Short communications

Seroprevalence of *Toxoplasma gondii* in free-ranging lion and leopard populations in southern Africa

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Antibodies to *Toxoplasma gondii* were detected in 92% of 53 sera from lions from Botswana, in 100% of 21 sera from Zimbabwe, in 100% of 12 sera from Kruger National Park and 100% of 30 sera from Hluhluwe-Umfolozi Park, South Africa. The single leopard serum from Botswana was positive, while 86% of 7 leopard sera from Kruger National Park were positive. Clinical implications of *T. gondii* infection in free-ranging non-domestic felids are unknown.

Key words: leopard, lion, *Toxoplasma gondii*, toxoplasmosis.

The first reference to *Toxoplasma gondii* infection in a lion *(Panthera leo)* was from Serengeti National Park, Tanzania, where a single specimen was found to be seropositive (Riemann *et al.* 1975). Captive lions and leopards *(Panthera pardus)* have been found to be seropositive (Patton *et al.* 1986; Lappin *et al.* 1991), and acute disseminated toxoplasmosis has been reported from two captive lion cubs in Nigeria (Ocholi *et al.* 1989).

In a wide-ranging survey of the prevalence of antibodies to various feline viruses, sera were collected from 53 lions and one leopard at various sites in Botswana, from 12 lions and seven leopards in Kruger National Park, South Africa, from 30 lions in Hluhluwe-Umfolozi Park, KwaZulu-Natal, South Africa, and from 21 lions in Zimbabwe (Van Vuuren *et al.* 1997) (Fig. 1). Other than single specimens from Omay Communal Lands and Gweru, most probably from problem animals straying into communal lands, the specimens from Zimbabwe were mainly from the Zambezi Valley, *i.e.* Matusadona National Park (Fothergill Island, Bumi Hills) and Victoria Falls. Except for sera from three 17-month-old immature lions found orphaned at Bumi Hills, Zimbabwe, all specimens were presumably from adult animals. A retrospective study was initiated to determine the prevalence of antibodies to *T. gondii* in these sera.

Blood samples were collected in plain glass tubes by venipuncture, allowed to clot and then centrifuged. Serum was decanted into screw-top microtubes and frozen at –20°C until examined by the indirect fluorescent antibody test (IFAT). The IFAT was performed according to standard procedures. Briefly, sera were diluted 1:20 in phosphate-buffered saline containing 0.05% Tween 20 (PBS-T) to avoid non-specific fluorescent reactions, *e.g.* conjugate trapping on the substrate. As we were only interested in the prevalence of infection, sera were screened at a set dilution and end titres were not determined. Diluted sera were transferred to the wells of antigen-coated slides (Diagnostic and Technical Services, Randburg, South Africa) and incubated at 37°C for 30 min. After washing the slides for 5 min in PBS-T and 5 min in distilled water, the wells were covered with fluorescein-labelled anti-cat IgG antibody (The Binding Site, Birmingham, U.K.). IgG was chosen as 100% of experimentally infected cats develop detectable IgG titres that persist in the continued presence of antigen (Dubey & Lappin 1998). The use of anti-cat IgG to detect antibodies in the sera of wild felids is a standard procedure (Heeney *et al.* 1990; Spencer 1991; Osofsky *et al.* 1996). Slides were again washed, as described above. After drying, the slides were covered with mounting fluid (pH 7.4) and examined with a fluorescence microscope. Results were recorded as positive or negative. Samples that only displayed apical fluorescence on the capture antigens (*T. gondii* trophozoites) were considered negative (Paré *et al.* 1995).

