http://dx.doi.org/10.1590/1678-4162-8157

Arq. Bras. Med. Vet. Zootec., v.68, n.3, p.571-578, 2016

Endoparasites of wild animals from three biomes in the State of Mato Grosso, Brazil

[*Endoparasitas de animais silvestres de três biomas do Mato Grosso, Brasil*]

D.G.S. *Ramos*[1], A.R.G.L.O. *Santos*[2], L.C. *Freitas*[2], S.H.R. *Correa*[2], G.V. *Kempe*[2], T.O. *Morgado*[2], D.M. *Aguiar*[2], R.W. *Wolf*[2], R.V. *Rossi*[2], A.L. *Sinkoc*[2], R.C. *Pacheco*[2]

[1]Universidade Federal de Goiás – Jataí, GO
[2]Universidade Federal de Mato Grosso - Cuiabá, MT

ABSTRACT

The population of wild animals is regulated by many biotic and abiotic factors, and parasites are a biotic factor that affects the dynamic and density of host populations. From 2002 to 2014, 62 wild animals from the biomes Pantanal, Amazon, and "Cerrado" (or Savanna), which died in attendance in the veterinary hospital or have been road-killed, underwent necropsy for parasitological examination. Overall, 36 species of parasites were identified from 24 host species. Among the parasites, the most prevalent order was Oxyurida (29.1%), followed by Strongylida (20.9%), Spirurida (19.4%), Ascaridida (16.2%), Pentastomida (3.2%), Echinostomida (3.2%), Gygantorhynchia (3.2%), Rhabditida (1.6%), Plagiorchiida (1.6%), and Monilimorfida (1.6%), especially nematodes, which have more biotic potential and is more easily adapted to the environment than other classes. The occurrence of endoparasites was observed more frequently in endothermic than ectothermic animals, and herein is reported eleven new host occurrences for endoparasites in wild animals. The study has contributed to the knowledge on the biodiversity of parasites in wild animals from three biomes in central-western Brazil.

Keywords: helminths, parasitism, Amazon, Cerrado, Pantanal

RESUMO

Populações de animais selvagens são reguladas por diversos fatores bióticos e abióticos, e parasitas são um fator biótico que afetam a dinâmica e a densidade de populações. De 2002 até 2014, 62 animais silvestres provenientes dos biomas Pantanal, Amazônia e Cerrado, que vieram a óbito no atendimento do hospital veterinário ou foram encontrados atropelados em rodovias, foram submetidos à necropsia parasitológica. Ao todo 36 espécies de parasitas foram identificadas em 24 espécies de hospedeiros. Entre os parasitas, a ordem mais prevalente foi Oxyurida (29,1%), seguida por Strongylida (20,9%), Spirurida (19,4%), Ascaridida (16,2%), Pentastomida (3,2%), Echinostomida (3,2%), Gygantorhynchia (3,2%), Rhabditida (1,6%), Plagiorchiida (1,6%) e Monilimorfida (1,6%), destacando-se os nematódeos, por seu maior potencial biótico e facilidade de adaptação ao meio do que as demais classes. A maior ocorrência de endoparasitas foi observada em animais endotérmicos que ectotérmicos, e este estudo registra onze novas ocorrências de hospedeiros para endoparasitas de animais selvagens. O estudo contribui para o conhecimento da biodiversidade de parasitas em animais silvestres dos três biomas do Centro-Oeste do Brasil.

