



Checklist of the Helminth Parasites of South American Bats

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Abstract

Although the Chiroptera represents a significant proportion (*c.*20%) of the mammalian fauna and South America has the highest diversity of bat species, only about a third of the known species in this region have had helminth parasites reported from them. This work represents the first comprehensive checklist of the helminth parasites (nematodes, acanthocephalans, trematodes and cestodes) of South American bats. The data were extracted from more than 120 references and are presented as a key to each group of parasites down to the generic level, with an indication of how the bats become infected, accompanied by a list of the species recorded for each genus. This is followed, in tabular form, by parasite-host and host-parasite checklists. The parasite-host list also includes their geographical distribution in South America (at the country level) and site data, plus the references in which the parasite records occur. The host-parasite list is arranged according to the classification of the hosts. In all, *c.*370 host-parasite associations are recorded, involving 114 nominal species of helminths from 92 named chiropteran taxa.

Key words: Chiroptera, bats, helminths, South America, checklist, Nematoda, Acanthocephala, Trematoda, Cestoda

Introduction

The Chiroptera is a large group, representing 20–22% of mammalian species (e.g. Simmons, 2005), and some of the highest chiropteran (bat) species diversity in the world occurs in the Neotropical region (Willig & Selcer 1989). Since the work of Diesing (1850), the helminth parasites of bats in South America have been studied sporadically and locally in more than 120, generally small, investigations with little or no continental or national compilation or evaluation. Given that there is increasing evidence suggesting that there is cryptic diversity in Neotropical bats and that many bat species are endangered, ‘a comprehensive survey of potential diversity is needed on a scale which is taxonomically diverse’ and ‘geographically broad’ (Clare *et al.* 2011). The same is true for their helminth parasites, for, as indicated below, only about a third of the known bat species in South America have had helminths reported from them.

Recorded helminths include members of the phyla Nematoda, Acanthocephala and Platyhelminthes, the latter including the classes Trematoda and Cestoda. These records exclusively represent endoparasites. Bats generally acquire such parasites in the form of a passive infection via their diet, with the result that the alimentary canal and thoracic and abdominal cavities are the most parasitized sites. Infected bats usually represent the ‘definitive (or final) host’, harbouring the parasite as a sexual adult, or, more rarely, as either an ‘intermediate host’, in which one or more larval stages develop, or a ‘paratenic host’, in which a larval stage can survive without further development. In addition to increasing our knowledge in terms of biodiversity and disease, the study of the helminth parasites of bats is important as it contributes to our understanding of feeding habits and other aspects of their biology, and may indicate useful biological markers for bat populations.

Methods

The identification of helminths is best realized using specimens in good condition, which means that the parasites

groups which involve insects as intermediate hosts. Consequently, it would appear that the endoparasitic fauna of this group in South America appears rather depauperate when compared to the rich ectoparasitic fauna reported by Frank *et al.* (2014), i.e. 273 species. Thus, in terms of those chiropteran taxa examined so far, the diversity of helminth parasites is only slightly greater than that of their hosts.

