Junín, Piura

Site of infection: intestine

Stage: adult

References: [8]

***Aplectana vellardi* Travassos, 1926**

Hosts: *Gastrotheca peruana*, *Rhinella arequipensis*, *Rhinella marina*, *Rhinella spinulosa*

Locality: Ancash, Arequipa, La Libertad, Lima, San Martin

Site of infection: intestine, large intestine

Stage: adult

References: [6,8,9,38,40]

***Cosmocerca brasiliense* Travassos, 1925**

Hosts: *Adenomera andreae* (Müller, 1923), *Adenomera hylaedactyla* (Cope, 1868), *Dendropsophus koechlini* (Duellman & Trueb, 1989), *Dendropsophus leali* (Bokermann, 1964), *Dendropsophus leucophyllatus* (Beireis, 1783), *Dendropsophus marmoratus* (Laurenti, 1768), *Dendropsophus parviceps* (Boulenger, 1882), *Dendropsophus rhodopeplus* (Günther, 1858), *Dendropsophus schubarti* (Bokermann, 1963), *Edalorhina perezi* Jiménez de la Espada, 1871, *Gastrotheca stictopleura* (Duellman, Lehr, and Aguilar, 2001), *Boana boans* (Linnaeus, 1758), *Boana calcarata* (Troschel, 1848), *Boana cinerascens*, *Boana fasciata* (Günther, 1858), *Leptodactylus bolivianus*, *Leptodactylus pentadactylus*, *Leptodactylus petersii* (Steindachner, 1864), *Osteocephalus taurinus*, *Callimedusa atelopoides* Duellman, Cadle & Cannatella, 1988, *Pithecopus palliatus* Peters, 1873, *Callimedusa tomopterna*, *Phyllomedusa vaillanti* Boulenger, 1882, *Pristimantis fenestratus* (Steindachner, 1864), *Pristimantis peruvianus* (Melin, 1941), *Pristimantis toftae* (Duellman, 1978), *Scarthyla goinorum*, *Scinax garbei* (Miranda-Ribeiro, 1926), *Scinax ictericus* Duellman & Wiens, 1993, *Scinax pedromedinae*, *Sphaenorhynchus lacteus*, *Oreobates cruralis* (Boulenger, 1902), *Rhinella marina*, *Trachycephalus coriaceus*

Locality: Cuzco, Pasco

Site of infection: intestine

Stage: adult

References: [2,8,33]

***Cosmocerca cajamarquensis* Ibañez, 1982**

Host: *Atelopus peruensis* Grey & Cannatella, 1985

Locality: Cajamarca

Site of infection: intestine

Stage: adult

References: [40,41]

***Cosmocerca cruzi* Rodrigues and Fabio, 1970**

Host: *Gastrotheca excubitor*

Locality: Cusco

Site of infection: intestine

Stage: adult

References: [8]

***Cosmocerca parva* Travassos, 1925**

Hosts: *Ameerega picta* (Tschudi, 1838), *Ameerega trivittata* (Spix, 1824), *Edalorhina perezi*, *Elachistocleis ovalis*, *Hamptophryne boliviana* (Parker, 1927), *Boana fasciata*, *Leptodactylus leptodactyloides*, *Leptodactylus mystaceus*, *Oreobates quixensis* (Jiménez de la Espada, 1872), *Callimedusa atelopoides*, *Pristimantis fenestratus*, *Pristimantis peruvianus*, *Pristimantis toftae*, *Rhaebo glaberrimus* (Günther, 1869), *Rhinella marina*, *Rhinella margaritifera*, *Scarthyla goinorum*, *Scinax garbei*, *Scinax ictericus*

Locality: Cuzco, Ucayali

Site of infection: intestine

Stage: adult

References: [2,33,34,40]

***Cosmocerca podicipinus* Baker & Vaucher, 1984**

Hosts: *Allobates marchesianus*, *Allobates femoralis* (Boulenger, 1884), *Pristimantis imitatrix* (Duellman, 1978), *Leptodactylus leptodactyloides*, *Rhinella margaritifera*

Locality: Cuzco
 Site of infection: intestine
 Stage: adult
 References: [2,33]

***Cosmocercella phyllomedusae* Bacher & Vaucher, 1986**

Hosts: *Pithecopus palliatus*, *Callimedusa tomopterna*, *Phyllomedusa vaillanti*
 Locality: Cuzco
 Site of infection: intestine
 Stage: adult
 References: [2,33]

***Cosmocercoides dukae* (Holl, 1928)**

Hosts: *Rhinella arequipensis*, *Rhinella limensis*
 Locality: Lima
 Site of infection: intestine
 Stage: adult
 References: [38,40]

***Cosmocercoides lilloi* Ramallo, Bursey y Goldberg, 2007**

Hosts: *Gastrotheca excubitor*, *Gastrotheca griswoldi*, *Gastrotheca monticola*, *Gastrotheca peruana*
 Locality: Ancash, Cajamarca, Cusco, Junín, Huánuco, La Libertad, Piura
 Site of infection: intestine
 Stage: adult
 References: [8]

***Raillietnema gubernaculatum* Freitas & Ibañez, 1965**

Hosts: *Elachistocleis ovalis*, *Rhinella limensis*
 Locality: Cuzco, La Libertad
 Site of infection: intestine
 Stage: adult
 References: [2,33,40,42]

***Raillietnema ibañezi* Cordova, 1998**

Host: *Rhinella spinulosa*
 Locality: Arequipa
 Site of infection: intestine
 Stage: adult
 References: [40,43]

***Cosmocercidae* gen. sp. Railliet, 1916**

Host: *Telmatobius jelskii*
 Locality: Ayacucho, Huancavelica, Junín
 Site of infection: intestine
 Stage: larvae
 References: [3]

Family Kathlaniidae (Lane, 1914) Travassos, 1918

***Falcaustra mascula* (Rudolphi, 1819) Freitas & Lent, 1941**

Hosts: *Rhinella limensis*, *Rhinella spinulosa*, *Telmatobius jelskii*, *Telmatobius marmoratus*
 Locality: Arequipa, Cuzco, Ica, Lima
 Site of infection: small intestine
 Stage: adult
 References: [3,38–40,44]

***Falcaustra condorcanquii* Ibañez & Cordova, 1976**

Hosts: *Telmatobius macrostomus*, *Rhinella marina*, *Telmatobius jelskii*, *Telmatobius peruvianus*
 Locality: Arequipa, Junín, Lima, San Martín
 Site of infection: small intestine
 Stage: adult

References: [2,9,38,40,45]

***Falcaustra* sp. Lane, 1915**

Hosts: *Rhinella limensis*, *Rhinella marina*

Locality: Huánuco, Lima

Site of infection: small intestine, stomach

Stage: adult

References: [5,38,40]

***Oxyascaris* sp. Travassos, 1920**

Host: *Gastrotheca peruana*, *Pleurodema marmoratum*

Locality: Ancash, La Libertad, Junín

Site of infection: large intestine, small intestine

Stage: adult

Reference: [8,40]

Order Enoplida Schuurmans & Deconing, 1933

Superfamily Dioctophymatoidea (Railliet, 1915)

Family Trichuridae (Ransom, 1911) Railliet, 1915

***Capillaria* sp. Zeder, 1800**

Hosts: *Atelopus* aff. *bomolochos*, *Telmatobius jelskii*

Locality: Lima, Piura

Site of infection: small intestine

Stage: adult

References: [2,24,30]

