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Antibodies to *Toxoplasma gondii* in Eurasian Badgers

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ABSTRACT: Antibodies to *Toxoplasma gondii* were detected in samples collected from 90 live-trapped adult Eurasian badgers (*Meles meles*) sampled at three sites (two agricultural and one woodland) in southern England. Serum was tested using a qualitative latex agglutination test procedure and 63 of 90 (70%) badgers tested positive for *T. gondii* antibodies. Antibody prevalence varied between the sites; 67% and 77% of badgers from agricultural sites and 39% from a nonagricultural site tested positive.

Key words: *Toxoplasma*, Eurasian badger, *Meles*, parasite, protozoan.

Toxoplasma gondii is an intracellular zoonotic protozoan parasite and is possibly the most widespread parasite of warm-blooded animals (Kreier and Baker, 1987), and it is maintained in an indirect life cycle with felids representing the only known definitive hosts. In infected cats, oocysts are produced and are shed in the feces. Oocysts require a few days of adequate temperature and moisture to sporulate before they become infective to birds and mammals, which serve as intermediate hosts (Kreier and Baker 1987; Gajadhar et al., 2004). In intermediate hosts *T. gondii* does not produce oocysts but instead forms cysts in muscular or neural tissues, causing latent toxoplasmosis. The life cycle is completed when a felid ingests infected tissue. Intermediate hosts can also acquire infection through this route and by transplacental transmission (Kreier and Baker, 1987). Prevalence levels of *T. gondii* infection can be high, for example, 62% in outdoor-living domestic cats (Dubey et al., 2002), 35% in wild rats (*Rattus norvegicus*; Webster, 1994), and 12–90% in humans (Hegab and Al-Mutawa, 2003).

In intermediate hosts, latent toxoplasmosis can have behavioral consequences (Webster et al., 1994; Berdoy et al., 1995a, b, 2000). *T. gondii* can manipulate a rat's perception of predation risk, in some cases completely overturning their innate aversion to cats (Berdoy et al., 2000). This change in rat behavior increases the likelihood of cat predation, therefore enhancing the chances of *T. gondii* completing its life cycle. The development of immunity rarely results in the complete destruction of the parasite (Kreier and Baker, 1987) and the presence of antibodies to *T. gondii* is therefore used as an indicator of persistent infection.

In this report we provide the first evidence of *T. gondii* antibodies in Eurasian badgers (*Meles meles*) from the UK. Badgers were sampled from three study areas in the south of England, one in Wiltshire (51°28′N, 2°03′W), one site on the South Gloucestershire/Somerset border (51°27′N, 2°25′W), and one site in Wytham woods (51°46′N, 1°18′W), Oxfordshire. Badgers from the first two sites were largely captured on agricultural land (mainly dairy and beef farms), while the Oxfordshire site is an area of ancient woodland. Animals were live-trapped between 2002 and 2004 (under Home Office and English Nature licenses) as part of a continuing study of their ecology and behavior, following protocols as described by Macdonald and Newman (2002) for Wytham, and Cheeseman and Mallinson (1979) for the other sites. Individuals were anesthetized by intramuscular administration of 20 mg/kg ketamine (Vetalar; Pharmacia & Upjohn, Crawley, UK) or a com-

bination of ketamine hydrochloride (100 mg/ml), medetomidine hydrochloride (1 mg/ml, Domitor®, Pfizer, Sandwich, UK), and butorphanol tartrate (10 mg/ml, Torbugesic®, Fort Dodge Animal Health Ltd, Southampton, UK) by intramuscular (IM) injection at a ratio of 2:1:2 by volume, respectively, and a dose rate of 0.2 ml/kg^{-1}. Blood was collected by jugular venepuncture, and serum was stored at −20 C. All animals were released at their site of capture.

Serum samples were tested for antibodies to *T. gondii* by using a commercial qualitative latex agglutination test on undiluted serum as described by the manufacturer (Biokit, Barcelona, Spain; Gray et al., 1990). In a previous study, the performance of the latex agglutination test, when compared with that of the Dye test, showed a sensitivity of 98.7%, the specificity was 95.8%, the positive predictive value was 99.4%, and the negative predictive value was 92.0% (Dunford and Johnson, 1991).

Sixty-three of 90 (70%) badgers tested positive for *T. gondii* antibodies; none of the animals sampled showed any clinical signs of toxoplasmosis. There was apparent variation in antibody prevalence between sites, with the two sites in the southwest having 67% (n=15) and 77% (n=60) testing seropositive, while the Wytham population had a lower prevalence (39% seropositive, n=15).

Although this is the first record of *T. gondii* antibodies in badgers, given the widespread occurrence of this parasite, our finding is perhaps not surprising. In the Mustelidae, infection has been reported in black-footed ferrets (*Mustela nigripes*; Burns et al., 2003), mink (*Mustela vison*; Frank, 2001), river otters (*Lontra canadensis*; Tocidlowski et al., 1997) and southern sea otters (*Enhydra lutris nereis*; Cole et al., 2000). In clinical situations, where badgers display symptoms such as lethargy, anorexia, and abnormal behavior, a quantitative test for toxoplasmosis should be considered.

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