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References

- Almeida, J.L. (1936) Sobre um parasito de Chiroptera: *Litomosoides brasiliensis*. *Revista do Departamento Nacional de Produção Animal*, 3, 133–139.
- Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.) (2009) *Keys to the Nematode Parasites of Vertebrates: Archival Volume*. CABI, Wallingford, 424 pp.
- Araújo, T.L. (1940) *Parallintoshius parallintoshius* n.g., n.sp., (Nematoda, Trichostrongylidae) parasita de Chiroptera. *Revista da Faculdade de Medicina Veterinária de São Paulo*, 1, 205–210.
<http://dx.doi.org/10.11606/issn.2318-5066.v1i3/4p205-210>
- Bain, O., Guerrero, R., Rodriguez, B., Babayan, S. & Jouvenet, N. (2003) Examination of type material of two species of *Litomosoides* (Filarioidea: Onchocercidae), parasites from bats; taxonomic consequences. *Parasite*, 10, 211–218.
<http://dx.doi.org/10.1051/parasite/2003103211>
- Barker, F.D. (1916) A new monostome trematode parasitic in the muskrat with a key to the parasites of the American muskrat. *Transactions of the American Microscopical Society*, 35, 175–184.
<http://dx.doi.org/10.2307/3222011>
- Boeger, W.A., Thatcher, V.E. & Marques, S.A. (1985) A validade de *Czosnowia* Zdzitowiecki, 1967, a redescricao de *C. paraguayensis* (Fischthal & Martin, 1978) n. comb. (Trematoda: Lecithodendriidae) e aspectos de sua patologia no fígado do morcego, *Molossus ater* (Geoffrey), no Brasil. *Studies on Neotropical Fauna and Environment*, 20, 7–155.
<http://dx.doi.org/10.1080/01650528509360683>
- Boero, J.J. & Delpietro, H. (1970) El parasitismo de la fauna autóctona. VII. Los parásitos de los murciélagos argentinos. *Jornadas Internas de la Facultad de Ciencias Veterinarias. La Plata*, 1970, 76–82.
- Boero, J.J. & Led, J.E. (1971) El parasitismo de la fauna autóctona. V. Los parásitos de las aves argentinas. VI. Los parásitos de los ofidios argentinos. VII. Los parásitos de los murciélagos argentinos. *Analecta Veterinaria*, 3, 91–103.
- Brant, S.V. & Gardner, S.L. (2000) Phylogeny of species of the genus *Litomosoides* (Nematoda: Onchocercidae): Evidence of rampant host switching. *Journal of Parasitology*, 86, 545–554.
<http://dx.doi.org/10.2307/3284870>
- Braun, M.G.C.C. (1900) Trematoden der Chiroptera. *Annalen des Naturhistorischen Museums in Wien*, 15, 217–236.
- Bray, R.A., Gibson, D.I. & Jones, A. (Eds.) (2008) *Keys to the Trematoda*. Vol. 3. CABI, Wallingford, 824 pp.
- Braun, M.G.C.C. (1900) Trematoden der Chiroptera. *Annalen des K.K. Naturhistorischen Hofmuseums, Wien*, 15, 217–236.
- Bremser, J.G. (1811) *Nachricht von einer beträchtlichen Sammlung thierischer Eingeweidewürmer; und Einladung zu einer literarischen Verbindung, um dieselbe zu vervollkommen, und sie für die Wissenschaft und die Liebhaber allgemein nützlich zu machen*. K.K. Naturalienkabinettsdirektion, Wien, 31 pp.
- Caballero y C., E. (1943) Tremátodos de los murciélagos de México. IV. Descripción de un nuevo género de la subfamilia Lecithodendriinae Looss, 1902, y una nueva especie de *Prosthodendrium* Dollfus, 1931. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoológica*, 14 (1), 173–193.
- Caballero y C., E. (1961) Trematodos de los murciélagos de México. VIII. Catalogo taxonomico de los trematodos que parasitan a los murciélagos (Mammalia, Chiroptera Blumenbach, 1774). *Anales del Instituto de Biología. Universidad México, México DF*, 31, 215–287.
- Caballero y C., E. & Caballero, G. (1969) Trematodos de los murciélagos de México. IX. Descripción de una nueva especie de *Platynosomum* Looss, 1907 y a continuación el primer suplemento del catalogo taxonomico de los trematodos que parasitan a los murciélagos. *Revista de la Sociedad Mexicana de Historia Natural*, 30, 263–290.
- Cardia, D.F.F., Hoppe, E.G.L., Tebaldi, J.H., Fornazari, F., Menozzi, B.D., Langoni, H., do Nascimento, A.A. & Bresciani, K.D.S. (2014) Redescription and taxonomical considerations about *Aonchotheca* (*Aonchotheca*) *pulchra* n. comb. (Enoplida: Trichuridae), a nematode of *Nyctinomops* spp. *Brazilian Journal of Veterinary Parasitology*, 23, 399–402.
<http://dx.doi.org/10.1590/s1984-29612014070>
- Caro, F., Carvajal, H., Bonelo, A. & Vélez, I. (2003) Trematodos de murciélagos de la ciudad de Cali y áreas vecinas (Colombia). *Actualidades Biológicas (Medellin)*, 25 (78), 79–88.