Palavras-chave: helmintos, parasitismo, Amazônia, Cerrado, Pantanal

INTRODUCTION

The population of wild animals is regulated by many biotic or abiotic factors, and parasites are a biotic factor that affects the dynamic and density of host populations (Anderson and May, 1979). The main relationships between parasites and hosts are that parasites may: kill their hosts; interfere in feeding and reproduction; contribute to the host dispersion; or not show any effect (Borgsteede, 1996). In this sense, serious

Recebido em 9 de fevereiro de 2015
Aceito em 4 de janeiro de 2016
E-mail: dgramos_vet@hotmail.com

problems may arise if a parasite is introduced into a new environment where suitable hosts are available, which are fully susceptible to these parasites (Borgsteede, 1996). Furthermore, most wild parasite biology is fully or partially unexplained, and may often occur in domestic animals and humans, such as have reported for *Spirometra mansonoides* and *Sphaerirostris erraticus* in cats by Ramos *et al*. (2013), and for sparganosis (*Spirometra* spp.) in humans by Mentz *et al*. (2011). These reports show how helminths that have wild animals as hosts in their life cycle may occur in domestic animals and humans in anthropic areas.

The Amazon biome is comprised of the Amazon forest, which is the biggest tropical forest in the world, with great richness of flora and fauna (Ab'Saber, 1977). The Pantanal biome is the largest tropical wetland area in the world. Located in central South America, including Brazil, Bolivia and Paraguay, the Pantanal ecosystem is characterized by flooding and drying cycles, which causes a constant movement of animals, variations in flora, and landscape changes (Junk and Cunha, 2005). It has been considered a World Natural Heritage and World Biosphere Reserve by UNESCO. Its fauna and flora are similar to the Brazilian "Cerrado" (Brazilian Savanna) biome (adjacent biome), which is a tropical savanna with unique and distinct characteristics from other savannas, with dimensions that extend across the Brazilian central plateau (Oliveira and Marquis, 2002). Although these biomes contain large preserved areas, animals routinely pass by roads or access the anthropic regions that are close to them.

Considering few records about parasite helminths in vertebrate species from these biomes, this study aimed to identify endoparasites in wild animals from the Pantanal, Amazon, and Cerrado biomes in the State of Mato Grosso, central-western Brazil.

MATERIALS AND METHODS

From 2002 to 2014, 62 wild animals from the Amazon (Alta Floresta, and Jauru municipalities), Cerrado (Chapada dos Guimarães and Cuiabá municipalities), and Pantanal (Poconé municipality) biomes (Fig. 1), that died in attendance in the veterinary hospital of the Federal University of Mato Grosso or were road-killed, were submitted to necropsy for parasitological examination. The esophagus, stomach, small intestine and large intestine were individually washed and filtered in 0.15 mm sieve, and examined in stereomicroscope under 10x magnification. The same procedure was performed with lungs, trachea, liver, heart, pancreas, kidneys, bladder, and the musculature (Ramos *et al*., 2013). All helminth parasites found were collected and processed according to Hoffman (1987). The identification was carried out following specific keys according to each taxonomic group: Anderson *et al*. (2009) and Gibbons (2010) for nematodes; and Bray *et al*. (2008) for trematodes. The specimens of Pentastomida have been clarified in Hoyer's medium and subsequently identified according to Riley *et al*. (1990). Revision works of Machado Filho (1950) were used to identify Acanthocephalans. The Ethic Committee on Animal Research of the Universidade Federal de Mato Grosso (UFMT) approved this study under protocol n° 23108.043095/13-6, and the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) authorized the procedures for primates under the protocol n° 6364-1. Road-killed animals were cordially donated by IBAMA to the Veterinary Hospital of the Federal University of Mato Grosso.

Figure 1. Map of the biomes of Mato Grosso State, Brazil, and location of Alta Floresta, Jauru, Cuiabá, Chapada dos Guimarães and Poconé municipalities in their respective biomes.

RESULTS

Overall, 36 species of parasites were identified from 24 host species and are listed in Table 1, according to hosts, animal's common name, number of parasitized animals, location of endoparasites, taxonomic identification, and location. Among parasites, the most prevalent order was Oxyurida (29.1%), followed by Strongylida (20.9%), Spirurida (19.4%), Ascaridida (16.2%), Pentastomida (3.2%), Echinostomida (3.2%), Gygantorhynchia (3.2%), Rhabditida (1.6%), Plagiorchiida (1.6%), and Monilimorfida (1.6%). Considering the animal regulation of body temperature, 49 endothermic animals were parasitized (79%) against 13 ectothermic animals (21%).

