ISSN Versión impresa 2218-6425 ISSN Versión Electrónica 1995-1043

## ORIGINAL ARTICLE /ARTÍCULO ORIGINAL

# HELMINTHS IN *TADARIDA BRASILIENSIS* (CHIROPTERA: MOLOSSIDAE) FROM SOUTHERN BRAZIL

# HELMINTOS EM *TADARIDA BRASILIENSIS* (CHIROPTERA: MOLOSSIDAE) DO SUL DO BRASIL

Tatiana Cheuiche Pesenti[1], Sâmara Nunes Gomes[1], Ana Maria Rui[2] & Gertrud Müller[1]

[1] Laboratório de Parasitologia de Animais Silvestres - Instituto de Biologia – Universidade Federal de Pelotas - Campus universitário s/nº CEP 96010-900, Capão do Leão, Pelotas, RS, Brazil. E-mail: tatianapesenti@yahoo.com.br
[2] Departamento de Ecologia, Zoologia e Genética - Instituto de Biologia – Universidade Federal de Pelotas - Campus Universitário s/nº CEP 96010-900, Capão do Leão, Pelotas, RS, Brazil

Neotropical Helminthology, 2015, 9(1), jan-jun: 13-20.

## ABSTRACT

The aim of this study was to identify the helminths of *Tadarida brasiliensis* in southern Brazil. The study was conducted in Rio Grande do Sul State, southern Brazil, between 2010 and 2011. Hundred and sixty *T. brasiliensis* were captured from a colony in the rural area of the Municipality of Capão do Leão, and 20 from a colony in the urban area of the Municipality of Pelotas, for analysis of helminths. The hosts the rural area were parasitized by *Ochoterenatrema labda* (Trematoda) (71.8%), *Limatulum oklahomense* (Trematoda) (22.5%), *Urotrema scabridum* (Trematoda) (11.25%), *Vampirolepis decipiens* (Cestoda) (40.6%) e *Molinostrongylus delicatus* (Nematoda) (59.37%). The hosts of the urban area were parasitized by *O. labda* (55%), *L. oklahomense* (35%), *V. decipiens* (60%) e *M. delicatus* (15%). This is the first report of the occurrence of these helminths parasitizing *T. brasiliensis* in Brazil, and the first record of occurrence of *O. labda*, *L. oklahomense* and *M. delicatus* in Brazil, expanding the area of geographical distribution of these species.

**Keywords**: Brazilian free-tailed bat - Helminths - *Limatulum* - *Molinostrongylus* - *Ochoterenatrema* - *Urotrema* - *Vampirolepis*.

## RESUMO

O objetivo do estudo foi identificar os helmintos de *Tadarida brasiliensis* no sul do Brasil. O trabalho foi realizado no Estado do Rio Grande do Sul, Brasil, entre os anos de 2010 e 2011. Foram capturados 160 *T. brasiliensis* de uma colônia na zona rural do município do Capão do Leão e 20 de uma colônia na zona urbana do munícipio de Pelotas para análise de helmintos. Os hospedeiros da área rural estavam parasitados por *Ochoterenatrema labda* (Trematoda) (71,8%), *Limatulum oklahomense* (Trematoda) (22,5%), *Urotrema scabridum* (Trematoda) (11,25%), *Vampirolepis decipiens* (Cestoda) (40,6%) e *Molinostrongylus delicatus* (Nematoda) (59,37%). Os hospedeiros da área urbana estavam parasitados por *O. labda* (55%), *L. oklahomense* (35%), *V. decipiens* (60%) e *M. delicatus* (15%). Este é o primeiro relato de ocorrência desses helmintos parasitando *T. brasiliensis* no Brasil e o primeiro registro de ocorrência de *O. labda*, *L. oklahomense* e *M. delicatus* no Brasil, ampliando a área de distribuição geográfica destas espécies.

**Palavras-chave:** Helmintos - *Limatulum* - *Molinostrongylus* - Morcego brasileiro da cauda livre - *Ochoterenatrema* - *Urotrema* - *Vampirolepis*.