The results are given in Table 1. Three of the four lion sera from Mohamodi Pan, Botswana, were

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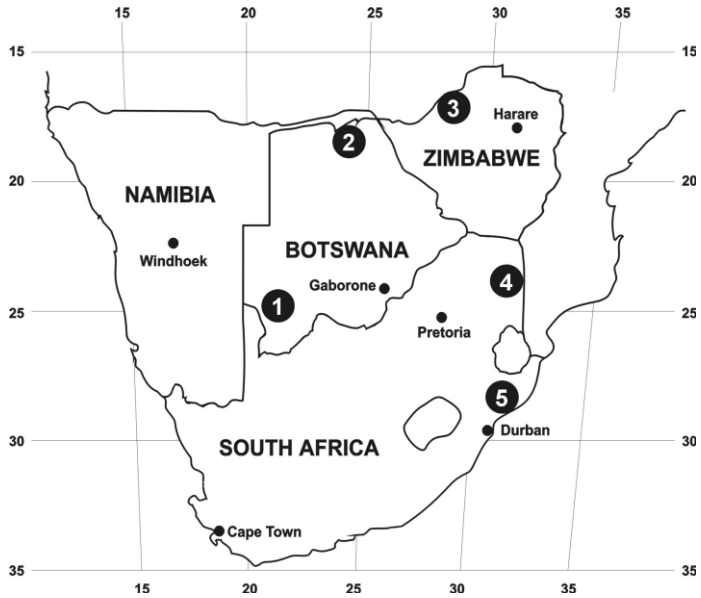

Fig. 1. Map of southern Africa showing the five main collection sites (**1**, Kgalagadi Transfrontier Park, Botswana; **2**, Chobe National Park, Botswana; **3**, Matusadona National Park, Zambezi Valley, Zimbabwe; **4**, Kruger National Park, South Africa; **5**, Hluhluwe-Umfolozi Park, KwaZulu-Natal, South Africa).

negative. The only other negative lion serum was from Chobe National Park, Northern Botswana. Seroprevalence rates found in this study are comparable to previous investigations (Spencer & Morkel 1993; Cheadle *et al.* 1999) and indicate that infection is common and widespread among free-ranging lions and leopards in southern Africa. The concentration of seronegative lions at Mohamodi Pan is of interest. These samples originated from lions inhabiting the more remote parts of the Kgalagadi Transfrontier Park.

High serum antibody prevalence rates to *T. gondii* have also been reported in free-ranging large felids elsewhere, *e.g.* in cougars *(Felis concolor vancouverensis)* on Vancouver Island, Canada (Aramini *et al.* 1998). Surprisingly, serum antibody prevalence in conspecific Florida panthers *(Felis concolor cori)* was only 9%, which may indicate that the assay used was insensitive (Roelke *et al.* 1993). Only 15.3% of lynxes *(Felis lynx)* trapped in the interior of Alaska were regarded as seropositive to *T. gondii* (Zarnke *et al.* 2001).

Potential definitive hosts of *T. gondii* are plentiful in Africa. African wild cats *(Felis sylvestris),* conspecific with domestic cats (Wilson & Reeder 1993), are widespread on the continent south of the Sahara, being absent only in tropical and montane forests; in many parts of their range they are the most common small carnivore (Skinner & Smithers 1990). Domestic cats have a wide habitat tolerance and have established feral popula-

Table 1. Prevalence of antibodies to *Toxoplasma gondii* in sera from lions and leopards collected at various sites in southern Africa

	No. of specimens	No. seropositive to *T. gondii* (%)
Lions		
Botswana	53	49 (92)
Zimbabwe	21	21 (100)
Kruger National Park	12	12 (100)
Hluhluwe-Umfolozi Park	30	30 (100)
Leopards		
Botswana	1	1 (100)
Kruger National Park	7	6 (86)

tions in many parts of southern Africa, including the Kalahari in Botswana (Skinner & Smithers 1990). Larger felids may be intermediate hosts only, but the possibility of lions and leopards being definitive hosts of *T. gondii* should not be discounted.

There is no information on the prevalence of *T. gondii* infection in potential prey species of lions and leopards in southern Africa. Studies elsewhere have indicated that the probability of infection with *T. gondii,* and therefore prevalence of antibodies in wildlife, is greatest in carnivores (Smith & Frenkel 1995).

The clinical implications of these infections in free-ranging felids are unknown. Toxoplasmosis has been reported in a six-month-old, free-ranging bobcat *(Felis rufus)* in the U.S.A. (Smith *et al.* 1995). Concomitant toxoplasmosis and feline infectious peritonitis were diagnosed in a cheetah *(Acinonyx jubatus)* in Namibia, nine weeks after it was trapped in the wild (van Rensburg & Silkstone 1985).

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