Order Oxyurida Railliet, 1916

Superfamily Oxyuroidea Railliet, 1916

Family Pharyngodonidae Travassos, 1919

***Batracholandros spectatus* (Freitas & Ibañez, 1962) Freitas & Ibañez, 1965**

Hosts: *Atelopus* aff. *bomolochos*, *Osteocephalus taurinus*, *Rhinella limensis*, *Rhinella spinulosa*, *Trachycephalus typhonius*

Locality: Arequipa, Cuzco, Huánuco, Ica, La Libertad, Lima, Piura

Site of infection: small intestine

Stage: adult

References: [2,30,33,38,40,42]

***Parapharyngodon* sp. (Chatterji, 1933)**

Hosts: *Gastrotheca griswoldi*

Locality: Junín, Huánuco

Site of infection: intestine

Stage: adult

References: [8]

Order Rhabditida Chitwood, 1933

Superfamily Rhabditoidea Travassos, 1920

Family Rhabdiasidae Railliet, 1915

***Rhabdias* aff. *elegans* Gutierrez, 1945**

Host: *Gastrotheca griswoldi*, *Gastrotheca peruana*, *Rhinella poeppigii*

Locality: Ancash, Amazonas, Junín, Huánuco, La Libertad

Site of infection: lungs

Stage: adult

Reference: [4,8]

***Rhabdias fuelleborni* Travassos, 1926**

Host: *Rhinella limensis*

Locality: Lima

Site of infection: lungs

Stage: adult

Reference: [5]

***Rhabdias pseudosphaerocephala* Kuzmin, Tkach & Brooks, 2007**

Host: *Rhinella marina*, *Rhinella spinulosa*

Locality: Lima, San Martin

Site of infection: lungs

Stage: adult

Reference: [6,9]

***Rhabdias sphaerocephala* Goodey, 1924**

Hosts: *Atelopus* aff. *bomolochos*, *Rhinella arequipensis*, *Rhinella limensis*, *Rhinella margaritifera*, *Rhinella marina*, *Rhinella spinulosa*

Locality: Arequipa, Cuzco, Huánuco, Ica, Junín, Pasco, Piura

Site of infection: lungs

Stage: adult

References: [2,30,38,40,46,47]

Order Spirurida Chitwood, 1933

Superfamily Acuarioidae Molin, 1860

Family Acuariidae Seurat, 1913

Acuarioidae gen. sp. Ditwood & Wehr 1934

Hosts: *Dendropsophus rhodopeplus*, *Edalorhina perezii*

Locality: Cuzco

Site of infection: stomach

Stage: larvae

Reference: [33]

Superfamily Camallanoidea Chabaud, 1965

Family Camallanidae Railliet and Henry, 1915

***Camallanus* sp. Railliet & Henry, 1915**

Host: *Telmatobius jelskii*

Locality: Lima

Site of infection: intestine

Stage: larvae

Reference: [40]

Superfamily Filarioidea (Weinland, 1858) Stiles, 1907

Family Filariidae (Weinland, 1858) Cobbold, 1879

***Ochoterenella digiticauda* Caballero, 1944**

Hosts: *Leptodactylus mystaceus*, *Rhinella poeppigii*

Locality: Amazonas, Cuzco

Site of infection: body cavity, subcutaneous

Stage: adult

References: [4], Present study: MUSM 2296

***Ochoterenella figueroai* Esslinger, 1988**

Hosts: *Rhinella poeppigii*

Locality: Amazonas

Site of infection: body cavity

Stage: adult

Reference: [4]

***Ochoterenella vellardi* (Travassos, 1929) Esslinger, 1986**

Hosts: *Boana fasciata*, *Osteocephalus taurinus*, *Rhinella margaritifera*, *Rhinella marina*

Locality: Cuzco, San Martin

Site of infection: body cavity

Stage: adult

References: [2,9,33]

Superfamily Habronematoidea Chabaud, 1959

Family Hedruridae Petter, 1971***Hedruris juninensis* Sarmiento, 1976**

Hosts: *Telmatobius brachydactylus*, *Telmatobius macrostomus*

Locality: Junín

Site of infection: stomach

Stage: adult

References: [2,31,40,48–50]

***Hedruris moniezi* Ibañez & Cordova, 1976**

Hosts: *Rhinella spinulosa*, *Telmatobius jelskii*, *Telmatobius marmoratus*, *Telmatobius peruvianus*, *Telmatobius culeus*, *Telmatobius* sp.

Locality: Arequipa, Cuzco, Junín, Lima, Puno

Site of infection: stomach

Stage: adult

References: [2,3,6,38–40,45,49–51]

Note: Referred as *Hedruris heyeri* Bursey & Goldberg, 2007 by Serrano-Martinez et al. [24].

***Hedruris* sp. Nitzsch, 1821**

Hosts: *Rhinella spinulosa*, *Telmatobius jelskii*

Locality: Junín, Lima

Site of infection: stomach

Stage: adult

References: [3,40]

Superfamily Physalopteroidea Sobolev, 1949**Family Physalopteridae Railliet, 1893 Leiper, 1908*****Physaloptera huascari* Ibañez, 1973**

Hosts: *Rhinella limensis*, *Rhinella spinulosa*

Locality: La Libertad

Site of infection: stomach

Stage: larvae

References: [40,52]

***Physaloptera* sp. Rud, 1819**

Hosts: *Ctenophryne geayi* Mocquard, 1904, *Dendropsophus leali*, *Dendropsophus leucophyllatus*, *Dendropsophus marmoratus*, *Edalorhina perezii*, *Hamptophryne boliviana*, *Boana boans*, *Boana fasciata*, *Boana cinerascens*, *Leptodactylus bolivianus*, *Leptodactylus leptodactyloides*, *Leptodactylus mystaceus*, *Leptodactylus pentadactylus*, *Leptodactylus rhodonotus*, *Lithodytes lineatus*, *Oreobates cruralis*, *Osteocephalus taurinus*, *Callimedusa tomopterna*, *Pristimantis fenestratus*, *Pseudis paradoxo* Linnaeus, 1758, *Rhinella limensis*, *Rhinella marina*, *Rhinella spinulosa*, *Scinax ictericus*, *Scinax ruber* (Laurenti, 1768), *Trachycephalus coriaceus*, *Trachycephalus typhonius* (Linnaeus, 1758)

Locality: Cuzco, Junín, San Martín

Site of infection: stomach

Stage: larvae

References: [2,9,33,40,52]

***Physalopteroides venancioi* (Lent, Freitas & Proença, 1946) Sobolev, 1949**

Hosts: *Adenomera hylaedactyla*, *Edalorhina perezii*, *Leptodactylus bolivianus*, *Leptodactylus mystaceus*, *Osteocephalus taurinus*, *Phyllomedusa vaillanti*, *Scinax ruber*, *Pristimantis fenestratus*, *Trachycephalus coriaceus*

Locality: Cuzco

Site of infection: stomach

Stage: adult

References: [2,33]

Orden Strongylida Molin, 1861**Superfamily Trichostrongyloidea Cram, 1927**

Family Molineidae Durette-Desset & Chabaud, 1977***Oswaldocruzia proencai* Ben Slimane & Durette-Desset, 1995**Hosts: *Gastrotheca peruana*, *Rhinella margaritifera*