## INTRODUCTION

*Tadarida brasiliensis* (Geoffroy, 1824), the Brazilian free-tailed bat, is an insectivorous bat of the family Molossidae with a widely geographical distribution occurring from the United States southwards through Mexico, Central America and western South America, including Brazil, Uruguay, Chile, and Argentina, to about 45ºS. It also occurs in the Greater Antilles, Lesser Antilles, and Caribbean islands (Simmons, 2005; Wilkins, 1989). In Brazil, this species occurs in south and southeast regions (Wilkins, 1989), where the temperatures are lower, but there are sparse records further north, as far as the State of Mato Grosso do Sul (Santos & Bordignon, 2011).

Studies on the species diet conducted in Texas in the United States found that they consumed individuals in the orders including Lepidoptera, Coleoptera, Hymenoptera, Diptera and Hemiptera (Kunz *et al.*, 1995; Whitaker *et al*., 1996), and in New Mexico, Lepidoptera and Coleoptera were present in the diet with higher frequency and volume during the summer (McWilliams, 2005). In studies conducted in southern Brazil, it was found that *T. brasiliensis* consumes species of Coleoptera, Lepidoptera and Diptera throughout the year, diversifying the diet in months with higher temperature (Fabián *et al*., 1990).

With respect to knowledge of the helminths of *T. brasiliensis*, there are several studies conducted in the Northern Hemisphere, mainly in the United States (Macy, 1931; Jameson, 1959; Cain, 1966; Nickel & Hansen, 1967; Martin, 1976; Foster & Mertins, 1996; Hilton & Best, 2000; McAllister *et al*., 2006), and Mexico (Caballero, 1942; Guzmán–Cornejo *et al.*, 2003). In the Southern Hemisphere, the broader study was conducted by Muñoz *et al*. (2011) in Chile. There are also studies conducted in Argentina (Lunaschi, 2004; Lunaschi & Notarnicola, 2010). Although many studies reported helminth parasites of *T. brasiliensis*, studies temporally broader and with analysis of a large number of individuals are rare.

In Brazil, there is only one helminth reported to *T. brasiliensis*, the nematodeo *Rictularia* sp., in the State of Rio de Janeiro, but is not reported the number of hosts analyzed and parasitic indexes (Pinto *et al*., 2011), which prevents comparative analysis with populations of *T. brasiliensis* from other countries of South America and North America. The aim of this study was to identify the helminths of *T. brasiliensis* in southern Brazil, estimate the parameters of prevalence and mean abundance, and report new distribution records of these parasites, contributing to the knowledge of parasite diversity of this species of Chiroptera.

## MATERIAL AND METHODS

The study was conducted in the municipalities of Pelotas (31°46'10"S; 52°20'32"W) and Capão do Leão (31°48'03"S; 52°24'29"W) in the Coastal Plain of Rio Grande do Sul State, southern Brazil, both localities at sea level.

In March 2010, 20 adult specimens were collected using a mist net at nightfall from a colony housed in a vacated building in downtown Pelotas. From March 2010 to November 2011, 160 adult individuals were collected from a colony housed in the attic of a single story masonry building in the Municipality of Capão do Leão. The capture was also done at nightfall with a harp trap at the exit of the shelter. During the study were performed nine collections lasting five hours each.

The captured bats were euthanized (CFMV Resolution 714/2002), and immediately

frozen. In the laboratory, the individuals were thawed and necropsied. Their organs (pharynx, lungs, heart, esophagus, stomach, intestines, liver, and gallbladder) were removed, individualized in Petri dishes and examined by stereomicroscope, for collection of the helminths. Digeneans and cestodes were compressed and fixed in A.F.A. solution (alcohol 70 ºGL 92%, acetic acid 3%, formalin 5%), and subsequently stained with Langeron's Carmine. Nematodes were cleared in lacto phenol. All helminths were placed in a glass slide covered with a cover slip for identification.

The following articles were used to identify the helminths: Travassos *et al.* (1969) and Bray *et al.* (2008) for digeneans, Rego (1962) for cestodes, and Travassos (1937) and Anderson *et al*. (2009) for nematodes. The parasitological indices were calculated according to Bush *et al.* (1997). Fifteen specimens were deposited in the Helminthological Collection of the Laboratory of Parasitology of Wild Animals of Universidade Federal de Pelotas (CHLPAS/UFPel).