- Chabaud, A.G. & Bain, O. (1974) Données nouvelles sur la biologie des Nématodes Muspiceides, fournies par l'étude d'un parasite de Chiroptères: *Lukonema lukoschusi* n. gen. n. sp. *Annales de Parasitologie Humaine et Comparée*, 48, 819–834.
- Chandler, A.C. (1938) A report on the parasites of a bat, *Nycticeius humeralis*, with descriptions of four new helminths. *Livro Jubilar do Professor Lauro Travassos, Rio de Janeiro*, 3, 107–114.
- Chitwood, B.G. (1938) Some nematodes from the caves of Yucatan. *Publications of the Carnegie Institute of Washington*, 491, 51–66.
- Clare, E.L., Lim, B.K., Fenton, M.B. & Hebert, P.D.N. (2011) Neotropical bats: estimating species diversity with DNA barcodes. *PLoS ONE*, 6 (7), e22648.
<http://dx.doi.org/10.1371/journal.pone.0022648>
- Cribb, T.H. & Bray, R.A. (2010) Gut wash, body soak, blender and heat-fixation: approaches to the effective collection, fixation and preservation of trematodes of fishes. *Systematic Parasitology*, 76, 1–7.
<http://dx.doi.org/10.1007/s11230-010-9229-z>
- Cuartas-Calle, C. & Muñoz-Arango, J. (1999) Nematodos en la cavidad abdominal y el tracto digestivo de algunos murciélagos Colombianos. *Caldasia*, 21, 10–25.
- Diaz-Ungria, C. (1963) Nématodes parasites, nouveaux ou intéressants, du Vénézuéla. *Annales de Parasitologie Humaine et Comparée*, 38, 893–914.
- Diaz-Ungria, C. (1973) Helmintos endoparasitos de Venezuela. *Ciência Veterinária, Maracaibo*, 3, 37–343.
- Diaz-Ungria, C. (1979) Algunas especies de helmintos nuevas para Venezuela. *Revista Ibérica de Parasitología*, 39, 313–336.
- Diesing, K.M. (1850) *Systema Helminthum. Vol. 1*. Braumüller, Vindobonae, 679 pp.
- Drago, F.B., Lunaschi, L.I., Delgado, L. & Robles, R. (2007) Helminthofauna de quirópteros de la Reserva Natural Punta Lara, Provincia de Buenos Aires. *XXI Jornadas Argentinas de Mastozoología*, No. 236, 255.
- Dubois, G. (1960) Contribution à l'étude des Trématodes de Chiroptères. *Revue Suisse de Zoologie, Genève*, 67, 1–80.
- Dubois, G. (1983) Un neodiplostome peruvien, *Neodiplostomum (N.) vaucheri* n. sp. (Trematoda: Strigeoidea: Diplostomidae), parasite d'une chauve-souris. *Revue Suisse de Zoologie, Genève*, 90, 179–182.
- Durette-Desset, M.-C. & Pinto, R.M. (1977) Nouvelles données morpho-logiques sur des Nématodes trichostrongylides des collections de l'Institut Oswaldo Cruz. *Bulletin du Muséum National d'Histoire Naturelle, Paris*, 469, 755–764.
- Durette-Desset, M.-C. & Vaucher, C. (1988) Trichostrongyloidea (Nematoda) parasites de Chiroptères neotropicaux. II. Nouvelles données sur le genre *Cheiropterone* Sandground, 1929. *Revue Suisse de Zoologie, Genève*, 95, 889–899.
- Durette-Desset, M.-C. & Vaucher, C. (1989) Trichostrongyloidea (Nematoda) parasites de chiroptères neotropicaux. III. *Carostongylus touzeti* gen. n., sp. n. chez *Carollia* spp. (Phyllostomatidae). *Revue Suisse de Zoologie, Genève*, 96, 697–706.
- Durette-Desset, M.-C. & Vaucher, C. (1996) *Molostrongylus acanthocolpos* gen. n. sp. n. (Nematoda, Trichostrongylina, Molineoidea) parasite de *Molossops temmincki* (Chiroptera, Molossidae) au Paraguay. *Revue Suisse de Zoologie, Genève*, 103, 905–913.
- Durette-Desset, M.-C. & Vaucher, C. (1999) *Molostrongylus mbopi* sp. n. (Nematoda, Trichostrongylina, Molineoidea), parasite de *Molossops* spp. (Chiroptera, Molossidae) au Paraguay. *Revue Suisse de Zoologie, Genève*, 106, 407–418.
- Esslinger, J.H. (1973) The genus *Litomosoides* Chandler, 1931 (Filaroidea: Onchocercidae) in Colombian bats and rats. *Journal of Parasitology*, 59, 225–246.
<http://dx.doi.org/10.2307/3278809>
- Esslinger, J.H., Vaughn, J.B. & Arata, A.A. (1968) Filarial infections in Colombian bats. *Bulletin of Tulane University Medical Faculty*, 27, 19–22.
- Ferreira, V.S., Brasil-Sato, M.C. (1998) Digeneticos (Cercomeria, Lecithodendriidae) de morcegos (Chiroptera) dos municípios de Seropédica e Rio de Janeiro, do Estado do Rio de Janeiro, Brasil. *Bios (Belo Horizonte)*, 6 (6), 83–88.
- Fischthal, J.H. & Martin, R.L. (1978) *Postorchigenes paraguayensis* sp. n. (Trematoda, Pleurogenidae), a digenetic trematode from the large fishing bat, *Noctilio leporinus rufescens* Olfers, from Paraguay. *Acta Parasitologica Polonica*, 25, 217–221.
- Frank, R., Münster, J., Schulze, J., Liston, A. & Klimpel, S. (2014) Macroparasites of Microchiroptera: Bat ectoparasites of Central and South America. In: Klimpel, S. & Mehlhorn, H. (Eds.), *Bats (Chiroptera) as Vectors of Diseases and Parasites. Parasitology Research Monographs*, 5, 87–130.
http://dx.doi.org/10.1007/978-3-642-39333-4_5
- Freitas, J.F.T. (1934) Sobre as espécies do gênero *Capillaria* Zeder, 1800, parasitas de morcegos. *Memórias do Instituto Oswaldo Cruz*, 28, 239–261.
<http://dx.doi.org/10.1590/S0074-02761934000200004>
- Freitas, J.F.T. (1957) *Ochoterentrema caballeri* sp. n. (Trematoda: Lecithodendriidae). *Revista Brasileira de Biologia*, 17, 285–289.
- Freitas, J.F.T. (1960) Sobre uma nova espécie do gênero “*Prosthodendrium*” Dollfus, 1931 (Trematoda, Lecithodendriidae). *Revista Brasileira de Biologia*, 20, 265–268.
- Freitas, J.F.T. (1961) Sobre o *Paralecithodendrium liliputianum* Travassos, 1928 (Trematoda). *Memórias do Instituto Oswaldo Cruz*, 59, 45–57.
- Freitas, J.F.T. & Dobbin, J.E. Jr. (1960a) Nota prévia sobre novo nematóide Strongyloidea parasito de quiroptera. *Atas da Sociedade de Biologia do Rio de Janeiro*, 4, 56–58.
- Freitas, J.F.T. & Dobbin, J.E. Jr. (1960b) Nota prévia sobre novo trematódeo do gênero *Paralecithodendrium*. *Atas da Sociedade de Biologia do Rio de Janeiro*, 4, 59–60.