Locality: Ancash, La Libertad, Ucayali

Site of infection: intestine

Stage: adult

References: [2,8,34]

***Oswaldocruzia subauricularis* (Rudolphi, 1819) Travassos, 1917**Hosts: *Leptodactylus rhodonotus*, *Rhinella margaritifera*, *Rhinella marina*

Locality: Cuzco, Ucayali

Site of infection: small intestine

Stage: adult

References: [33,40,47]. Present study: MUSM 1316

***Oswaldocruzia lopesi* Freitas & Lent, 1938**Hosts: *Ameerega picta*, *Hamptophryne boliviana*, *Boana fasciata*, *Leptodactylus bolivianus*, *Pristimantis fenestratus*, *Rhaebo glaberrimus*, *Rhinella margaritifera*, *Trachycephalus coriaceus*

Locality: Cuzco

Site of infection: intestine

Stage: adult

References: [2,33]

***Oswaldocruzia manuensis* Guerrero, 2013**Hosts: *Rhinella marina*

Locality: Cuzco

Site of infection: intestine

Stage: adult

Reference: [53]

***Oswaldocruzia urubambaensis* Guerrero, 2013**Host: *Rhinella marina*

Locality: Cuzco, San Martin

Site of infection: intestine

Stage: adult

Reference: [9,53]

***Schulzia chiribita* Durette-Desset, Florindez & Morales, 2000**Host: *Leptodactylus rhodonotus*

Locality: Pasco

Site of infection: intestine

Stage: adult

References: [31,54]

***Schulzia* sp. Travasos, 1937**Host: *Leptodactylus rhodonotus*

Locality: Pasco

Site of infection: large intestine

Stage: adult

Reference: [40]

Family Nicollinidae Durette-Desset & Chabaud, 1981***Batrachonema bonai* Durette-Desset, Baker & Vaucher, 1984**Host: *Rhinella margaritifera*

Locality: Loreto

Site of infection: large intestine

Stage: adult

References: [2,40,55]

Family Thrichostrongylidae Cram, 1927

***Borrellostrongylus lumbrerasi* Tantaleán & Naupay, 1974**Hosts: *Rhinella arequipensis*, *Rhinella spinulosa*

Locality: Arequipa, Junín

Site of infection: intestine, cyst in lung tissue

Stage: adult

References: [40,56]. Present study (MUSM 1418–1419)

Phylum Rotifera Cuvier, 1817**Class Hemirotratoria Markevich, 1989****Subclass Acanthocephala Koelreuther, 1771****Order Echinorhynchida Southwell Southwell & MacFie, 1925****Family Echinorhynchidae Cobbold, 1876*****Pseudoacanthocephalus lutzi* (Hamann, 1891)**Hosts: *Rhinella arequipensis*, *Rhinella limensis*, *Rhinella marina*, *Rhinella spinulosa*

Locality: Arequipa, Huánuco, Ica, Lima, Ucayali, San Martín

Site of infection: intestine

Stage: adult

References: [6,57–60]

Order Polymorphida Petrochenko, 1956**Family Centrorhynchidae Van Cleave, 1916*****Centrorhynchus* sp. Kuntzi Schmidt and Neiland, 1966**Hosts: *Atelopus* aff. *bomolochos*, *Telmatobius jelskii*

Locality: Piura, Lima

Site of infection: mesentery

Stage: cystacanth

References: [2,3,30]

***Oncicola* sp. Travassos, 1916**Hosts: *Telmatobius jelskii*

Locality: Lima

Site of infection: mesentery

Stage: cystacanth

Reference: [3]

Acanthocephala gen. sp. Koelreuther, 1771Hosts: *Pithecopus palliatus*, *Rhinella margaritifera*, *Scinax pedromedinae*

Locality: Cuzco

Site of infection: mesentery

Stage: cystacanth

Reference: [33]

HOST-PARASITE LIST**Clase Amphibia****Order Anura****Family Bufonidae*****Atelopus* aff. *bomolochos***

IUCN Red List Status: Critically Endangered (CR)

Digenea:

Gorgoderina parvicava

Cestoda:

Cylindrotaenia americana

Nematoda:

*Aplectana hylambatis**Batracholandros spectatus**Capillaria* sp.*Rhabdias sphaerocephala*

Acantocephala:

Centrorhynchus sp.

Atelopus ignescens

IUCN Red List Status: Critically Endangered (CR)

Digenea:

Rudolphitrema rudolphi

Atelopus peruensis

IUCN Red List Status: Critically Endangered (CR)

Nematoda:

Cosmocerca cajamarquensis

Rhaebo glaberrimus

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca parva

Oswaldocruzia lopesi

Rhinella arequipensis

IUCN Red List Status: Endangered (EN)

Digenea:

Gorgoderina parvicava

Nematoda:

Aplectana hylambatis

Aplectana vellardi

Rhabdias sphaerocephala

Cosmocercoides dukae

Borrellostrongylus lumbrerasi

Acantocephala:

Pseudoacanthocephalus lutzi

Rhinella limensis

IUCN Red List Status: Least Concern (LC)

Digenea:

Gorgoderina parvicava

Haematoloechus medioplexus

Mosesia sp.

Nematoda:

Cosmocercoides dukae

Raillietnema gubernaculatum

Falcaustra máscula

Falcaustra sp.

Batracholandros spectatus

Rhabdias sphaerocephala

Physaloptera huascari

Physaloptera sp.

Acantocephala:

Pseudoacanthocephalus lutzi

Rhinella margaritifera

IUCN Red List Status: Least Concern (LC)

Monogenea:

Wetapolytoma almae

Digenea:

Gorgoderina parvicava

Mosesia sp.

Cestoda:

Cylindrotaenia americana

Nematoda:

Oswaldocruzia proencai

Aplectana hylambatis

Cosmocerca parva

Cosmocerca podicipinus

Raillietnema ibañezi

Falcaustra mascula

Rhabdias sphaerocephala

Ochoterenella vellardi

Oswaldocruzia subauricularis

Oswaldocruzia lopesi

Batrachonema bonai

Acantocephala:

Acantocephala gen. sp.

Rhinella marina

IUCN Red List Status: Least Concern (LC)

Digenea:

Mesocoelium monas

Mesocoelium waltoni

Cestoda:

Cylindrotaenia americana

Nematoda:

Aplectana hylambatis

Aplectana vellardi

Cosmocercoides brasiliense

Cosmocerca parva

Falcaustra condorcanquii

Falcaustra sp.

Rhabdias sphaerocephala

Rhabdias pseudosphaerocephala

Physaloptera sp.

Ochoterenella vellardi

Oswaldocruzia subauricularis

Oswaldocruzia manuensis

Oswaldocruzia urubambaensis

Acantocephala:

Pseudoacanthocephalus lutzi

Rhinella poeppigii

IUCN Red List Status: Least Concern (LC)

Nematoda:

Aplectana hylambatis

Ochoterenella digiticauda

Ochoterenella figueroai

Rhabdias aff. *elegans*

Cestoda:

Cylindrotaenia aff. *americana*

Rhinella spinulosa

IUCN Red List Status: Least Concern (LC)

Digenea:

Gorgoderina parvicava

Phyllostomum (*Microlecithus*) sp.

Haematoloechus sp.

