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RESEARCH NOTE / NOTA CIENTÍFICA

FREQUENCY OF ANTIBODIES AGAINST *TOXOPLASMA GONDII* IN WILD CARNIVORES AND MARSUPIALS IN NORTHEAST MEXICO

FRECUENCIA DE ANTICUERPOS CONTRA *TOXOPLASMA GONDII* EN CARNIVOROS Y MARSUPIALES SILVESTRES EN EL NORESTE DE MEXICO

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Abstract

There is little previous information about the wild cycle of *Toxoplasma gondii* in wild carnivores and marsupials in Mexico. The objective of this study was to determine the presence of antibody against *T. gondii* in wild carnivores and marsupials in northeast Mexico. Frequency of *T. gondii* in captured specimens was: margay (*Leopardus wiedii*; n=3; 33%), jaguarundi (*Puma yagouaroundi*; n=2; 0%), bobcat (*Lynx rufus*; n= 1; 100%), coatimundi (*Nasua narica*; n=7; 42%), coyote (*Canis latrans*; n=4; 25%), gray fox (*Urocyon cinereoargenteus*; n=3; 66%), hog-nosed skunk (*Conepatus leuconotus*; n=1; 0%), and opossum (*Didelphis* sp.; n=5; 20%). Therefore, natural infection with *T. gondii* in wild carnivores and marsupials in northeast Mexico was present.

Keywords: canidae - felidae - mustelidae - procionidae.

Resumen

Existe poca información acerca del ciclo silvestre de *Toxoplasma gondii* en carnívoros y marsupiales silvestres en México. El objetivo de este estudio fue determinar la presencia de anticuerpos contra *T. gondii* en carnívoros y marsupiales silvestres en el noreste de México. La frecuencia de *T. gondii* en los especímenes capturados fue: margay (*Leopardus wiedii*; n=3; 33%), jaguarundi (*Puma yagouaroundi;* n=2; 0%), lince (*Lynx rufus;* n= 1; 100%), coatí (*Nasua narica*; n=7; 42%), coyote (*Canis latrans;* n=4; 25%), zorra gris (*Urocyon cinereoargenteus;* n=3; 66%), zorrillo (*Conepatus leuconotus;* n=1; 0%), y tlacuache (*Didelphis* sp.; n=5; 20%). Se comprueba la infección natural con *T. gondii* en carnívoros y marsupiales silvestres en el noreste de México.

Palabras clave: canidae – felidae – mustelidae – procionidae.

INTRODUCTION

Toxoplasma gondii (Nicolle, Manceaux and Splendore 1908) is an intracellular parasite that affects all homeothermic vertebrate. In the domestic cat, the complete cycle of the parasite occurs because the cat is the only definitive host.

Infected hosts may be in an infectious stage all their lives and this helps the worldwide distribution of the disease (Frenkel, 1990; Della, 1999; Wolfe, 2003). The wild felids are also considered definitive hosts since this parasite have been found in different species of wild cats (Dreesen, 1990; Wolfe, 2003; Cañon-Franco *et al*., 2013). Even though these animals have been the definitive hosts, there are a few studies about their role on the wild cycle of the parasite. A recent revision reported that in the only neotropical small felid species that this parasite has been found is in ocelot (*Leopardus pardalis;* Linné,1758), Geoffroy´s Cat (*L. geoffroyi;* D´Orbigny and Gervais, 1844) and Oncilla (*L. tigrinus*; Schreber, 1775) (Cañon-Franco *et al*., 2013).