- Freitas, J.F.T. & Dobbin, J.E. Jr. (1961a) *Aonchotheca parca* sp. nov., nematódeo capilarídeo parasito de quiróptero. *Atas da Sociedade de Biologia do Rio de Janeiro*, 5, 21–22.
- Freitas, J.F.T. & Dobbin, J.E. Jr. (1961b) *Plagiorchis parumbursatus* sp. nov., trematódeo parasito de quiróptero. *Atas da Sociedade de Biologia do Rio de Janeiro*, 5, 22–25.
- Freitas, J.F.T. & Dobbin, J.E. Jr. (1962) Contribuição ao conhecimento da fauna helmintológica de quirópteros no Estado de Pernambuco, Brasil. *Anais da Faculdade de Farmácia*, 5, 53–83.
- Freitas, J.F.T. & Ibañez, H.N. (1963) Fauna helmintologica do Peru – *Ochoterentrema fraternum* sp. n. (Trematoda, Lecithodendriidae). *Revista Brasileira de Biologia*, 23, 255–258.
- Freitas, J.F.T. & Lent, H. (1935) Nota prévia sobre duas novo especies do gênero *Capillaria* (Nematoda), e referencia a novos hospedadores de helmintos conhecidos. *Revista Médico-Cirúrgica do Brasil*, 43, 301–303.
- Freitas, J.F.T. & Lent, H. (1936) Estudo sobre os Capillariinae parasitos de mamíferos (Nematoda: Trichuroidea). *Memórias do Instituto Oswaldo Cruz*, 31, 85–160.
- Freitas, J.F.T. & Mendonça, J.M. (1960a) Novo nematódeo trichostrongilídeo parasito de quiróptero. *Boletim do Museu Paraense Emílio Goeldi*, 29, 1–4.
- Freitas, J.F.T. & Mendonça, J.M. (1960b) Novo nematódeo do gênero *Pterothominx* Freitas, 1959 (Trichuroidea, Capillariidae). *Revista Brasileira de Biologia*, 20, 269–272.
- Freitas, J.F.T. & Mendonça, J.M. (1961) Novo capilariíneo do gênero *Aonchotheca* López-Neyra, 1949 (Nematoda, Trichuroidea). *Memórias do Instituto Oswaldo Cruz*, 59, 59–63.
- Freitas, J.F.T. & Mendonça, J.M. (1963) Quarta espécie do gênero *Parallintoshius* Araújo, 1940 (Nematoda: Trichostrongylidae). *Revista Brasileira de Biologia*, 23, 223–226.
- Gibson, D.I. & McCarthy, T.J. (1987) Bats as hosts of acanthocephalan parasites. *Helminthological Abstracts*, Series A, 56, 159–162.
- Gibson, D.I., Bray, R.A. & Harris, E.A. (Compilers) (2005) *Host-Parasite Database of the Natural History Museum, London*. Available from: <http://www.nhm.ac.uk/research-curation/scientific-resources/taxonomy-systematics/host-parasites/> (accessed 3 March 2014)
- Gibson, D.I., Jones, A. & Bray, R.A. (Eds.) (2002) *Keys to the Trematoda. Vol. 1*. CABI, Wallingford, 521 pp.
- Guerrero, R. (1985) Parasitología. In: Aguilera, M. (Ed.), *El Estudio de los Mamíferos en Venezuela. Evaluación y Perspectivas*. Fondo Editorial Acta Científica Venezolana, Caracas, Venezuela, pp. 35–91.
- Guerrero, R., Martin, C., Gardner, S.L. & Bain, O. (2002) New and known species of *Litomosoides* (Nematoda: Filarioidea): important adult and larval characters and taxonomic changes. *Comparative Parasitology*, 69, 177–195. [http://dx.doi.org/10.1654/1525-2647\(2002\)069\[0177:naksol\]2.0.co;2](http://dx.doi.org/10.1654/1525-2647(2002)069[0177:naksol]2.0.co;2)