Cestoda:

Cylindrotaenia americana

Nematoda:

Aplectana hylambatis

Aplectana vellardi

Raillietnema ibañezi

Falcaustra máscula

Batracholandros spectatus

Rhabdias sphaerocephala

Hedruris moniezi

Physaloptera huascari

Physaloptera sp.

Acantocephala:

Pseudoacanthocephalus lutzi

Family Dendrobatidae

Allobates femoralis

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca podicipinus

Allobates marchesianus

IUCN Red List Status: Least Concern (LC)

Cestoda:

Cylindrotaenia americana

Nematoda:

Cosmocerca podicipinus

Ameerega trivittata

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca parva

Ameerega picta

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca parva

Family Hemiphractidae

Gastrotheca marsupiata

IUCN Red List Status: Least Concern (LC)

Nematoda:

Aplectana hylambatis

Aplectana membranosa

Gastrotheca excubitor

IUCN Red List Status: Vulnerable (VU)

Nematoda:

Cosmocerca cruzi

Cosmocercoides lilloi

Gastrotheca griswoldi

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocercoides lilloi

Aplectana hylambatis

Parapharyngodon sp.

Rhabdias aff. *Elegans*

Gastrotheca monticola

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocercoides liloi

Gastrotheca peruana

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocercoides liloi

Aplectana hylambatis

Aplectana vellardi

Oxyascaris sp.

Oswaldocruzia proencai

Rhabdias aff. *Elegans*

Gastrotheca stictopleura

IUCN Red List Status: Endangered (EN)

Nematoda:

Cosmocerca brasiliensis

Family Hylidae

Dendropsophus brevifrons

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Dendropsophus koechlini

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Dendropsophus leali

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliensis brasiliense

Physaloptera sp.

Dendropsophus leucophyllatus

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Physaloptera sp.

Dendropsophus marmoratus

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Physaloptera sp.

Dendropsophus parviceps

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Dendropsophus rhodopeplus

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Acuarioidea gen. sp.

Dendropsophus schubarti

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Dendropsophus sarayacuensis

IUCN Red List Status: Least Concern (LC)

Digenea:

Glypthelmis parva

Boana boans

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Physaloptera sp.

Boana calcarata

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Boana cinerascens

IUCN Red List Status: Least Concern (LC)

Nematoda:

Brevimulticaecum sp.

Cosmocerca brasiliense

Physaloptera sp.

Boana fasciata

IUCN Red List Status: Least Concern (LC)

Nematoda:

Brevimulticaecum sp.

Cosmocerca brasiliense

Ochoterenella vellardi

Physaloptera sp.

Oswaldocruzia lopesi

Osteocephalus taurinus

IUCN Red List Status: Least Concern (LC)

Monogenea:

Wetapolystoma almae

Nematoda:

Cosmocerca brasiliense

Batracholandros spectatus

Ochoterenella vellardi

Physaloptera sp.

Physalopteroides venancioi

Scarthyla goinorum

IUCN Red List Status: Least Concern (LC)

Nematoda:

Brevimulticaecum sp.

Cosmocerca brasiliense

Cosmocerca parva

Scinax garbei

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Cosmocerca parva

Scinax ictericus

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense**Cosmocerca parva**Physaloptera* sp.***Scinax pedromedinae***

IUCN Red List Status: Least Concern (LC)

Digenea:

Glypthelmis parva

Cestoda:

Cylindrotaenia americana

Nematoda:

*Cosmocerca brasiliense**Acantocephala*:*Acantocephala* gen. sp.***Scinax ruber***

IUCN Red List Status: Least Concern (LC)

Nematoda:

Physaloptera sp.*Physalopteroides venancioi****Sphaenorhynchus lacteus***

IUCN Red List Status: Least Concern (LC)

Nematoda:

Brevimulticaecum sp.*Cosmocerca brasiliense****Trachycephalus coriaceus***

IUCN Red List Status: Least Concern (LC)

Digenea:

Glypthelmis parva

Nematoda:

Brevimulticaecum sp.*Cosmocerca brasiliense**Physaloptera* sp.*Physalopteroides venancioi**Oswaldocruzia lopesi****Trachycephalus typhoni***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Batracholandros spectatus**Physaloptera* sp.***Callimedusa atelopoides***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense**Cosmocerca parva****Pithecopus palliatus***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocercella phyllomedusae**Acantocephala*:*Acantocephala* gen. sp.

Callimedusa tomopterna

IUCN Red List Status: Least Concern (LC)

Nematoda:

Ophidascaris sp.*Cosmocerca brasiliense**Cosmocercella phyllomedusae**Physaloptera* sp.***Phyllomedusa vaillanti***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense**Cosmocercella phyllomedusae**Physalopteroides venancioi****Pseudis paradoxa***

IUCN Red List Status: Least Concern (LC)

Nematoda:

Physaloptera sp.**Family Leptodactylidae*****Adenomera andreae***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense****Adenomera hylaedactyla***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense**Physalopteroides venancioi****Edalorhina perezi***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense**Cosmocerca parva*

Acuarioidea gen. sp.

Physaloptera sp.*Physalopteroides venancioi****Leptodactylus bolivianus***

IUCN Red List Status: Least Concern (LC)

Nematoda:

Brevimulticaecum sp.*Aplectana hylambatis**Cosmocerca brasiliense**Physaloptera* sp.*Physalopteroides venancioi**Oswaldocruzia lopesi****Leptodactylus leptodactyloides***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Aplectana hylambatis**Cosmocerca parva**Cosmocerca podicipinus**Physaloptera* sp.

Leptodactylus mystaceus

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Schrankiana larvata**Schrankiana schrankai**Cosmocerca parva**Ocheterenella digicauda**Physaloptera* sp.*Physalopteroides venancioi**Leptodactylus pentadactylus*

IUCN Red List Status: Least Concern (LC)

Nematoda:

Brevimulticaecum sp.*Schrankiana larvata**Schrankianella brasili**Aplectana hylambatis**Cosmocerca brasiliense**Physaloptera* sp.***Leptodactylus petersii***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense****Leptodactylus rhodonotus***

IUCN Red List Status: Least Concern (LC)

Digenea:

Gorgoderina parvicava

Nematoda:

*Oswaldocruzia subauricularis**Schrankiana inconspicata**Aplectana hylambatis**Physaloptera* sp.*Schulzia chiribita****Lithodytes lineatus***

IUCN Red List Status: Least Concern (LC)

Cestoda:

*Cylindrotaenia americana****Pleurodema marmoratum***

IUCN Red List Status: Vulnerable (VU)

Nematoda:

*Aplectana hylambatis**Oxyascaris* sp.**Family Microhylidae*****Ctenophryne geayi***

IUCN Red List Status: Least Concern (LC)

Nematoda:

Physaloptera sp.***Elachistocleis ovalis***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Aplectana hylambatis**Cosmocerca parva**Raillietnema gubernaculatum*

Hamptophryne boliviana

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca parva**Physaloptera* sp.*Oswaldocruzia lopesi***Family Pipidae*****Pipa pipa***

IUCN Red List Status: Least Concern (LC)

Nematoda:

Porrocaecum sp.**Family Ranidae*****Lithobates palmipes***

IUCN Red List Status: Least Concern (LC)

Digenea:

*Iquitos ceii***Family Strabomantidae*****Oreobates cruralis***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense**Physaloptera* sp.***Oreobates quixensis***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca parva****Pristimantis fenestratus***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense**Cosmocerca parva**Physaloptera* sp.*Physalopteroides venancioi**Oswaldocruzia lopesi****Pristimantis imitatrix***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca podicipinus****Pristimantis nephophilus***

IUCN Red List Status: Near Threatened (NT)

Cestoda:

Spirometra sp.***Pristimantis peruvianus***

IUCN Red List Status: Least Concern (LC)

Nematoda:

*Cosmocerca brasiliense**Cosmocerca parva****Pristimantis rhodostichus***

IUCN Red List Status: Least Concern (LC)

Cestoda:

Spirometra sp.