Among animals sampled, five were from captivity, and of these, three (*Chrysocyon brachyurus*, *Panthera onca*, and *Tamandua tetradactyla*) showed occurrence of parasites (*Ancylostoma caninum*, *Toxascaris leonina*, and *Physaloptera praeputialis*), commonly found in domestic animals. Furthermore, this study provided eleven new occurrences of endoparasites in wild animals as showed in Table 1.

Table 1. Endoparasites found in wild vertebrates examined in the present study. Parasite specimens are deposited in the Laboratory of Parasitic Diseases, Veterinary Hospital, Federal University of Mato Grosso, Cuiabá, Mato Grosso State, Brazil.

Hosts	Common Name	N	Organs	Endoparasites Identification	Parasite Order	Location	Parasite Description Reference
Anphibians							
Rhinella schneideri	Cururu Toad	1	Lungs	*Rhabdias* sp.	Rhabditida	Poconé	Stiles and Hassall, 1906
Reptiles							
Boa constrictor	Boa	1	Celomatic Cavity	*Hastospiculum onchocercum*	Spirurida	Chapada dos Guimarães	Chitwood, 1932
		3	Small Intestine	*Kalicephalus subulatus*	Strongylida	Chapada dos Guimarães; Cuiabá; Poconé	Molin, 1861
		1	Celomatic Cavity	*Ophidascaris* spp.	Ascaridida	Poconé	Baylis, 1920
		1	Lung	*Sebekia oxicephala****	Pentastomida	Poconé	Diesing, 1835
Eunectes murinus	Anaconda	1	Stomach	*Physaloptera liophis****	Spirurida	Poconé	Vicente and Santos, 1974
		1	Lung	*Sebekia oxicephala****	Pentastomida	Poconé	Diesing, 1835
*Gerochelone carbonaria**	-	1	Small Intestine	*Labiduris gulosa*	Ascaridida	Cuiabá	Rudolphi, 1819
Iguana iguana	Green Iguana	2	Large Intestine	*Ozolaimus cirratus*	Oxyurida	Chapada dos Guimarães; Cuiabá	Linstow, 1906
Tupinambis sp.	Crocodile Tegu	1	Stomach	*Physaloptera retusa*	Spirurida	Chapada dos Guimarães	Rudolphi, 1819
Birds							
Crotophaga ani	Smooth-billed Ani	1	Small Intestine	*Cyrnea semilunaris****	Spirurida	Poconé	Molin, 1860
Pavo cristatus	Peafowl	1	Large Intestine	*Heterakis nattereri*	Strongylida	Chapada dos Guimarães	Travassos, 1923
Rhea americana	Greater Rhea	1	Large Intestine	*Deletrocephalus* spp.	Strongylida	Cuiabá	Diesing, 1851
		1	Celomatic Cavity	*Dicheilonema rheae*	Spirurida	Chapada dos Guimarães	Owen, 1843
		1	Proventriculus	*Odontospirura zschokkei*	Spirurida	Poconé	Railliet and Henry, 1911
Mammals							
Ateles chamek[1]	Black Spider Monkey	1	Large Intestine	*Trypanoxyuris* spp.	Oxyurida	Alta Floresta	Vevers, 1923
Callicebus moloch	Titi Monkey	1	Small Intestine	*Prosthenorchis sigmoides****	Gigantorhynchia	Alta Floresta	Machado Filho, 1950