- Guerrero, R., Martin, C. & Bain, O. (2003) *Litomosoides yutajensis* n. sp., first record of this filarial genus in a mormoopid bat. *Parasite*, 10, 219–225. <http://dx.doi.org/10.1051/parasite/2003103219>
- Guerrero, R., Bain, O., Attout, T. & Martin, C. (2006) The infective larva of *Litomosoides yutajensis* Guerrero *et al.*, 2003 (Nematoda: Onchocercidae), a Wolbachia-free filaria from bat. *Parasite*, 13, 127–130. <http://dx.doi.org/10.1051/parasite/2006132127>
- Jones, A., Bray, R.A. & Gibson, D.I. (Eds) (2005) *Keys to the Trematoda. Vol. 2*. CABI, Wallingford, 745 pp.
- Joyeux, C. (1945) Cestodes du Brésil. I. *Arkiv för Zoologi, Uppsala*, 37, 1–4.
- Kanarek, G., Zalesny, G., Sitko, J. & Tkach, V.V. (2014) Phylogenetic relationships and systematic position of the families Cortrematidae and Phaneropsolidae (Platyhelminthes: Digenea). *Folia Parasitologica*, 61, 523–528. <http://dx.doi.org/10.14411/fp.2014.057>
- Khalil, L.F., Jones, A. & Bray, R.A. (Eds.) (1994) *Keys to the Cestode Parasites of Vertebrates*. CABI, Wallingford, 751 pp.
- Lent, H. & Freitas, J.F.T. (1937) Espécies do *Capillaria* em Cuba. *Anais da Academia Brasileira de Ciências*, 9, 91–97.
- Lent, H. & Freitas, J.F.T. (1940) *Histiostrongylus octacanthus* n. sp. (Nematoda: Strongyloidea). *Arquivo Instituto Benjamin Baptista, Rio de Janeiro*, 6, 91–96.
- Lent, H., Freitas, J.F.T. & Proença, M.C. (1945) Trematódeos de morcegos colecionados no Paraguai. *Revista Brasileira de Biologia*, 5, 499–507.
- Lent, H., Freitas, J.F.T. & Proença, M.C. (1946) Algunos nemátodos de murciélagos colecionados en el Paraguai. *Revista Brasileira de Biologia*, 6, 485–497.
- Linstow, O. von (1904) Beobachtungen an Nematoden und Cestoden. *Archiv für Naturgeschichte*, 70, 297–309.
- Lotz, J.M. & Font, W.F. (2008a) Family Lecithodendriidae Lühe, 1901. In: Bray, R.A., Gibson, D.I. & Jones, A. *Keys to the Trematoda. Vol. 3*. CABI, Wallingford, pp. 527–536.
- Lotz, J.M. & Font, W.F. (2008b) Family Phaneropsolidae Mehra, 1935. In: Bray, R.A., Gibson, D.I. & Jones, A. *Keys to the Trematoda. Vol. 3*. CABI, Wallingford, pp. 545–562.
- Lunaschi, L. (2002) Tremátodos Lecithodendriidae y Anenterotrematidae de Argentina, México y Brazil. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México*, 73, 1–10.
- Lunaschi, L. (2004) Redescrición de *Limatuloides limatulus* (Braun) [Braun] Dubpris [Dubois], 1964 (Trematoda, Lecithodendriidae [Lecithodendriidae]), un parasito de *Tadarida brasiliensis* [brasiliensis] (Geof.) (Chiroptera, Molossidae) de Argentina. *Gayana*, 68, 102–107. <http://dx.doi.org/10.4067/s0717-65382004000100011>
- Lunaschi, L. (2006) Redescrición y reubicación sistematica del trematodo *Topsiturvitrema verticalia* (Trematoda: Digenea) en