Pristimantis toftae

IUCN Red List Status: Least Concern (LC)

Nematoda:

Cosmocerca brasiliense

Cosmocerca parva

Family Telmatobiidae

Telmatobius brachydactylus

IUCN Red List Status: Endangered (EN)

Nematoda:

Hedruris juninensis

Digenea:

Gorgoderina carli

Gorgoderina chilensis

Gorgoderina megacysta

Telmatobius macrostomus

IUCN Red List Status: Endangered (EN)

Digenea:

Gorgoderina chilensis

Gorgoderina parvicava

Gorgoderina parvicava minuta

Gorgoderina sp.

Cestoda:

Batrachotaenia sp.

Nematoda:

Falcaustra condorcanquii

Hedruris juninensis

Telmatobius culeus

IUCN Red List Status: Endangered (EN)

Digenea:

Gorgoderina parvicava

Telmatobius jelskii

IUCN Red List Status: Near Threatened (NT)

Digenea:

Gorgoderina attenuata

Gorgoderina parvicava

Gorgoderina sp.

Cestoda:

Cylindrotaenia americana

Ophiotaenia sp.

Nematoda:

Aplectana hylambatis

Capillaria sp.

Cosmocercidae gen. sp.

Falcaustra mascula

Falcaustra condorcanquii

Camallanus sp.

Hedruris moniezi

Hedruris sp.

Acantocephala:

Centrorhynchus sp.

Oncicola sp.

Telmatobius marmoratus

IUCN Red List Status: Endangered (EN)

Cestoda:

Cylindrotaenia americana

Nematoda:

*Aplectana hylambatis**Falcaustra mascula**Hedruris moniezi****Telmatobius peruvianus***

IUCN Red List Status: Vulnerable (VU)

Digenea:

*Gorgoderina parvicava**Haematoloechus arequipensis**Haematoloechus pukinensis*

Nematoda:

*Falcaustra condorcanquii**Hedruris moniezi****Telmatobius* sp.**

IUCN Red List Status: not applied

Digenea:

*Gorgoderina alobata***4. Discussion**

To date, a total of 83 helminth parasite taxa have been documented in 78 amphibian species in Peru, marking a significant increase of 176.7% in comparison to the earlier findings reported by Campião et al. [2], who registered only 30 taxa in Peru. Nematodes exhibit the highest species richness with 52 taxa, followed by digeneans with 21 taxa. Gonzalez and Hamann [60] reported 47 nematode taxa in 34 species of Argentinean amphibians. In contrast, Fernandez and Kohn [7] cited only 11 species of trematode parasites in Peruvian amphibians. This diversity pattern is consistent with that observed in helminth parasites of other anurans across South American countries [2]. The majority of collected parasites in Peruvian amphibians were identified as mature helminths. Campião et al. [2] noted that adult nematodes are typically found in the gastrointestinal tract and are the most prevalent helminths in South American amphibians. Nematode species have been reported as adults and have dominated the helminth fauna of Argentinean amphibians [60].

Among nematodes, *C. brasiliense*, *Physaloptera* sp., *A. hylambatis*, and *C. parva* displayed the highest number of hosts, with 34, 27, 18, and 17 hosts, respectively. In South American countries, *C. parva*, *Cosmocerca podicipinus*, *A. hylambatis*, *Oswaldocruzia proencai*, and *G. palmipedis* have been documented to exhibit a wide distribution across five countries and infect a greater number of hosts [2,61,62].

In Peru, *R. marina*, followed by *Rhinella margaritifera*, hosted the most diverse range of helminth parasites (17 spp. and 16 spp., respectively). In South America, *Leptodactylus latrans* and *Rhinella marina* were the hosts with the highest number of reported helminth taxa, with 81 and 47 helminth species, respectively [2]. In Argentina, the bufonid *Rhinella schneideri* (Werner, 1894) and the leptodactylid *Leptodactylus bufonius* Boulenger, 1894 displayed the highest species richness of parasitic nematodes (nine spp.) among Argentinean amphibians [60]. In Mexico, anuran host species with the largest number of parasite species are *R. marina* with 49 species, *L. vaillanti* with 34, and *Lithobates montezumae* Baird, 1854, with 30 [13]. Campião et al. [2] indicated that the genus *Rhinella* (Fitzinger, 1826) had among the highest numbers of helminths in South America [63]. *Rhinella marina* and *R. margaritifera* are species complexes of semiaquatic toads found in tropical and subtropical South America and Central America. This species group is poorly delineated, with numerous undescribed cryptic species, which could explain the high diversity of helminth parasites infecting this group [63–66]. *Rhinella marina* is known for having a highly diverse diet, primarily

consisting of ants and Coleoptera larvae, which may contribute to the high diversity of helminth parasites in this anuran species [67]. In South America, the most prominent families of anurans are Hylidae and Leptodactylidae, comprising nearly 60% of the species studied for helminth parasites [2]. In Peru, Hylidae and Leptodactylidae also have the most hosts evaluated, but Bufonidae and Telmatobiidae are the families with the highest richness of helminth parasites. In Argentina, Bufonidae and Leptodactylidae exhibit the highest species richness of nematodes [60].

Regarding the conservation status of amphibian hosts, it was observed that three families, namely Telmatobiidae, Bufonidae, and Hemiphractidae, contained the highest percentages of host species considered of conservation importance. Understanding the diversity of parasites in amphibians, particularly those species listed as endangered, is crucial. Helminth parasites are integral components of biodiversity, and their extinction can occur in tandem with that of their hosts.

Among the 78 amphibians surveyed for helminths in Peru, there were no caecilian or caudata species. Remarkably, nearly 88% of Peruvian amphibians have not been subjected to studies on helminth parasites. The helminth parasite fauna is a crucial component of the natural history of amphibian hosts and can serve as a valuable and predictive tool for understanding parasite–host interactions and supporting biodiversity conservation research [13,68–75]. However, further research in this area is warranted.

5. Conclusions

This comprehensive update on helminth parasite biodiversity and richness in Peruvian amphibians provides valuable insights into the diversity and distribution of helminth parasites in this region. This research has important implications for conservation, as understanding the diversity and distribution of helminth parasites can aid in the development of conservation strategies and the use of parasites as bioindicators of contamination in specific areas. Additionally, the study highlights the potential threat of extinction faced by helminth parasites if their hosts become threatened. Overall, this study represents a significant contribution to the knowledge of helminth parasite biodiversity in Peruvian amphibians and underscores the need for further research in this field to protect both the amphibian hosts and their associated parasites.