## RESULTS

We collected 5599 helminths from 180 bats examined. The 160 hosts collected in the Municipality of Capão do Leão were parasitized by 4654 helminths of five species: 3368 *Ochoterenatrema labda* (Caballero, 1943) (Trematoda: Lecithodendriidae), 312 *Limatulum oklahomense* (Macy, 1931) (Trematoda: Phaneropsolidae), 34 *Urotrema scabridum* (Braum, 1900) (Trematoda: Urotrematidae), 330 *Vampirolepis decipiens* Spasskii, 1954 (Cestoda: Hymenolepididae), and 610 *Molinostrongylus delicatus* Travassos, 1937 (Nematoda: Molineidae). The 20 hosts collected from the colony in the Municipality of Pelotas were parasitized by 945 helminths of four different species: 822 *O. labda*, 80 *L. oklahomense*, 38 *V. decipiens* and five *M. delicatus*. Table 1 shows the parasitological indexes of helminth of two localities.

**Table 1**- Parasitological indexes of helminths collected of 180 brazilian free-tailed ba (*Tadarida brasiliensis*) of two localities from southern Brazil in 2010 and 2011.

| | Infected Bats | No. Parasites | Prevalence (%) | Mean Abundance ± SD |
|---|---|---|---|---|
| Capão do Leão (n=160) | | | | |
| *Ochoterenatrema labda* | 115 | 3368 | 71.8 | 21.05 ± 31.5 |
| *Limatulum oklahomense* | 36 | 312 | 22.5 | 1.95 ± 5.03 |
| *Urotrema scabridum* | 18 | 34 | 11.25 | 0.21 ± 0.73 |
| *Vampirolepis decipiens* | 65 | 330 | 40.6 | 2.06 ± 5.04 |
| *Molinostrongylus delicatus* | 95 | 610 | 59.37 | 3.81 ± 6.06 |
| Pelotas (n=20) | | | | |
| *Ochoterenatrema labda* | 11 | 822 | 55 | 41.1 ± 75.3 |
| *Limatulum oklahomense* | 7 | 80 | 35 | 4 ± 9.48 |
| *Urotrema scabridum* | 0 | 0 | - | - |
| *Vampirolepis decipiens* | 12 | 38 | 60 | 1.9 ± 2.73 |
| *Molinostrongylus delicatus* | 3 | 5 | 15 | 0.25 ± 0.63 |

Of 180 hosts captured, it was noted that 164 (91.1%) were parasitized by at least one species of helminth, and 16 (8.9%) were negative. Forty-six of the infected hosts (28.4%) harbored one helminth species, 48 (29.26%) harbored two species, 48 (29.26%) harbored three, 17 (10.36%) harbored four species, and 5 (3.04%) harbored five helminth species described in this study.

Helminths were found only in the digestive tract: *O. labda*, *U. scabridum*, *V. decipiens* and *M. delicatus* in the small intestine; and *L. oklahomense* in the stomach and small intestine.

Number of the specimens in the collection: *Ochoterenatrema labda* (CHLPAS/UFPel 330, 331, 332, 333), *Limatulum oklahomense* (CHLPAS/UFPel 334, 335, 336, 337), *Urotrema scabridum* (CHLPAS/UFPel 338), *Molinostrongylus delicatus* (CHLPAS/UFPel 339, 340) *Vampirolepis decipiens* (CHLPAS/UFPel 341, 342, 343, 344).

## DISCUSSION

All five helminth species found parasitizing *T. brasiliensis* in southern Brazil are known as parasites of the species in North America, and some in South America. They are species of wide geographic distribution. Another characteristic of these parasites is their low specificity since they occur in several species in different bat families (Guzmán-Cornejo *et al*., 2003). The exception is *M. delicatus* that, until now, was only collected in *T. brasiliensis* (in the United States of America) and *Molossus ater* E. Geoffroy, 1805 in Mexico (Cain & Studier, 1976). These results indicate that probably there is a group of helminth species that share insectivorous bats as hosts throughout its geographical distribution in the Neotropics. This issue deserves further investigation, as well as the degree of specificity of different species of helminths.