*Chrysocyon brachyurus**[·2]	Maned Wolf	1	Small Intestine	*Ancylostoma caninum*	Strongylida	Cuiabá	Ercolani, 1859
Dasyprocta azarae	Azara's Agouti	1	Large intestine	*Eucyathostomum copulatum*	Strongylida	Chapada dos Guimarães	Molin, 1861
Didelphis albiventris	White-eared Opossum	2	Small Intestine	*Cruzia tentaculata*	Oxyurida	Cuiabá	Rudolphi, 1819
Didelphis marsupialis	Black-eared Opossum	1	Liver	*Zonorchis* spp.	Plagiorchiida	Cuiabá	Travassos, 1944
		2	Small Intestine	*Aspidodera* spp.	Ascaridida	Cuiabá; Poconé	Railliet and Henry, 1912
		1	Small Intestine	*Cruzia tentaculata*	Oxyurida	Poconé	Rudolphi, 1819
Herpailurus yagouaroundi[2]	Jaguarundi	1	Lung	*Metathelazia* spp.***	Spirurida	Poconé	Skinker, 1931
Hydrochoerus hydrochaeris	Capybara	1	Large Intestine	*Taxorchis schistocotyle*	Echinostomida	Poconé	Fischoeder, 1901
		3	Large Intestine	*Protozoophaga obesa*	Oxyurida	Chapada dos Guimarães	Diesing, 1851
Mico emiliae	Snethlage's Marmoset	2	Small Intestine	*Primasubulura* spp.	Ascaridida	Alta Floresta	Inglis, 1958
		4	Large Intestine	*Trypanoxyuris callithricis****	Oxyurida	Alta Floresta	Solomon, 1933
*Mico melanurus***	Black-tailed Marmoset	4	Large Intestine	*Trypanoxyuris callithricis*	Oxyurida	Chapada dos Guimarães; Cuiabá; Poconé	Solomon, 1933
Myrmecophaga tridactyla[1]	Giant Anteater	3	Small Intestine	*Primasubulura* spp.	Ascaridida	Cuiabá	Inglis, 1958
		1	Small Intestine	*Moniliformis moniliformis****	Monilimorfida	Chapada dos Guimarães	Bremser, 1811
*Panthera onca**[·2]	Jaguar	1	Small Intestine	*Toxascaris leonina*	Ascaridida	Cuiabá	Linstow, 1902
Sapajus apella	Tufted Capuchin	2	Lungs	*Filariopsis barreto*i	Strongylida	Alta Floresta	Travassos, 1921
		1	Small Intestine	*Molineus torulosus*	Strongylida	Alta Floresta	Molin, 1861
		3	Stomach	*Physaloptera* spp.	Spirurida	Alta Floresta	Rudolphi, 1819
		1	Small Intestine	*Prosthenorchis sigmoides****	Gigantorhynchia	Alta Floresta	Machado Filho, 1950
		1	Small Intestine	*Spirura* spp.	Spirurida	Alta Floresta	Blanchard, 1849
		1	Small Intestine	*Trichostrongylus cesticillus*	Strongylida	Alta Floresta	Molin, 1861
		1	Large Intestine	*Trypanoxyuris callithricis****	Oxyurida	Alta Floresta	Solomon, 1933
*Tamandua tetradactyla**	Southern Tamandua	1	Stomach	*Physaloptera praeputialis****	Spirurida	Cuiabá	Linstow, 1889
Tapirus terrestris[1]	Lowland Tapir	2	Large Intestine	*Neomurshidia* spp.	Strongylida	Jauru; Poconé	Chabaud, 1957
		1	Large Intestine	*Cladorchis pyriformis*	Echinostomida	Jauru	Diesing, 1838

N= numbers of specimens analyzed. *Animals raised in captivity in the zoo at the Federal University of Mato Grosso. **Only one specimen raised in the zoo at the Federal University of Mato Grosso. ***New host occurrence.
[1]Risk of extinction according to both, IUCN (2014) and ICMBio (2014).
[2]Risk of extinction according to ICMBio (2014).