Author Contributions: Conceived and designed the study, J.D.C., C.L.C., G.S., L.A., L.S. and J.I.; carried out the desk work, J.D.C., C.L.C., E.R.C. and J.A.P.; analyses were performed by J.D.C., C.L.C., E.R.C., J.L., G.S. and J.A.P.; wrote the manuscript, J.D.C., C.L.C., J.L., G.S., R.J.D.S. and J.I. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Ethical review and approval were waived for this study due to this study did not consider experiments with live animals.

Data Availability Statement: The data presented in this study are contained within the article.

Acknowledgments: The authors are grateful to David Minaya (UNFV) and all anonymous researchers who provided studies and to the reviewers for suggestions that improved the quality of the paper.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. A.W. (*Amphibia Web*). *Information on Amphibian Biology and Conservation*. Available online: <http://amphibiaweb.org> (accessed on 26 October 2023).
2. Campião, K.M.; Morais, D.H.; Dias, O.T.; Aguiar, A.; Toledo, G.D.; Tavares, L.E.; Silva, R.J. Checklist of Helminth parasites of Amphibians from South America. *Zootaxa* **2014**, *3843*, 1–93. [CrossRef] [PubMed]
3. Chero, J.; Cruces, C.; Iannaccone, J.; Sáez, G.; Alvarino, L.; Silva, R.J.; Morales, V.R. Gastrointestinal parasites in three species of *Telmatobius* (Anura: Telmatobiidae) of an area of high Andes, Peru. *Neotrop. Helminthol.* **2014**, *8*, 439–461.

4. Chero, J.; Cruces, C.; Iannacone, J.; Sáez, G.; Alvarino, L.; Guabloche, A.; Romero, S.; Tuesta, E.; Morales, V.; Silva, R.J. Ecological indices of helminth parasites of the Andean toad *Rhinella poeppigii* (Tschudi, 1845) (Anura: Bufonidae) from Peru. *Biologist* **2015**, *13*, 111–124.
5. Chero, J.; Cruces, C.; Iannacone, J.; Sáez, G.; Alvarino, L.; Silva, R.J.; Morales, V.; Minaya, D. Parasitofauna of the neotropical amphibian *Rhinella limensis* Werner, 1901 (Anura: Bufonidae) from Peruvian central coast. *Neotrop. Helminthol.* **2015**, *9*, 87–102. [\[CrossRef\]](#)
6. Chero, J.; Cruces, C.; Iannacone, J.; Sáez, G.; Alvarino, L.; Luque, J.; Morales, V. Community of helminth parasites of thorny toad *Rhinella spinulosa* (anura: Bufonidae) of Peru. *Rev. Investig. Vet. Perú* **2016**, *27*, 114–129. [\[CrossRef\]](#)
7. Fernandes, B.M.; Kohn, A. *South American Trematodes Parasites of Amphibians and Reptiles*; Ministerio da Saúde, FIOCRUZ, Fundacao Oswaldo Cruz, CNPq, Oficina de Livros: Rio de Janeiro, Brazil, 2014.
8. Gómez, G.; Sánchez, L.; Nacari, L.A.; Espínola-Novelo, J.F. Nematode Parasites from Six Species of Marsupial *Gastrotheca* (Anura: Hemiphractidae) Frogs from the Peruvian Andean Highlands. *Pac. Sci.* **2020**, *74*, 65–73. [\[CrossRef\]](#)
9. Toledo, G.; Fonseca, M.; Iannacone, J.; Cardenas, J.; Pineda, C.; Silva, J. Helminth parasites of *Rhinella marina* (Linnaeus, 1758) (Anura: Bufonidae) from Tarapoto, Peru. *Biologist* **2017**, *15*, 459–468.
10. Bower, D.S.; Brannelly, L.A.; McDonald, C.A.; Webb, R.J.; Greenspan, S.E.; Vickers, M.; Gardner, M.G.; Greenlees, M.J. A review of the role of parasites in the ecology of reptiles and amphibians. *Austral Ecol.* **2019**, *44*, 433–448. [\[CrossRef\]](#)
11. Campião, K.M.; Ribas, A.C.; Cornell, S.J.; Begon, M.; Tavares, L.E. Estimates of coextinction risk: How anuran parasites respond to the extinction of their hosts? *Int. J. Parasitol. Parasites Wildl.* **2015**, *45*, 885–889. [\[CrossRef\]](#)
12. Campião, K.M.; Ribas, A.C.; Morais, D.H.; Silva, R.J.; Tavares, L.E. How many parasites species a frog might have? Determinants of parasite diversity in South American Anurans. *PLoS ONE* **2015**, *10*, e0140577. [\[CrossRef\]](#)
13. Paredes-León, R.; García-Prieto, L.; Guzmán-Cornejo, C.; León-Régagnon, V.; Pérez, T.M. Metazoan parasites of Mexican amphibians and reptiles. *Zootaxa* **2008**, *1904*, 1–166. [\[CrossRef\]](#)
14. Amin, O.M. Classification of the Acanthocephala. *Folia Parasitol.* **2013**, *60*, 273–305. [\[CrossRef\]](#)
15. Anderson, R.C.; Chabaud, A.G.; Willmott, S. *Keys to the Nematode Parasites of Vertebrates: Archival Volume*; CAB International: London, UK, 2009.
16. Gibson, D.I.; Jones, A.; Bray, R. *Keys to the Trematoda*; CAB International: London, UK, 2002; Volume 1.
17. Jones, A.; Bray, R.A.; Gibson, D.I. *Keys to the Trematoda: Volume 2*; CAB International: London, UK, 2005.
18. Bray, R.A.; Gibson, D.I.; Jones, A. *Keys to the Trematoda, Volume 3*; CAB International: London, UK, 2008.
19. Cohen, S.C.; Justo, M.C.; Kohn, A. *South American Monogeneoidea Parasites of Fishes, Amphibians and Reptiles*; Ministerio da Saúde, FIOCRUZ, Fundacao Oswaldo Cruz, CNPq, Oficina de Livros: Rio de Janeiro, Brazil, 2013.
20. Khalil, L.F.; Jones, A.; Bray, R.A. *Keys to the Cestode Parasites of Vertebrates*; CAB International: Wallingford, UK, 1994.
21. Vaucher, C. *Mesopolystoma samiriense* n. gen. n. sp. (Monogenea: Polystomatidae), parasite de *Osteocephalus taurinus* Steindachner (Amphibia: Hylidae) en Amazonie péruvienne. *Rev. Suisse Zool.* **1981**, *88*, 797–802. [\[CrossRef\]](#)
22. Gray, M.E. *Wetapolystoma almae* n. gen., n. sp. (Monogenea: Polystomatidae) Parasite of *Bufo typhonius* (Linnaeus, 1758) (Amphibia: Bufonidae) from Tropical Peru. *Trans. Kans. Acad. Sci.* **1993**, *96*, 181–185. [\[CrossRef\]](#)
23. Mane-Garzon, F.; Gil, O. On a new trematode of *Lithobates palmipes* del Peru: *Iquitos ceii* n. gen. n. sp. *Neotropica* **1963**, *9*, 124–128.
24. Serrano-Martinez, E.; Quispe, M.; Placencia, P.; Hinojosa, E. Parásitos Zoonóticos en Ranas Destinadas a la Elaboración de Bebidas para el Consumo Humano en Lima, Perú. *Rev. Investig. Vet. Peru* **2017**, *28*, 642–649. [\[CrossRef\]](#)
25. Tantaleán, M.V.; García, L. Trematodes de la familia Gorgoderidae en anfibios Leptodactylidae de la región altoandina del Perú. *Bol. Lima* **1993**, *85*, 25–27.
26. Ibáñez, H.N.; Córdova, B.E. Algunos Tremátodos de Telmatobius del Sur del Perú. *Boletín Peru. Parasitol.* **1979**, *1*, 54–66.
27. Tantaleán, M.V.; Sarmiento, J.L.; Huiza, A. Digeneos (Trematoda) del Perú. *Bol. Lima* **1992**, *80*, 47–84.
28. Ibáñez, H.N. Mención de algunos tremátodos en la fauna helmintológica peruana. *Rev. Per Parasit.* **1998**, *13*, 90–97.
29. Iannacone, J. Helminth parasites of *Telmatobius jelskii* (Peters) (Anura, Leptodactylidae) from Lima, Peru. *Rev. Bras. Zool.* **2003**, *20*, 131–134. [\[CrossRef\]](#)
30. Iannacone, J. Helminth parasites of *Atelopus bomolochus* Peters 1973 (Anura: Bufonidae) from Piura, Peru. *Gayana* **2003**, *67*, 9–15.
31. Morales, E.; Sarmiento, L.; Sánchez, L.; Floríndez, D.; Lamas, G. Material tipo de helmintos en el Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, (MUSM), Lima, Perú. *Rev. Peru. Biol.* **2005**, *12*, 463–472. (In Spanish) [\[CrossRef\]](#)
32. Vivar, R.G.; Larrea, H.C.; Uyema, N.T. Algunos trematodos del departamento de Lima. *Bol. Lima* **1994**, *16*, 84–85.
33. Bursey, C.R.; Goldberg, S.R.; Pamarlee, J.R. Gastrointestinal helminths of 51 species of anurans from Reserva Cuzco Amazónico, Peru. *Comp. Parasitol.* **2001**, *68*, 21–35.
34. Mcallister, C.T.; Bursey, C.R.; Freed, P.S. Helminth parasites of amphibians and reptiles from the Ucayali region, Peru. *J. Parasitol.* **2010**, *96*, 444–447. [\[CrossRef\]](#)
35. García, L.V.; Tantaleán, M.V. *Gorgoderina* sp. y *Batrachotaenia* sp. parásitos de *Telmatobius macrostomus* Peters 1873 (Anphibios) de la laguna de Huicra, Pasco, Perú. *Biota* **1987**, *94*, 34–39.
36. Gomez-Puerta, L.A.; Chavez, G.; Enciso, M.A.; Mendoza, A.P. Infestación por esparganos en ranas del genero *Pristimantis* (Anura, Strabomantidae) del Perú. *Rev. Peru. Biol.* **2010**, *17*, 265–266. [\[CrossRef\]](#)