*Ochoterenatrema labda* has already been reported parasitizing several species of bats in the United States, Mexico, Panama, Colombia, and Argentina (see Guzmán-Cornejo *et al*., 2003). This is the first record of the occurrence of *O. labda* in Brazil, expanding the area of distribution of this parasite. In this study, *O. labda* showed high prevalence (71.8% and 55%) in the two study areas. High prevalence was also reported in studies with *T. brasiliensis* by Lotz and Font (1991), in USA, (87.8%, 66.7% and 55.6%), by Guzmán-Cornejo *et al*. (2003), in Mexico, (61.3%), and by Lunaschi & Notarnicola (2010), in Argentina, (65.1%). *Ochoterenatrema labda* also had its highest mean abundance in the two study areas, with a total of 4190 specimens collected. The high prevalence and the abundance of *O. labda* may be related to collection sites that are near wetlands and rice fields, because the parasites of the family Lecithodendriidae have fresh water insects as intermediate hosts (Yamaguti, 1971); this could influence the infection of bats by this helminth.

*Limatulum oklahomense* has already been reported in other species of bats in the USA (Macy 1931; Martin 1976; Foster & Mertins 1996), Mexico (Caballero & Bravo-Hollis, 1950) and Paraguay (Lent *et al*., 1945). This study records the first occurrence of *L. oklahomense* in Brazil, expanding the area of distribution of this parasite. Macy (1931) observed low prevalence (3.6%), whereas Foster & Mertins (1996) recorded a prevalence of 36% in *T. brasiliensis* in USA, a value that is closest to those obtained in our study (22.5% and 35%).

*Urotrema scabridum* has already been recorded parasitizing a wide variety of bat species in Brazil, USA, Cuba, Mexico, Jamaica, Costa Rica, Panama, Colombia, Uruguay, and Argentina, showing a wide geographic distribution (see Guzmán-Cornejo

*et al*., 2003). In this study, we report the first occurrence of *U. scabridum* parasitizing *T. brasiliensis* in Brazil. The values of prevalence of this helminth in *T. brasiliensis* are quite discrepant in the different regions studied. We obtained a prevalence of 11.25%, a higher value than that obtained by Guzmán-Cornejo *et al*. (2003) in Mexico (8.3%), and lower than those obtained by Lunaschi & Notarnicola (2010) in Argentina (16.7%), Lotz & Font (1991) in USA (22.4%), and Foster & Mertins (1996) in USA (22%). *Urotrema scabridum* was not found in the colony located in the urban area, but it may be due to the small number of hosts analyzed.

*Vampirolepis decipiens* has already been found parasitizing several bat species in Brazil (*Chilonycteris rubiginosa* Wagner, 1843 and *Eumops perotis* (Schinz, 1821)) (Diesing 1850), Paraguay (Vaucher 1986), and the USA (Foster & Mertins, 1996; McAllister et al., 2006), but this is the first report of occurrence of *V. decipiens* parasitizing *T. brasiliensis* in Brazil. In this study, high prevalences (40.6% and 60%) were obtained, mainly when compared with those recorded in the USA by Foster & Mertins (1996) (22%), and by McAllister *et al*. (2006) (10%).

*Molinostrongylus delicatus* presents high prevalence of *T. brasiliensis*. In the present study, we obtained a prevalence of 59.37% in the hosts collected in one area of study, while Foster & Mertins (1996) obtained a prevalence of 53% and McAllister *et al.* (2006) 70%, both in the USA. The only record of the occurrence of this helminth species and another outside the USA was made by Cain & Studier (1974) in *Molossus ater* in Mexico. This is the first record of *M. delicatus* in Brazil and in South America, thus expanding its distribution area outside of Mexico.

The life cycle of helminths found in this study is unknown, but it is known that the parasites of Chiroptera belonging to the families Lecithodendridae, Phaneropsolidae, Urotrematidae and Hymenolepididae, are usually found in insectivorous hosts and have an indirect life cycle, utilizing insects as intermediate hosts (Berenguer, 2006; Bray *et al*., 2008). Family Molineidae parasites have a direct life cycle and the infection of the definitive host occurs by eating a larva in its third stage of development. Although most have a direct life cycle, some species can use paratenic host, among them insects (Bush *et al*., 2001) which would facilitate the infection of bats by these nematodes. However, there is little information on the biology of helminths and there is a need for more studies to a better understanding of their life cycle and its interaction with the host.

This study represents a significant contribution to the knowledge of the parasites of bats reporting new distribution records of helminthes. *Ochoterenatrema labda* had been described in the USA, Mexico, Panama, Colombia and Argentina; *L. oklahomense* in the USA, Mexico and Paraguay; and *M. delicatus* only in the USA and Mexico. These records to extreme south of Brazil expand the geographic distribution of these helminths species.