DISCUSSION

Considering identification of three of the four major groups of helminths (nematodes, trematodes and acanthocephalans), as well as arthropods species (pentastomida – *Sebekia oxycephala*), this study showed diversity of endoparasites of wild animals commonly found in the Amazon, Pantanal, and Cerrado biomes. Between 1828 and 1829, Diesing and Rudolphi have described parasites of several species of hosts from the Pantanal region and Cuiabá municipality, State of Mato Grosso, which were deposited in Berlin and Vienna museums (Rego and Vicente, 1988). These and the samples collected by Travassos from 1922 to 1948, resulted practically in all parasitic fauna currently known that occurs in wild animals from Pantanal (Rego and Vicente, 1988). After these reports, there are few records of wild animals' helminths from Pantanal, and from other biomes of the State (Costa and Catto, 1994; Zattermann *et al*., 2005; Lopes Torres *et al*., 2009; Simões *et al*., 2010; Campião *et al*., 2014). The spectrum of parasitic disease in wild animals has great importance in human and veterinary medicine, and the knowledge about their parasites is essential since biotic and abiotic components may interfere in the dynamics and structure of parasite communities, as well as in the parasite communities of humans and domestic animals (Esch *et al*., 1990). The occurrence of *Trypanoxyuris callithricis* in primates of genera *Sapajus* and *Mico*, may be associated to the fact that *T. callithricis* has been adapted to parasitize infra communities of primates in Amazonia and Cerrado biomes, since it is commonly observed infecting *Callithrix jacchus*, and other species of the same gender (Vicente *et al*., 1997). This possible adaptation described above has also been observed in *Prosthenorchis sigmoides*, which was described parasitizing the small intestine of *C. jacchus* (Machado Filho, 1950), and herein it was detected in *Callicebus moloch* and *Sapajus apella*.

It is possible that the dynamics of infection may have possibly been modified in animals raised in captivity. Reports of *Toxascaris leonina* and *Ancylostoma caninum* detected in *Panthera onca* and *Chrysocyon brachyurus*, respectively, are scarce (Vincent *et al*., 1997). However, *T. leonina* has been found in carnivores in captivity, which is possibly associated with its short life cycle, and may be easily concluded in captivity compared with other parasites such as *Toxocara* spp. (Bowman, 2009). In contrast, *Physaloptera praeputialis*, which is a stomach parasite of mammals of the Carnivora order, especially domestic animals such as cats and dogs (Vicente *et al*., 1997), was reported for the first time in *Tamandua tetradactyla*. Other species of *Physaloptera*, such as *P. magnipapilla* and *P. papillotruncata*, have already been described parasitizing *Myrmecophaga tridactyla* and *T. tetradactyla*, respectively (Vicente *et al*., 1997). The occurrence of these parasites commonly described in domestic animals may be associated to their presence close to the wild animal's captivities, as observed in animals raised in the zoo at the Federal University of Mato Grosso.

Moniliformis moniliformis detected in the giant anteater (*M. tridactyla*) has already been described in humans (Salehabadi *et al*., 2008), and domestic animals (Asato *et al*., 1986). The acanthocephalan species usually found in rodents uses an arthropod as the intermediate host (Gadale *et al*., 1989), so the giant anteaters may act as definitive hosts by consuming infected intermediate hosts (cockroach and ants) during feeding. Also concerning endothermic hosts, the occurrence of *Cyrnea semilunaris* in *Crotophaga ani* is described for the first time. *Metathelazia* sp. has already been described in *Puma concolor* (Vicente *et al*., 1997), but its occurrence in *Herpailurus yagouarandi* is herein described for the first time

The occurrence of endoparasites was mostly observed in endothermic animals (79%). Esch *et al*. (1990) highlighted that the parasite communities of endothermic animals are higher due to greater movement and digestive complexity in these species, and to greater exposure to parasites with direct cycle and active penetration in ectothermic hosts.