There are also a few records of the presence of antibodies of this parasite in other wild neotropical carnivores. A research on neotropical mammals, included in its analysis the coatimundi (*Nasua nasua* Linnaeus, 1766) and common opossum (*Didelphis marsupialis* Linnaeus, 1758) (Thoisy *et al*., 2003). Other carnivores such as canids have been used as indicators for *T. gondii*, however these studies have been done in the neartic regions (Dubey *et al*., 1999). In Mexico, studies about *T. gondii* in wildlife are in small numbers and also focused on neartic species (Kikuchi *et al*., 2004; Suzan & Ceballos, 2005; Rendón-Franco *et al*., 2012). In areas where domestic cats are not present, wild felids are the final hosts; therefore it is very important to evaluate which role they play in the wild cycle of the parasite. In the other hand, it is important to determine if other carnivores or marsupials participate in the wild cycle of *T. gondii* as an infectious host for the felids or even for humans, since some carnivores such as the coatimundi, skunk, and opossum are consumed by people in rural areas (Naranjo *et al*., 2004; Tlapaya & Gallina, 2010; Contreras-Moreno *et al*., 2012).

The objective of this study is to determine the presence of *T. gondii* antibodies in wild carnivores and marsupials in a neotropical area within northeast Mexico.

MATERIAL AND METHODS

As a part of a felid ecological project developed by Caso, captures were done with the use of box traps (Tomahawk live Trap model No. 109.5, Tomahawk Live Trap Company, Hazelhurst, Wisconsin 54531,USA; Caso, 2013). Blood was obtained from jaguarundis (*Puma yagouaroundi* É. Geoffroy, 1803), coyotes (*Canis latrans* Say, 1823), coatimundis (*Nasua narica* Linnaeus, 1766), bobcats (*Lynx rufus* Schreber, 1777), hog-nosed skunks (*Conepatus leuconotus*; Lichtenstein, 1832), and common opossums (*Didelphis* sp.) at Los Ebanos and Los Pericos (23º 27' N, 97º 48' W) cattle ranches from 1998 to 2006 (Caso, 2013). In the other hand, captures of margays (*Leopardus wiedii* Schinz, 1821), gray foxes (*Urocyon cinereoargenteus* Schreber, 1775) and coatimundis were done at El Cielo Biosphere Reserve (23º03'N, 90º13'W) in 2003 (Carvajal-Villarreal *et al*., 2012). Both study areas are in the state of Tamaulipas, Mexico. *P. yagouaroundi and L. wiedii* are protected by Mexican laws under category of near threatened and risk of extinction respectively (SEMARNAT, 2010). All carnivores in this study are considered as least concern by the UICN, except *L. wiedii*, which is considered near threatened (UICN, 2014).

Samples were obtained after chemical immobilization, and serum was maintained frozen at -20 Cº until lab analysis (Caso *et al.*, 2005; Caso, 2013). Each individual was safely handled according to the recommendations of the American Society of Mammalogists (Sikes & Gannon, 2007) and all were released at the same capture point when the effects of immobilization were not present.

Antibody detection was done through a test latex

agglutination test (Toxotest-MT, Eiken Chemical Co. LTD, Tokyo 110-8408, Japan) accordingly with lab specifications. This test has been used before in wild felids to test the presence of *T. gondii* (Ramos *et al*., 2001; Kikuchi *et al*., 2004; Rendón-Franco *et al*., 2012). Titers > 1:32 were considered positives for felines while titers > 1:16 were considered positives for the other species according with manufacture recommendations. We calculated the frequencies and confidence intervals 95% for each species using epidemiological software (Epidat 3.1 ® software, Servicio de Epidemiología Dirección Xeral de Innovación e Xestión de Saúde Pública, Santiago de Compostela, Coruña, Spain).

RESULTS

Results obtained were the following: margay 1 of 3 (33%), jaguarundi 0 of 2 (0%), bobcat 1 of 1 (100%), coatimundi 3 of 7 (42%), coyote 1 of 4 (25%), gray fox 2 of 3 (66%), hog-nosed skunk 0 of 1 (0%) and common opossum 1 of 5 (20%). Titers in positive animals were from 1:16 in carnivores to 1:256 in coatimundis, and positive for opossum 1:16 titer (Table 1).