## ACKNOWLEDGEMENTS

We thank the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) for the license (Nº 23720-1) for capturing the bats, Núcleo de Reabilitação da Fauna Silvestre e Centro de Triagem de Animais Silvestres da Universidade Federal de Pelotas (NURFS/CETAS/UFPel) for opening the building for the bats capture, and CNPq and CAPES for financial support.

## BIBLIOGRAPHIC REFERENCES


Anderson, RC, Chabaud, AG & Willmott, S (eds). 2009. *Keys to the Nematode Parasites of Vertebrates.* CABI Head Office, Oxfordshire.

Berenguer, JG (ed). 2006. *Manual de Parasitologia – Morfologia e Biologia dos Parasitos de Interesse Sanitário*. Argos, Chapecó.

Bray, RA, Gibson, DI & Jones, A (eds). 2008. *Keys to the Trematoda. Volume 3*. CABI, Natural History Museum, London.

Bush, AO, Lafferty, KD, Lotz, JM & Shostak, AW. 1997. *Parasitology meets ecology on its own terms: Margolis et al. revisited*. Journal of Parasitology, vol. 83, pp. 575–583.

Bush, AO, Fernandez, JC, Esch, GW & Seed, JR (eds). 2001. *Parasitism: The diversity and ecology of animal parasites*. Cambridge University Press, United Kingdon.

Caballero, CE. 1942. *Trematodos de los murcielagos de Mexico. III. Descripcion de Urotrema scabridum Braun, 1900 y posicion sistematica de lãs especies norte-americanas de este genera.* Anales del Instituto de Biologia, Universidad Nacional Autonoma Mexico, vol. 13, pp. 641-648.

Caballero, CE & Bravo-Hollis, M. 1950. *Trematodos de los murcielagos de Mexico. VI. Descripcion de una nueva especie de Limatulum (Trematoda: Lecithodendriidae).* Anales del Instituto de Biologia, Universidad Nacional Autonoma Mexico, vol. 21, pp. 345-350.

Cain, GD. 1966. *A survey of the parasites of five species of bats. Helmith parasites of bats from Carlsbad Caverns, New Mexico*. Journal of Parasitology, vol. 52, pp. 351–357.

Cain, GD & Studier, EH. 1974. *Parasitic helminthes of bats from the southwestern United States and Mexico*. Proceedings of the Helminthological Society of Washington, vol. 41, pp. 113-114.

CFMV - Conselho Federal de Medicina Veterinária. *Resolução 714 de 20 de junho de 2002.* Access in: February of 2010. Available from: <http://www.usp.br/bioterio/Artigos/Eutanasia/resolucao_714.pdf>

Diesing, KM. 1850. *Systema Helminthum. Vol. I*, Vindobonae.

Fabián, ME, Hartz, SM & Arigony, THA. 1990. *Alimentação de Tadarida brasiliensis brasiliensis (Geoffroy, 1824) na região urbana de Porto Alegre, RS, Brasil (Chiroptera, Molossidae).* Brazilian Journal of Biology, vol. 50, pp. 387-392.

Foster, GW & Mertins, JW. 1996. *Parasitic helminths and arthropods from Brazilian free-tailed bats (Tadarida brasiliensis cynocephala) in Florida*. Journal of Helminthology, vol. 63, pp. 240-245.

Guzmán-Cornejo, C, Garcia-Prieto, L, De Leon, GPP & Morales-Malacara, JB. 2003. *Parasites of Tadarida brasiliensis mexicana (Chiroptera: Molossidae) from arid regions of Mexico*. Comparative Parasitology, vol. 7, pp. 11-25.

Hilton, CD & Best, TL. 2000. *Gastrointestinal helminth parasites of bats in Alabama*. Occasional papers of the North Carolina Museum of Natural Sciences and North Carolina Biological Survey, pp. 57-66.

Jameson, DK. 1959. *A survey of the parasites of five species of bats*. The Southwestern Association of Naturalists, vol. 4, pp. 61–65.

Kunz, TH, Whitaker JR, JO & Wadanoli, MD. 1995. *Dietary energetics of the insectivorous Mexican free-tailed bat (Tadarida brasiliensis) during pregnancy and lactation.* Oecologia, vol. 101, pp. 407-415.