Regarding the ectothermic animals, the genus *Physaloptera* is commonly observed parasitizing the stomach of their definitive hosts, which includes the *Liophis miliaris* snake as described by Vicente *et al*. (1993). However, this is the first occurrence of *Physaloptera liophis* in *Eunectes murinus*. Pentastomid species of the family Sebekidae are known to parasite fishes, using turtles and caimans as definitive hosts (Riley, 1986). Brito *et al*. (2012) have described

the parasitism of *Sebekia oxycephala* in lung, stomach and intestine of *Cayman yacare*, but there are no records of this Pentastomid species in Pantanal snakes, such as *Boa constrictor* and *Eunectes murinus* as observed.

Our study contributes to knowledge of parasites in wild animals from Amazon, Pantanal, and Cerrado due to the importance of these biomes, its biodiversity and the increasing anthropic action and possible changes in the dynamics of transmission of helminths in wildlife, especially considering the scarce information about these relationships evidenced by the new host occurrences of parasites herein described. Finally, the occurrence of helminths in animals at risk of extinction showed how the knowledge of wild parasitism, so important for the management and conservation of species, needs to be increased and developed.

ACKNOWLEDGMENTS

To the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA); Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for the financial support; to Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for the scholarships of D. M. Aguiar, and R.C. Pacheco; Fundação de Amparo à Pesquisa do Estado de Mato Grosso (FAPEMAT); Laboratório de Patologia Veterinária (LPV)-UFMT.

REFERENCES

AB'SABER, A.N. Os domínios morfoclimáticos na América do Sul: primeira aproximação. *Geomorfologia*, v.51, p.1-23, 1977.

ANDERSON, R.C.; CHABAUD, A.G.; WILMOTT, S. *Keys to the nematode parasites of vertebrates:* archival volumes. Cambridge: Cabi, 2009. 463p.

ANDERSON, R.M.; MAY, R.M. Population biology of infectious diseases. Part I. *Nature*, v.280, p.361-367, 1979.

ASATO, R.; HASEGAWA, H.; KUNIYOSHI, S.; HIGA, T. Prevalence of helminthic infections in cats on Okinawa Island Japan. *Jap. J. Parasitol*., v.35, p.209-214, 1986.

BORGSTEEDE, F.H.M. The effect of parasites on wildlife. *Vet. Q.*, v.18, supl.3, p.138-140, 1996.

BOWMAN, D.D. *Georgis' parasitology for veterinarians.* 9.ed. St. Louis: Saunders Elsevier, 2009. 451p.

BRAY, R.A.; GIBSON, D.I.; JONES, A. *Keys to the Trematoda*. Cambridge: Cabi, 2008. 3v., 824p.

BRITO, S.V.; ALMEIDA, W.O.; ANJOS, L.A.; SILVA, R.J. New host records of Brazilian pentastomid species. *Braz. J. Biol.*, v.72, p.393-396, 2012.

CAMPIÃO, K.M.; SILVA, R.J.; FERREIRA, V.L. Helminth parasite communities of allopatric populations of the frog *Leptodactylus podicipinus* from Pantanal, Brazil. *J. Helminthol.*, v.88, p.13-19, 2014.

COSTA, C.A.; CATTO, J.B. Helminth parasites of capybaras (*Hydrochaeris hydrochaeris*) on sub-region of Nhecolândia, Pantanal, Mato Grosso do Sul. *Rev. Bras. Biol.*, v.54, p.39-48, 1994.

ESCH, G.; BUSH, A.; AHO, J. *Parasite comunities: pattern and process*. London: Chapman and Hall, 1990. 335p.

GADALE, O.I.; CAPELLI, G.; ALI, A.A.; POGLAYEN, G. Intestinal helminths of cats. First reports in Somalia. *Boll. Sci. Fac. Zootech. Vet. Univ. Naz. Somalia*, 1989. p.8-24.

GIBBONS, L.M. *Keys to the nematode parasites of vertebrates:* supplementary volume. Cambridge: Cabi; 2010. 416p.

HOFFMAN, R.P. *Diagnóstico de parasitismo veterinário*. Porto Alegre: Sulina; 1987. 156p.