37. Oda, F.H.; Borteiro, C.; Rodrigo, J.; Graca, R.J.; Tavares, L.E.; Crampete, A.; Guerra, V.; Lima, F.S.; Bellay, S.; Karling, L.C.; et al. Parasitism by larval tapeworms genus *Spirometra* in South American amphibians and reptiles: New records from Brazil and Uruguay, and a review of current knowledge in the region. *Acta Trop.* **2016**, *164*, 150–164. [\[CrossRef\]](#)
38. Tantaleán, M.V.; García, L. Contribución al estudio de los helmintos parásitos de anfibios del Perú. *Bol. Lima* **1989**, *64*, 69–77.
39. Recharte, C.A. Parásitos de *Bufo spinulosus* Weigmann, 1835 y *Telmatobius marmoratus pseudojelskii* Weigmann, 1834 de la Granja Káyra, Cusco. *Biotempo* **1995**, *2*, 87–90. [\[CrossRef\]](#)
40. Sarmiento, L.; Tantaleán, M.; Huiza, A. Nemátodos parásitos del hombre y de los animales en el Peru. *Rev. Peru. Parasitol.* **1999**, *14*, 9–65.
41. Ibáñez, H.N. Fauna helmintológica peruana. *Cosmocerca cajamarquensis* n. sp. parasito de *Atelopus laevis* Guenther de Cajamarca, Peru. *Bol. Peru. Parasit.* **1982**, *1–10*, 35–38.
42. Freitas, J.F.; Ibáñez, N. Fauna helminthologica do Peru: Alguns nematodeos parasitos de *Bufo spinulosus limensis* (Werner). *Pap. Avulsos Zool.* **1965**, *17*, 229–239.
43. Cordova, E. *Raillietnema ibañezi* sp. n. (Cosmocercidae: Nematoda) en *Bufo spinulosus* de Arequipa, Peru. *Rev. Peru. Parasitol.* **1998**, *13*, 72–75.
44. Cordova, E.; Martínez, E. Presencia de *Falcaustra mascula* (Rudolphi, 1819) Freitas y Lent, 1941 en *Bufo spinulosus* Wiegmann, 1835. *Bol. Peru. Parasit.* **1981**, *3*, 100–104.
45. Ibáñez, H.N.; Córdova, B.E. Quatro especies nuevas de nemátodos del sur del Peru y redescrípción *Hedruris orestiae* Moniez, 1889. *Memórias Inst. Oswaldo Cruz* **1976**, *74*, 231–253. [\[CrossRef\]](#)
46. Naupay, A. Helmintos parasitos de anfibios del Peru 2 especies de nemátodos parásitos de *Bufo spinulosus trifolium* (Tschudi). *Rev. Peru. Biol.* **1974**, *1*, 83. [\[CrossRef\]](#)
47. Tantaleán, M.V. Contribución al conocimiento de los helmintos de vertebrados de Perú. *Biota* **1976**, *10*, 437–443.
48. Sarmiento, L.B. Nueva especie del género *Hedruris* Nitzsch, 1821 nemátode parásito de *Telmatobius brachydactylus* Peters 1873. *Rev. Cienc. UNMSM* **1976**, *70*, 45–51.
49. Dyer, W.G.; Carr, J.L. Some Ascaridid, Spirurid, and Rhabditid Nematodes of the Neotropical Turtle Genus *Rhinoclemmys* in Mexico and South America. *J. Parasitol.* **1990**, *76*, 259–262. [\[CrossRef\]](#)
50. Bursey, C.R.; Goldberg, S.R. *Hedruris hanleyae* n. sp. (Nematoda: Hedruridae) from *Hemidactylus garnotii* (Sauria: Gekkonidae) from the Cook Islands, Oceania. *J. Parasitol.* **2000**, *86*, 556–559.
51. Lopez, D.F.; Quiñones, M.M.; Lopez, J.L.; Esquece, C.A.; Vasques, A.O.; Severino, R.; Chero, J. A redescription of *Hedruris moniezi* Ibáñez & Córdova, 1976 (Nematoda: Hedruridae), an endoparasite of the Titicaca water frog *Telmatobius culeus* (Garman, 1876) (Anura: Telmatobiidae), with comments on all other known *Hedruris* species in Peru. *Syst. Parasitol.* **2023**, *100*, 505–512. [\[PubMed\]](#)
52. Ibáñez, H.N. *Physaloptera huascari* sp. n. (Physalopteridae Leiper, 1908) en la fauna helmintológica peruana. *Rev. Peru. Med. Trop.* **1973**, *2*, 32–36.
53. Guerrero, R. Two new species of *Oswaldocruzia* (Nematoda: Trichostrongylinae: Molineoidea) parasites of the cane toad *Rhinella marina* (Amphibia: Anura) from Peru. *Acta Parasitol.* **2013**, *58*, 30–36. [\[CrossRef\]](#)
54. Durette-Desset, M.C.; Florindez, D.T.; Morales, E. *Schulzia chiribita* n. sp. (Nematoda, Trichostrongylinae, Molineoidea) parasite of *Leptodactylus rhodonotus* (Amphibian) from Peru. *Parasite* **2000**, *7*, 27–30. [\[CrossRef\]](#)
55. Durette-Desset, M.C.; Baker, M.; Vaucher, C. Présence chez un Amphibien du Pérou d’une nouvelle espèce du genre *Batrachonema* Yuen, 1965 (Nematoda-Trichostrongyloidea) connu chez des Amphibiens orientaux. *Rev. Suisse Zool.* **1984**, *91*, 459–466. [\[CrossRef\]](#)
56. Tantaleán, M.V.; Naupay, A. *Parabatrachostromylus lumbrerasi* n.g., n.sp. (Nematoda, Thrichostromylidae) parásito de anfibio de Arequipa, Peru. *Biota* **1974**, *79*, 159–166.
57. Tantaleán, M.V.; Sánchez, L.; Gómez, L.; Huiza, A. Acantocéfalos del Perú. *Rev. Peru. Biol.* **2005**, *12*, 83–92. [\[CrossRef\]](#)
58. Amin, O.M.; Heckmann, R.A. First description of *Pseudoacanthocephalus lutzi* from Peru using SEM. *Sci. Parasitol.* **2014**, *15*, 19–26.
59. Toledo, G.; Fonseca, M.; Iannaccone, J.; Cardenas, J.; Pineda, C.; Silva, J. Infection with *Pseudoacanthocephalus lutzi* (Hamann, 1891) (Acanthocephala: Echinorhynchidae) in *Rhinella marina* (Linnaeus, 1758) (Amphibia: Bufonidae) in Peru. *Neotrop. Helminthol.* **2017**, *11*, 405–411.
60. Gonzalez, C.; Hamann, M.I. Checklist of nematode parasites of amphibians from Argentina. *Zootaxa* **2015**, *3980*, 451–476. [\[CrossRef\]](#) [\[PubMed\]](#)
61. González, C.E.; Hamann, M.I.; Duré, M.I. Nematodes of amphibians from the south American Chaco: Distribution, host specificity and ecological aspects. *Diversity* **2021**, *13*, 321. [\[CrossRef\]](#)
62. Alcantara, E.P.; Ebert, M.B.; Müller, M.I.; Ungari, L.P.; Ferreira-Silva, C.; Emmerich, E.; Santos, A.L.Q.; O’Dwyer, L.H.; da Silva, R.J. First molecular assessment on *Cosmocerca* spp. from Brazilian anurans and description of a new species of *Cosmocerca* (Ascaridomorpha: Cosmocercidae) from the white-spotted humming frog *Chiasmocleis albopunctata* (Boettger, 1885) (Anura: Microhylidae). *J. Helminthol.* **2022**, *96*, e64. [\[CrossRef\]](#) [\[PubMed\]](#)
63. Santos, S.P.; Ibáñez, R.; Ron, S.R. Systematic of the *Rhinella margaritifera* complex (Anura, Bufonidae) from western Ecuador and Panama with insights in the biogeography of *Rhinella alata*. *Zookeys* **2015**, *501*, 109–145. [\[CrossRef\]](#) [\[PubMed\]](#)
64. Lavilla, E.O.; Caramaschi, U.; Langone, J.A.; Pombal, J.P.; SA, R.O. The identity of *Rana margaritifera* Laurenti, 1768 (Anura, Bufonidae). *Zootaxa* **2013**, *3646*, 251–264. [\[CrossRef\]](#)
65. Moravec, J.; Lehr, E.; Cusi, J.C.; Córdova, J.H.; Gvozdić, V. A new species of the *Rhinella margaritifera* species group (Anura, Bufonidae) from montane forest of the Selva Central, Peru. *Zookeys* **2014**, *371*, 35–56. [\[CrossRef\]](#)