Table 1. Frequencies and antibodies titer against *Toxoplasma gondii* in wild carnivores and marsupials.

Specie/serum dilution	>1:16	1:16b	1:32a	1:64	1:128	1:256	n	Positive	Frequency % (CI 95%)
Margay (*Leopardus wiedii*)	1	1		1			3	1	33 (1-90)
Jagurundi (*Puma yagouaroundi*)	1	1					2	0	0 (ND)
Bobcat (*Lynx rufus*)				1			1	1	100 (ND)
Coatimundi (*Nasua narica*)	4	1				2	7	3	42 (10-81)
Coyote (*Canis latrans*)	3	1					4	1	25 (1-80)
Gray fox (*Urocyon cinereoargenteus*)	1			1	1		3	2	66 (9-99)
Hog-nosed skunk (*Conepatus leuconotus*)	1						1	0	0 (ND)
Opossum (*Didelphis* sp)	4	1					5	1	20 (0-72)

a=positive feline b= positive other than feline, ND=no done.

DISCUSSION

There are not previous reports of antibodies prevalence of *T. gondii* in margay and jaguarundi; however, in jaguarundis it has been found that they can excrete oocytes naturally or during experiments (Jewell *et al*., 1972; Pizzie *et al*., 1978). In this study, we did not find any evidence of anti-*Toxoplasma* antibodies in jaguarundis, but because to the small sample size (n = 2), is not possible to say that jaguarundis could not be infected by the parasite in the wild. Even though the small number of individual margays, these results are important since they ensure that margays could be infected by *T. gondii* in the wild. In the case of the gray fox, there have been reports that indicate that the prevalence of *T. gondii* in this species is high in the U.S. since it runs from 25% to 75% depending on the area, and this is consistent with the present study. Same research also found that the prevalence of *T. gondii* in coyotes is 59%, however in the present study it is lower. It is important to mention that sample size of this study for both species is low; therefore is not possible compare these results with the ones in U.S (Dubey *et al*., 1999).

This is the study that has obtained the best sample size for wild coatimundis (n = 7). These results indicate that the prevalence found of 42% is lower of what was found by the only previous study of 72% of prevalence (Thoisy *et al*., 2003). Due to the small simple size in hog-nosed skunk (n = 1), is not conclusive that they could not be infected by *T. gondii*. In the case of opossums, 20% of prevalence was record, that is within the rank (13-29%) reported for the U.S., but it is higher with the one reported (10%) for central Mexico, where mean ambient humidity is lower (Smith & Frenkel, 1995; Hill *et al*., 1998; Suzan & Ceballos, 2005; Mitchell *et al*., 2006). This could explain the differences since in neotropical regions there is more humidity and this helps the parasite to remain viable for longer periods. In French Guyana, it was found 15% (n=34) of prevalence in common opossums and 20% (n=15) in white-eared opossum (*D. albiventris*; Thoisy *et al*., 2003). In Brazil, it was found 20.4% (n=396) of prevalence in common opossums (Yal *et al*., 2003).

The prevalence of *T. gondii* found in coatimundis and opossums have an important zoonotic risk, since as it was mentioned earlier; these species are hunted and consumed as food by people in rural areas of Mexico (Naranjo *et al*., 2004; Mitchell *et al.*, 2006; Tlapaya & Gallina, 2010; Contreras-Moreno *et al*., 2012).

The role of wild cats on the cycle of *T. gondii* is important particularly in areas where domestic cats coexist with them. In the case of other wild carnivores, there is little information about what is their role in the wild cycle of *T. gondii*. However, it is important to know their role as hosts since they compete for the infected prey and therefore they can lower the prevalence of the disease. Since opossums are commonly depredated by different carnivores including felids, it is important to determine the prevalence in them to know which is the parasite's infectious cycle. It is also important to generate studies that include intermediate hosts with the objective of identifying how the parasite cycle closes in the wild (ferraroni *et al.*, 1980).

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