- una familia nueva. *Revista de Biología Tropical*, 54, 1041–1045.
<http://dx.doi.org/10.15517/rbt.v54i3.13966>
- Lunaschi, L. & Drago, F.B. (2007) Checklist of digenean parasites of wild mammals from Argentina. *Zootaxa*, 1580, 35–50.
- Lunaschi, L. & Notarnicola, J. (2010) New host records for Anenterotrematidae, Lecithodendriidae and Urotrematidae trematodes in bats from Argentina, with redescription of *Anenterotrema liliputianum*. *Revista Mexicana de Biodiversidad*, 81, 281–287.
- Lunaschi, L., Urriza, L. & Alvarez, V.H.M. (2003) *Limatulum oklahomensis* Macy, 1932 in *Myotis nigricans* (Chiroptera) from Argentina and a redescription of *L. umbilicatum* (Vélez & Thatcher, 1990) comb. nov. (Digenea, Lecithodendriidae). *Acta Parasitologica*, 48, 172–175.
- Machado Filho, D.A. (1946) Sobre *Moniliformis moniliformis* (Bremser), *Moniliformis travassosi* Meyer, 1932 e outras espécies duvidosas do gênero (Acanthocephala). *Boletim de Escola Nacional Veterinária, Rio de Janeiro*, 1, 13–27.
- Macy, R.W. (1931a) A key to the species of *Hymenolepis* found in bats and the description of a new species, *H. christensoni*, from *Myotis lucifugus*. *Transactions of the American Microscopical Society*, 50, 344–347.
<http://dx.doi.org/10.2307/3222075>
- Macy, R.W. (1931b) New bat trematodes of the genera *Plagiorchis*, *Limatulum*, and *Dicrocoelium*. *Journal of Parasitology*, 18, 28–33.
<http://dx.doi.org/10.2307/3271740>
- Macy, R.W. (1935) A new trematode, *Limatulum gastroides* (Lecithodendriidae), from the little brown bat, *Myotis lucifugus*. *Proceedings of the Helminthological Society of Washington*, 2, 74–75.
- Mañé-Garzón, F. & González, L.E. (1976) Digenea de los murciélagos del Uruguay. I. *Limatulum brevicocum* n. sp. del estomago de *Myotis levis levis* (I. Geoffroy). *Revista de Biología del Uruguay*, 4, 79–84.
- Mañé-Garzón, F. & Telias, D. (1965) Un nuevo trematodo del género *Urotrema* de la rata de agua y redescription de *Urotrema scabridum* Braun, 1900. *Comunicaciones Zoológicas del Museo de Historia Natural de Montevideo*, 8, 1–9.
- Marinkelle, C.J. & Garcia-Castañeda, M.R. (1999) A key to the microfilariae of the genus *Litosomoides* (Phylum Nematoda), endoparasites from Colombian bats. *Caldasia*, 21, 167–173.
- Marshall, M.E. & Miller, G.C. (1979) Some digenetic trematodes from Ecuadorian bats including five new species and one new genus. *Journal of Parasitology*, 65, 909–917.
<http://dx.doi.org/10.2307/3280248>
- Martin, D.R. (1969) Lecithodendriid trematodes from the bat, *Peropteryx kappleri*, in Colombia, including discussions of allometric growth and significance of ecological isolation. *Proceedings of the Helminthological Society of Washington*, 36, 250–260.
- Mendoza, L., Chavez, J. & Tantaleán, M. (1997) Cestodos parasitos de murciélagos de Ica, Peru. *Parasitología al Día*, 21, 20–24.
- Meyer, A. (1932) Acanthocephala. In: Bronns, H.G. (Ed.), *Klassen und Ordnungen de Tierreichs*. Akadeische Verlagsgesellschaft, Leipzig, 582 pp.
- Molin, R. (1858) Versuch einer Monographie der Filarien. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftlich Classe, Wien*, 28, 365–461.
- Molin, R. (1861) Il sottordine degli acrofalli ordinato scientificamente secundo e risutamenti delle indagini anatomiche et embriogeniche. *Memorie del Real Istituto di Scienze, Lettere ed Arti, Venezia*, 9, 427–633.
- Mourão, E.D., Avilla, L.S. & Lent, H. (2002) Redescrção de *Litosomoides brasiliensis* Almeida, 1936 (Nematoda: Filariidae) Parasito de *Anoura caudifera* (Chiroptera: Phyllostomidae). *Memórias do Instituto Oswaldo Cruz*, 97, 495–499.
<http://dx.doi.org/10.1590/s0074-02762002000400007>
- Nama, H.S. (1990) An overview of the tapeworm genus *Hymenolepis* Weinland, 1958 *sensu lato* from arid and non-arid regions. *Scientific Reviews on Arid Zone Research*, 7, 1–80.
- Nogueira, M.R., de Fabio, S.R. & Peracchi, A.L. (2004) Gastrointestinal helminth parasitism in fruit-eating bats (Chiroptera, Stenodermatinae) from western Amazonian Brazil. *Revista de Biología Tropical*, 52, 387–392.
<http://dx.doi.org/10.15517/rbt.v52i2.15254>
- Nogueira, M.R., de Fabio, S.R., Moratelli, L., Tavares, V.C., Gregorin, R. & Peracchi, A.L. (2014) Checklist of Brazilian bats, with comments on original records. *Check List*, 10, 808–821.
<http://dx.doi.org/10.15560/10.4.808>
- Noronha, D., Vicente, J.J. & Magalhães Pinto, R. (2002) A survey of new host records for nematodes from mammals deposited in the Helminthological Collection of the Oswaldo Cruz Institute (CHIOC). *Revista Brasileira de Zoologia*, 19, 945–949.
<http://dx.doi.org/10.1590/s0101-81752002000300032>
- Notarnicola, J., Jimenez Ruiz, F.A. & Gardner, S.L. (2010) *Litosomoides* (Nemata: Filarioidea) of bats from Bolivia with records for three known species and the description of a new species. *Journal of Parasitology*, 96, 775–782.
<http://dx.doi.org/10.1645/ge-2371.1>
- Oviedo, M.C., Ramallo, G. & Claps, L.E. (2010) Una especie nueva de *Cheiropteroneuma* (Nematoda, Molineidae) en *Artibeus planirostris* (Chiroptera, Phyllostomidae) en la Argentina. *Iheringia, Série Zoologia*, 100, 242–246.
<http://dx.doi.org/10.1590/s0073-47212010000300009>
- Oviedo, M.C., Ramallo, G., Claps, L.E. & Miotti, M.D. (2012) A new species of *Biacantha* (Nematoda: Molineidae), a parasite of the common vampire bat from the Yungas, Argentina. *Journal of Parasitology*, 98, 1209–1215.
<http://dx.doi.org/10.1645/ge-3155.1>