IUCN red list of threatened species. Version 2014.3. 2014. Available in: <http://www.iucnredlist.org>. Accessed in: 17 november 2014.

JUNK, W.J.; CUNHA, C.N. Pantanal: a large South American wetland at a crossroads. *Eco. Engineering*, v.24, p.391-401, 2005.

LISTAS das espécies da fauna brasileira ameaçadas de extinção. 2014. Available in: <http://www.icmbio.gov.br/portal/biodiversidade/fauna-brasileira/lista-de-especies.html>. Accessed in: 19 December 2014.

LOPES TORRES, E.J.; MALDONADO, A. Jr.; LANFREDI, R.M. Spirurids from *Gracilinanus agilis* (Marsupialia: Didelphidae) in Brazilian Pantanal wetlands with a new species of *Physaloptera* (Nematoda: Spirurida). *Vet. Parasitol.*, v.163, p.87-92 2009.

MACHADO FILHO, D.A. Revisão do gênero *Prosthenorchis* Travassos, 1915 (Acanthocephala). *Mem. Inst. Oswaldo Cruz*, v.48, p.495-544, 1950.

MENTZ, M.B.; PROCIANOY, F.; MAESTRI, M.K.; ROTT, M.B. Case report human ocular sparganosis in southern Brazil. *Rev. Inst. Med. Trop. São Paulo*, v.53, p.51-53, 2011.

OLIVEIRA, P.S.; MARQUIS, R.J. *The Cerrados of Brazil: ecology and natural history of a neotropical savanna*. New York: Columbia University Press, 2002. 398p.

RAMOS, D.G.S.; SCHEREMETA, R.G.A.C.; OLIVEIRA, A.C.S. *et al.* Survey of helminth parasites of cats from metropolitan area of Cuiabá, Mato Grosso, Brazil. *Rev. Bras. Parasitol. Vet.*, v.22, p.201-206, 2013.

REGO, A.A.; VICENTE, J.J. Excursão científica ao Pantanal, estado de Mato grosso para coleta de helmintos. *Ciênc. Cult.*, v.40, p.65-68, 1988.

RILEY, J.; SPRATT, D.M.; WINCH, J.M. A revision of the genus *Sebekia* Sambon, 1922 (Pentastomida) from crocodilians with descriptions of five new species. *Syst. Parasitol.*, v.16, p.1-25, 1990.

RILEY, J. The biology of pentastomids. *Adv. Parasitol.*, v.25, p.45-128, 1986.

SALEHABADI, A.; MOWLAVI, G.R.; SADJJADI, S.M. Human infection with *Moniliformis moniliformis* (Bremser, 1811) (Travassos, 1915) in Iran: Another case report after decades. *Vector Borne Zoon. Dis.*, v.8, p.101-103, 2008.

SIMÕES, R.; GENTILE, R.; RADEMAKER, V. *et al.* Variation in the helminth community structure of *Thrichomys pachyurus* (Rodentia: Echimyidae) in two sub-regions of the Brazilian Pantanal: the effects of land use and seasonality. *J. Helminthol.*, v.84, p.266-275, 2010.

VICENTE, J.J.; RODRIGUES, H.O.; GOMES, D.C.; PINTO, R.M. Nematoides do Brasil. Parte III: Nematóides de mamíferos. *Rev. Bras. Zool.*, v.10, p.19-168, 1993.

VICENTE, J.J.; RODRIGUES, H.O.; GOMES, D.C.; PINTO, R.M. Nematóides do Brasil. Parte V: Nematoides de mamíferos. *Rev. Bras. Zool.*, v.14, supl.1, p.1-452, 1997.

ZATTERMANN, C.D.; NASCIMENTO, A.A.; TEBALDI, J.A.; SZABÓ, M.J. Observations on helminth infections of free-living and captive rheas (*Rhea americana*) in Brazil. *Vet. Parasitol.*, v.129, p.169-172, 2005.