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Prevalence of Anti-*Toxoplasma gondii* Antibody in Free-ranging Ocelots (*Leopardus pardalis*) from Tamaulipas, Mexico

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ABSTRACT: Prevalence of anti-*Toxoplasma* antibody in free-ranging ocelots (*Leopardus pardalis*) in northeastern Mexico was 69% ($n=26$). Grouping by age and sex, there were significant differences between sexes in subadults ($P=0.03$) and between age classes in males ($P=0.01$). Antibody titer increased in two recaptured ocelots and decreased in two others.

Toxoplasma gondii is an obligate intracellular protozoan of worldwide distribution, whose definitive host is the domestic cat (*Felis catus*). Virtually all homeothermic vertebrates are intermediate hosts of *T. gondii* (Wolfe, 2003). Neotropical felids are recognized as definitive hosts (Jewell et al., 1972). There are few studies of prevalence of antibody against *T. gondii* in ocelots (*Leopardus pardalis*), most of them in captive animals (Ramos et al., 2001). Reports from free-ranging Neotropical felids are limited to an oncilla (*Leopardus tigrinus*) from Bolivia (Deem et al., 2004), four ocelots from Amazonas (Ferraroni et al., 1980), and 10 ocelots from Bolivia (Fiorello et al., 2006), and a study in Belize found oocyst-like *T. gondii* in the feces of an ocelot (Patton et al., 1986). We know of only one previous study of *T. gondii* in wild felids in Mexico (Kikuchi et al., 2004), which reported *T. gondii* antibody in six bobcat (*Lynx rufus*) samples. Because wild felids are the only definitive hosts in areas where domestic cats do not exist, information about the prevalence of *T. gondii* in wild felid species is important. We measured anti-*Toxoplasma* antibody prevalence in free-ranging ocelots from northeastern Mexico and analyzed differences by sex, age, and titers over time.

We captured free-ranging ocelots using live capture traps (No. 109.5, Tomahawk Live Trap Company, Tomahawk, Wisconsin, USA) in Tamaulipas, Mexico. The study area included two cattle ranches, Los Ebanos and Los Pericos (23°27′N, 97°48′W). Fieldwork occurred from 1998 to 2006. Ocelots were chemically immobilized by intramuscular injection of ketamine-xilacine (Caso, 1994). Blood samples obtained by venipuncture were centrifuged to obtain serum, which was stored at −20 C until tested. Date of capture, age, and sex were recorded for each animal. Antibodies to *Toxoplasma* were detected using a commercial latex agglutination test (Toxotest-MT®, Eiken Chemical Co. Ltd., Tokyo, Japan), and a titer of ≥1:32 was considered positive, according to the manufacturer's indications. Data were analyzed using EpiData 3.0 (The EpiData Association, Odense, Denmark). Prevalence differences between sexes and ages were analyzed using Fisher's exact test, with the level of significance set at 0.05.

We captured 21 ocelots, of which four were recaptures with at least 6 months between captures. Each recapture was considered an independent event for the analysis. General antibody prevalence and prevalence by sex and age are presented in Table 1. There was no significant differ-

TABLE 1. Prevalence and confidence intervals of anti-*Toxoplasma gondii* antibodies in ocelots, grouping by age and sex.

Category	*n*	Positives (titer>1:32)	Prevalence % (95% confidence interval)[a]
All	26	18	69.2 (49.5–88.8)
Adults	17	14	82.3 (56.5–96.2)
Subadults	9	4	44.4 (13.7–78.7)
Males	11	6	54.5 (23.3–83.2)
Females	15	12	80 (51.9–95.6)
Adult males	7	6	85.7 (42.1–99.6) b
Adult females	10	8	80 (44.3–97.4)
Subadult males	4	0	0 a
Subadult females	5	4	80 (28.3–99.4) b

[a] Prevalences for categories with different lowercase letters are significantly different (Fisher's exact test, $P<0.05$).

ence between sexes for adults ($P=0.62$), but there was for subadults (4/5 females positive vs. 0/4 males; $P=0.03$; Table 1). There was not a statistically significant difference between adult and subadult females ($P=0.73$), but there was a significant difference ($P=0.01$) between adult males (6/7 positive) and subadult males (0/4; Table 1). In recaptured ocelots, antibody titer changed over time. The titer in two ocelots increased from 1:32 in 2001 to 1:64 in 2003 and from >1:16 in 2001 to 1:32 in 2006. The titer of one ocelot decreased from 1:64 in 2001 to 1:32 in 2005. Finally, for one ocelot that was captured three times, the titers detected were 1:32 in May 2005, 1:128 in November 2005, and 1:64 in May 2006.

Prevalence in our study (69%) was slightly different from previous reports for ocelots in the Amazon (50%, $n=4$; Ferraroni et al., 1980); in the Bolivian Chaco (100%, $n=10$; Fiorello et al., 2006), in captivity across Brazil (57.7%, $n=168$; Ramos et al., 2001), and in bobcats in Mexico (66%, $n=6$; Kikuchi et al., 2004). However, it might not be possible to compare results because of sample size, age, or species of cats and the serologic test used. Sex and age can influence antibody prevalence (Kikuchi et al., 2004). In our study, subadult female ocelots had higher prevalence than subadult males. Kikuchi et al. (2004) found higher prevalence in *Puma concolor* males, perhaps as a result of larger home ranges of males, and in a previous study at the same area as ours, the female ocelots had larger home ranges than males (Caso, 1994), so this might partially explain the higher antibody prevalence we found in subadult females. A study of domestic cats from Mexico City also showed higher prevalence in females (Besne-Merida et al., 2008); the authors presumed genetic or endocrine factors. Some authors have reported a high susceptibility to *T. gondii* in female mice (*Mus musculus*) because of levels of androgens and cytokines (Roberts et al., 1995; Liesenfeld et al., 2001). This explanation might also apply to ocelots and domestic cats.

We found higher prevalence in adult than subadult males similar to previous reports in felids, which could be explained by a longer time of exposure (Ryser-Degiorgis et al., 2006; Garcia-Bocanegra et al., 2010). However, there was no difference between adult and subadult females. This could indicate that, for female ocelots, seroconversion occurs before they become sexually mature (about 2 yr), which is similar to that reported by Ryser-Degiorgis et al., (2006) in Eurasian Lynx (*Lynx lynx*). We found changes in titers of antibody to *T. gondii*. Once the animal became positive, it remained positive for at least 4 yr. A similar dynamic occurred in Iberian lynx (*Lynx pardinus*; Garcia-Bocanegra et al.,

2010), and Dubey et al. (1995) found that domestic cats maintain antibody at least 6 yr. In addition to the long persistence of antibody, ocelots could be reinfected periodically, contributing to positive antibody status throughout life. Our study demonstrated contact of ocelots with *T. gondii* in a sylvatic cycle. Further studies will be necessary to determine intermediate hosts and how the sylvatic cycle is completed, as well as studies in other areas to identify environmental and population variables important for parasite maintenance.

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