- Padilha, T.N. & Barros-Araújo, J.L. (1976) Estudo sobre duas espécies do gênero *Litomosoides* Chandler, 1931, com novos aspectos biológicos (Nematoda: Filarioidea). *Revista Brasileira de Biologia*, 36, 251–256.
- Pinheiro, M.C., Ribeiro, C.C.D.U., Lourenço, E.C., Landulfo, G.A., Luz, H.R., Famadas, K.M. & Rodrigues, M.L.A. (2013) Levantamento de enteroparasitos em morcegos através de técnica de centrifugo flutuosa (Mammalia: Chiroptera) em área de floresta tropical. *Neotropical Helminthology*, 7, 143–147.
- Ramallo, G., Oviedo, M. & Claps, L.E. (2007) Nematofauna parasita de quirópteros de la Provincia de Entre Ríos, Argentina: Informe preliminar. *XXI Jornadas Argentinas de Mastozoología*, No. 237, 256.
- Rêgo, A.A. (1961) Sobre algumas espécies do gênero *Litomosoides* Chandler, 1931 (Nematoda, Filarioidea). *Memórias do Instituto Oswaldo Cruz*, 59, 1–9.
<http://dx.doi.org/10.1590/s0074-02761961000100001>
- Rêgo, A.A. (1962) Sobre alguns “*Vampirolepis*” parasitos de quirópteros (Cestoda, Hymenolepididae). *Revista Brasileira de Biologia*, 22, 129–136.
- Rêgo, A.A. (1963) Nova espécie do gênero *Mathevotaenia* Akhumián, 1946, parasita de quirópteros (Cestoda, Anoplocephalidae). *Revista Brasileira de Biologia*, 23, 31–34.
- Reis, N.R., Peracchi, A.L., Pedro, W.A. & Lima, I.P. (Eds.) (2007) *Morcegos do Brasil*. N.R. Reis, Londrina, 253 pp.
- Rodrigo, A.G. (1964) Contribución al estudio de los Filarioidea de Quiroptera, con descripción de *Litomosoides carolliae venezuelensis*, ssp. n. *Anais do Segundo Congresso Latino-Americano de Zoologia*, 16-21 July 1962, São Paulo, 7, 261–263.
- Rossi, P. & Vaucher, C. (2002) *Allintoshius bioccai* n. sp. (Nematoda), a parasite of the bat *Eptesicus furinalis* from Paraguay, and new data on *A. parallintoshius* (Araujo, 1940). *Parassitologia*, 44, 59–66.
- Rudolphi, C.A. (1819) *Entozoorum synopsis cui accedunt mantissa duplex et indices locupletissimi*. Berolini, 811 pp.
- Sandground, J.H. (1929) Some new parasitic nematodes from Yucatan (Mexico) including a new genus of strongyle from cattle. *Bulletin of the Museum of Comparative Zoology, Harvard College*, 69, 515–524
- Sandground, J.H. (1934) Description of a species of the filariid genus *Litomosoides* from *Glossophaga soricina* (Chiroptera). *Annals and Magazine of Natural History*, Series 10, 14, 595–599.
- Santos, C.P. & Gibson, D.I. (1998) *Apharyngotrema lenti* n. sp., a new anenterotrematid trematode from the gall-bladder of some Amazonian bats, with comments on *Anenterotrema* Stunkard, 1938 and *Apharyngotrema* Marshall & Muller, 1979. *Systematic Parasitology*, 41, 149–156.
<http://dx.doi.org/10.1023/a:1006011822647>
- Saoud, M.F.A. (1964) On a new trematode, *Tremajoannes buckleyi* gen. et sp. nov. (Lecithodendriidae) from Central American bats with some notes on *Phaneropsolus orbicularis* (Diesing, 1850) Braun, 1901. *Journal of Helminthology*, 38, 97–108.
<http://dx.doi.org/10.1017/s0022149x00033642>
- Sawada, I. (1990) *Vampirolepis ezoensis* sp. n. (Cestoda: Hymenolepididae) from Japanese northern bat, *Eptesicus nilssoni parvus* Kishida, with a list of known species of the genus *Vampirolepis* Spassky from bats. *Japanese Journal of Parasitology*, 39, 176–185.
- Sawada, I. (1997) Check-list of new cestode species recorded by Sawada. *Nara Sangyo University Journal of Industry and Economics*, 11, 111–127.
- Sawada, I. & Harada, M. (1986) Bat cestodes from Bolivia, South America, with descriptions of six new species. *Zoological Science, Tokyo*, 3, 367–377.
- Schmidt, G.D. & Martin, R.L. (1978) Tapeworms of the Chaco Boreal, Paraguay, with two new species. *Journal of Helminthology*, 52, 205–209.
<http://dx.doi.org/10.1017/s0022149x00005381>
- Simmons, N.B. (2005) Order Chiroptera. In: Wilson, D.E. & Reeder, D.M. (Eds.), *Mammal species of the world: a taxonomic and geographic reference*. 3rd Edition. Vol. 1. Johns Hopkins University Press, Baltimore Maryland, pp. 312–529.
- Smales, L.R. (2007) Oligacanthorhynchidae (Acanthocephala) from mammals from Paraguay with the description of a new species of *Neonicola*. *Comparative Parasitology*, 74, 237–243.
<http://dx.doi.org/10.1654/4271.1>
- Stiles, C.W. & Hassall, A. (1894) A new species of intestinal fluke (*Distoma tricolor*) in the cotton-tail rabbit (*Lepus sylvaticus* Bachman) and in the northern hare (*L. americana* Erxleben). *Veterinary Magazine*, 1, 729–737.
- Tantaleán, V.M., Sarmiento, B.L. & Huiza, P.A. (1992) Digeneos (Trematoda) del Peru. *Boletín de Lima*, 80, 47–84.
- Thatcher, V.E. (1993) *Trematódeos Neotropicals*. Instituto Nacional de Pesquisas da Amazônia, Manaus, 553 pp.
- Travassos, L. (1914) Sobre as espécies brasileiras do gênero *Capillaria* Zeder, 1800. *Brazil Médico*, 28, 429.
- Travassos, L. (1918) Contribuição para o conhecimento da fauna helmintológica brasileira. VII. Espécies brasileiras do gênero *Thelazia* Bosc, 1819. *Revista do Museu Paulista*, 10, 215–230.
- Travassos, L. (1920) Trichostrongylidae brasileiros. *Revista da Sociedade Brasileira de Ciências*, 3, 199–205.
- Travassos, L. (1921) Contribuições para o conhecimento da fauna helmintológica brasileira. XV. Sobre as espécies brasileiras da família Lecithodendriidae Odhner, 1911. *Archivos da Escola Superior de Agricultura e Medicina Veterinária*, 5, 73–79.
- Travassos, L. (1928) Sobre uma espécie do genero *Rictularia* Froelich (Nematoda). *Boletim Biologico, S. Paulo*, 14, 129–143.
- Travassos, L. (1935) Contribuição ao conhecimento dos Trichostrongylidae. *Anais Academia Brasileira de Ciências*, 7, 355–360.
- Travassos, L. (1937) *Revisão da Família Trichostrongylidae Leiper, 1912*. Monografia do Instituto Oswaldo Cruz, Rio de Janeiro, 512 pp.