Lent, H, Teixeira De Freitas, JF & Proença, MC. 1945. *Trematodeos de morcegos*

*coleccionados no Paraguay*. Brazilian Journal of Biology, pp. 499-507.

Lotz, JM & Font, WF. 1991. *The role of the positive and negative interspecific associations in the organization of communities of intestinal helminthes of bats*. Parasitology, vol. 103, pp. 127–138.

Lunaschi, L. 2004. *Redescripcion de* Limatuloides limatulus *(Braum) Dubpis, 1964 (Trematoda, Lecithodenfriidae), un parasito de* Tadarida brasilensis *(Geof.) (Chiroptera, Molossidae) de Argentina*. Gayana (Concepción), vol. 68, pp. 102-107.

Lunaschi, LI & 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, vol. 81, pp. 281-287.

Macy, RW. 1931. *New bat trematodes of the genera* Plagiorchis, Limatulum *and* Dicrocoelium. Journal of Parasitology, vol. 18, pp. 28-33.

Martin, DR. 1976. *New host and distributional records of helminth parasites of the Brazilian free-tailed bat,* Tadarida brasiliensis, *from Texas and Louisiana*. Proceedings of the Helminthological Society of Washington, vol. 43, pp. 85-86.

McAllister, CT, Bursey, CR & Wilson, N. 2006. *Parasites of the Brazilian free-tailed bat,* Tadarida brasiliensis, *from southwestern Arkansas*. Texas Journal of Science, vol. 58, pp. 87-92.

McWilliams, LA. 2005. *Variation in diet of the Mexican free-Tailed Bat* (Tadarida brasiliensis mexicana). Journal of Mammalogy, vol. 86, pp. 599-605.

Muñoz, P, Fredes, F, Raffo, E, Gonzáles-Acuña, D, Muñoz, L & Cid, C. 2011. *New report of parasite-fauna of the free-tailed bat* (Tadarida brasiliensis, *Geoffroy, 1824) in Chile*. Veterinary Research Communications, vol. 35, pp. 61-66.

Nickel, PA & Hansen, MF. 1967. *Helminths of bats collected in Kansas, Nebraska and Oklahoma*. The American Midland Naturalist Journal, vol. 78, pp. 481-486.

Pinto, RM, Knoff, M, Gomes, CD & Noronha, D. 2011. *Nematodes from mammals in Brazil: an updating*. Neotropical Helminthology, vol. 5, pp. 139-183.

Rego, AA. 1962. *Sobre alguns "Vampirolepis" parasitos de quirópteros*. Revista Brasileira de Biologia, vol. 22, pp.129-136.

Santos, TMR & Bordignon, MO. 2011. *Primeiro registro de* Tadarida brasiliensis *(I. Geoffroy, 1824) para o Pantanal brasileiro*. Chiroptera. Neotropical, vol. 17, no. 1, pp. 832-835.

Simmons, NB. 2005. *Order Chiroptera*. In: Wilson, DE & Reeder, DM (eds.). *Mammal species of the world: a taxonomic and geographic reference*. The Johns Hopkings University Press, Baltimore, USA.

Travassos, L (ed). 1937. *Revisão da Família Trichostrongylidae Leiper, 1912*. Instituto Oswaldo Cruz. Rio de Janeiro, Brasil.

Travassos, L, Teixeira De Freitas, JF & Kohn, A (eds). 1969. *Trematódeos do Brasil*. Memórias do Instituto Oswaldo Cruz, Rio de Janeiro. vol. 67, pp. 1-886.

Vaucher, C. 1986. *Helminthes parasites du Paraguay XI: Hymenolepididae (Cestoda) parasites de chiropteres Molossidae, avec description de deux espèces nouvelles*. Revue Suisse de Zoologie, vol. 93, pp. 393-407.

Wilkins, TK. 1989. Tadarida brasiliensis. Mammalian Species. American Society of Mammalogists, vol. 331, pp. 1-10.

Withaker, JO, Neefus JR, C & Kunz, TH. 1996. *Dietary variation in the Mexican free-tailed bat (*Tadarida brasiliensis *mexicana)*. Journal of Mammalogy, vol.

77, pp. 716-724.
Yamaguti, S. 1971. *Synopsis of digenetic trematodes of vertebrates. Volume I and II*. Keigaku Pub. Co. Tokio, Japão.

Received October 4, 2014.
Accepted January 24, 2015.