66. Rivera, D.; Prates, I.; Firneno, T.J.; Trefaut Rodrigues, M.; Caldwell, J.P.; Fujita, M.K. Phylogenomics, introgression, and demographic history of South American true toads (*Rhinella*). *Mol. Ecol.* **2022**, *31*, 978–992. [[CrossRef](#)]
67. Fajardo-Martínez, X.; Fajardo-Patiño, A.; De la Ossa, V.J. Hábitos alimentarios del complejo *Rhinella margaritifera* (Laurenti, 1768) (Amphibia: Bufonidae), Amazonas, Colombia. *Rev. Colomb. Cienc. Anim.* **2013**, *5*, 301–312. [[CrossRef](#)]
68. Aho, J.M. Helminth communities of amphibians and reptiles: Comparative approaches to understanding patterns and processes. In *Parasite Communities: Patterns and Processes*; Esch, G.W., Bush, A.O., Aho, J.M., Eds.; Chapman and Hall: London, UK, 1990; pp. 157–195.
69. Brooks, D.R.; León-Règagnon, V.; Pérez-Ponce de León, G. Los Parásitos y la Biodiversidad. In *Enfoques Contemporáneos Para el Estudio de la Biodiversidad*; Hernández, H.M., García, A.N., Alvarez, F., Ulloa, M., Eds.; Instituto de Biología, Universidad Nacional Autónoma de México, Fondo de Cultura Económica: Mexico City, Mexico, 2001; pp. 245–289.
70. Brooks, D.R.; León-Règagnon, V.; McLennan, D.A.; Zelman, D.A. Ecological Fitting as a Determinant of the Community Structure of Platyhelminth Parasites of Anurans. *Ecology* **2006**, *87*, S76–S85.
71. Lunaschi, L.; Drago, F.B. Checklist of digenean parasites of amphibians and reptiles from Argentina. *Zootaxa* **2007**, *1476*, 51–68. [[CrossRef](#)]
72. Espinoza-Jiménez, A.; García-Prieto, L.; Osorio-Sarabia, D.; León-Règagnon, V. Checklist of Helminth Parasites of the Cane Toad *Bufo marinus* (Anura: Bufonidae) From Mexico. *J. Parasitol.* **2007**, *93*, 937–944. [[CrossRef](#)] [[PubMed](#)]
73. Imkongwapang, R.; Jyrwa, D.B.; Lal, P.; Tandon, V. A checklist of helminth parasite fauna in anuran Amphibia (frogs) of Nagaland, Northeast India. *J. Parasit. Dis.* **2014**, *38*, 85–100. [[CrossRef](#)] [[PubMed](#)]
74. González, C.E.; Duré, M.I.; Palomas, S.; Schaefer, E.; Etchepare, E.G.; Acosta, J.L. Contributions to the knowledge of parasitic nematodes of amphibians from the Dry Chaco ecoregion in Argentina. *Cuad. De Herpetol.* **2021**, *35*, 35–42.
75. Hernandez-Caballero, I.; Garcia-Longoria, L.; Gomez-Mestre, I.; Marzal, A. The Adaptive Host Manipulation Hypothesis: Parasites Modify the Behaviour, Morphology, and Physiology of Amphibians. *Diversity* **2022**, *14*, 739. [[CrossRef](#)]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.