- Travassos, L. (1955) Sobre dois novos Dicrocoeliidae de Chiroptera. *Anais Academia Brasileira de Ciências, Rio de Janeiro*, 27, 561–565.
- Travassos, L. (1965) Contribuição para o inventário crítico da zoologia no Brasil: Fauna helmintológica: considerações preliminares – cestódeos. *Publicações Avulsas do Museu Nacional, Rio de Janeiro*, 48 (50), 1–84.
- Travassos, L. & Freitas, J.F.T. (1964) Pesquisas helmintológicas realizadas em Maicuru, estado do Pará. *Publicações Avulsas do Museu Paraense Emilio Goeldi*, 2, 3–16.
- Travassos, L., Freitas, J.F.T. & Kohn, A. (1969) Trematódeos do Brasil. *Memórias do Instituto Oswaldo Cruz*, 67, 1–886.
- Vargas, M., Martínez, R., Tantaleán, M., Cadenillas, R. & Pacheco, V. (2009a) *Tricholeiperia peruensis* n. sp. (Nematoda, Molineidae) del quiróptero *Lophostoma silvicolium occidentale* (Phyllostomidae) en Tumbes, Perú. *Revista Peruana de Biología*, 15 (2008), 23–26.
<http://dx.doi.org/10.15381/rpb.v15i2.1697>
- Vargas, M., Martínez, R. & Tantaleán, M. (2009b) Cestodos de quirópteros del Parque Nacional Cerros de Amotape, Tumbes, Perú. *Revista Peruana de Biología*, 16, 57–60.
<http://dx.doi.org/10.15381/rpb.v16i1.176>
- Vaucher, C. (1981) Helminthes parasites du Paraguay. II. *Postorchigenes mbopi* n. sp. (Trematoda: Lecithodendriidae) chez *Lasiurus ega argentinus* (Thomas). *Bulletin de la Société Neuchâteloise des Sciences Naturelles*, 104, 47–51.
- Vaucher, C. (1982a) Helminthes parasites du Paraguay. III: *Atriotaeonia hastati* n. sp. (Cestoda: Linstowiidae) parasite de *Phyllostomus hastatus hastatus* (Pallas). *Bulletin de la Société Neuchâteloise des Sciences Naturelles*, 105, 155–161.
- Vaucher, C. (1982b) Cestodes parasites de chiroptères en Amérique du Sud: révision de *Hymenolepis elongatus* (Rêgo, 1962) et description de *Hymenolepis phyllostomi* n. sp. *Revue Suisse de Zoologie*, 89, 451–459.
- Vaucher, C. (1985) Helminthes parasites du Paraguay. X: *Hymenolepis dasipteri* n. sp. (Cestoda, Hymenolepididae) chez *Dasipterus ega argentinus* Thomas (Chiroptera, Vespertilionidae). *Bulletin de la Société Neuchâteloise des Sciences Naturelles*, 10, 155–161.
- Vaucher, C. (1986a) Helminthes parasites du Paraguay. XI: Hymenolepididae (Cestoda) parasites de chiroptères Molossidae, avec description de deux espèces nouvelles. *Revue Suisse de Zoologie*, 93, 393–407.
- Vaucher, C. (1986b) Cestodes parasites de Chiroptères en Amérique du Sud. II: *Hymenolepis mazanensis* n. sp., chez *Saccopteryx bilineata* (Temm.) et *Rhynchonycteris naso* (Wied-Neuwied) (Chiroptera: Emballonuridae) en Amazonie péruvienne. *Revue Suisse de Zoologie*, 93, 817–821.
- Vaucher, C. (1992) Revision of the genus *Vampirolepis* Spasskij, 1954 (Cestoda: Hymenolepididae). *Memórias do Instituto Oswaldo Cruz*, 87, 299–304.
<http://dx.doi.org/10.1590/s0074-02761992000500056>
- Vaucher, C. & Durette-Desset, M.C. (1986) Trichostrongyloidea (Nematoda) parasites de Chiroptères néotropicaux. I. *Websternema parnelli* (Webster, 1971) n.gen. n.comb. et *Linustrongylus pteronoti* n.gen. n.sp., parasites de *Pteronotus* au Nicaragua. *Revue Suisse de Zoologie*, 93, 237–246.
- Vélez, I. & Thatcher, V. (1992a) Cinco especies de Lecithodendriidae (Trematoda) en murciélagos de Colombia, incluyendo tres nuevos generos. *Revista Brasileira de Zoologia*, 7, 155–164.
<http://dx.doi.org/10.1590/s0101-81751990000200015>
- Vélez, I. & Thatcher, V. (1992b) *Nudacotyle carollia* sp. nov. (Trematoda, Nudacotyliidae) parasito intestinal de *Carollia perspicillata* L. (Chiroptera) en Colombia. *Revista Brasileira de Zoologia*, 7, 69–72.
<http://dx.doi.org/10.1590/s0101-81751990000200005>
- Vicente, J.J., Rodrigues, H.O., Steindel, M., Padovani, C.R. & Schlemper, B.R. Jr (1987) Contribuição ao conhecimento da fauna helmintológica de mamíferos da Ilha de Santa Catarina, SC. *Atas da Sociedade de Biologia do Rio de Janeiro*, 27, 5–8.
- Vicente, J.J., Rodrigues, H.O., Gomes, D.C. & Pinto, R.M. (1997) Nematóides do Brasil. Parte V. Nematóides de Mamíferos. *Revista Brasileira de Zoologia*, 14, 1–452.
<http://dx.doi.org/10.1590/s0101-81751997000500001>
- Vigueras, P.I. (1934) Notas sobre las especies de Filarioidea encontradas en Cuba. *Memorias Sociedad Cubana Historia Natural*, 8, 55–58.
- Webster, W.A. (1971) Studies on the parasites of Chiroptera. I. Helminths of Jamaican bats of the genera *Tadarida*, *Chilonycteris*, and *Monophyllus*. *Proceedings of the Helminthological Society of Washington*, 38, 195–199.
- Wikipedia: The free encyclopedia (2014) *List of South American mammals*. Available from: http://en.wikipedia.org/wiki/List_of_South_American_mammals (accessed 5 December, 2014)
- Willig, M.R. & Selcer, K.W. (1989) Bat species density gradients in the new world: a statistical assessment. *Journal of Biogeography*, 16, 189–195.
<http://dx.doi.org/10.2307/2845093>
- Wilson, D.E. & Reeder, D.M. (Eds.) (2005) *Mammal species of the world. A taxonomic and geographic reference. 3rd Edition*. Johns Hopkins University Press, Baltimore, 2142 pp.
- Wolfgang, R.W. (1954) Studies on the endoparasitic fauna of Trinidad mammals. X. Parasites of Chiroptera. *Canadian Journal of Zoology*, 32, 20–34.
- Zdzitowiecki, K. & Rutkowska, M.A. (1980) The helminthofauna of bats from Cuba. 3. A review of trematodes. *Acta Parasitologica Polonica*, 26, 201–214.