

Exposure to *Toxoplasma gondii* in Marine Otters (*Lontra felina*) and Domestic Cats (*Felis catus*) in an Arid Environment in Chile

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ABSTRACT: *Toxoplasma gondii* is a worldwide-distributed protozoon that infects warm-blooded animals. We determined *T. gondii* exposure in one marine otter (*Lontra felina*) and four domestic cats (*Felis catus*) along the northern and central coast of Chile, indicating a low seroprevalence of 5% (1/19) and 8% (4/50) respectively, likely related to arid environment.

Toxoplasma gondii is a protozoon that infects warm-blooded animals, including man. Felids, the definitive hosts, excrete *T. gondii* oocysts in their feces that sporulate in the environment, infecting susceptible hosts (Jones and Dubey 2010). Domestic cats (*Felis catus*) are found in high densities in urban areas, where *T. gondii* oocyst contamination of soil is also high (Afonso et al. 2008; Gao et al. 2016). Oocysts can enter the marine coastal ecosystems through rainfall and water runoff, which have been described as risk factors for *T. gondii* infection in marine mammals such as sea otters (*Enhydra lutris*) along the California, US coast (Miller et al. 2002; VanWormer et al. 2016). Sea otter mortality events due to *T. gondii* infection have also been related to land-based runoff events (Shapiro et al. 2012). *Toxoplasma gondii* could have sublethal effects in wildlife populations, such as reproductive alterations (Formenti et al. 2015) or, as with other diseases, cause a weakening of populations, making them more vulnerable to stochastic events (Lafferty and Gerber 2002). Along the southern Pacific coast of South America, the endangered marine otter (*Lontra felina*) inhabits an increasingly fragmented habitat due to intensive urbanization of rocky shore patches (Valqui 2012). There are no studies on

pathogen exposure of marine otters. Our aim was to assess the seroprevalence of *T. gondii* in marine otters along the north-central coast of Chile, between 23°01'S and 33°11'S. This northern coastal area is part of the Atacama Desert, a mix of sand and stones with scarce vegetation, whereas the central coast is less arid, and the landscape has a mix of shrub area and sand. Between August 2013 and December 2017, we sampled blood from 19 marine otters at five study sites, following the trapping and immobilization protocol described by Soto-Azat et al. (2006) and Medina-Vogel et al. (2007). Otter trapping and handling was done under the permission number 1378 of 3 June 2013 of Subsecretaría de Pesca, Minister of Economy, Government of Chile. In addition, we sampled blood from 50 domestic cats (one manually-handled cat per household with owner consent) in local veterinary hospitals or in their houses, all living in watersheds that drain into marine otter habitat or in coastal lands bordering marine otter habitat.

Serum from the blood samples were tested for immunoglobulin G antibodies against *T. gondii* using an indirect ELISA test: ID Screen® Toxoplasmosis indirect enzyme-linked immunosorbent assay (ID VET, Grabels, France). Tests were conducted following the manufacturer's guidelines including positive and negative control provided by the supplier. Results were considered positive according to the manufacturer's instructions, when the optical density (OD) of the sample was at least equal to half of the signal of the positive control of the kit.

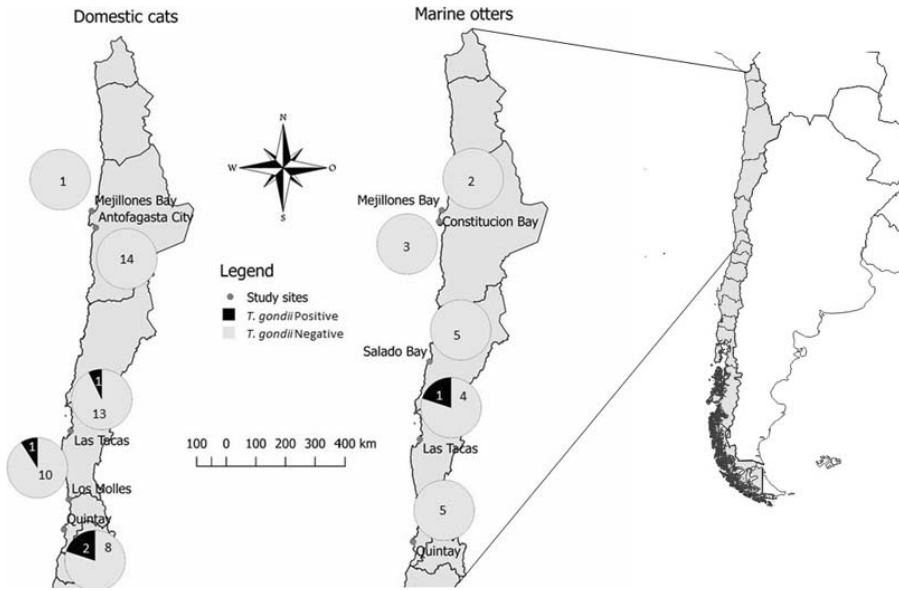


FIGURE 1. Map of northern and central Chile showing the proportion of positive (black) and negative (gray) domestic cats (*Felis catus*) and marine otters (*Lontra felina*) for antibodies against *Toxoplasma gondii* in five study sites.

One of the 19 marine otters (5%) and four of the 50 cats (8%) had antibodies against *T. gondii* (Fig. 1). The only positive marine otter was an adult female in a group of five (20%) otters sampled in a vacation resort located close to the cities of Coquimbo and La Serena. In that same location, one adult female cat of the 14 (7%) cats sampled there was also positive.

We recorded a lower *T. gondii* seroprevalence (5%) in marine otters than did previous studies in other aquatic mustelids, the southern river otter (*Lontra provocax*; 77%) and the American mink (*Neovison vison*; 59%) from southern Chile (Barros et al. 2018), where rainfall is above 815 mm. Seroprevalence in cats is also higher (33% to 68%) in southern Chile (Ovalle et al. 2000; Barros et al. 2018) than in our study (8%). A similar difference in seroprevalence was also seen in humans in Chile (Contreras et al. 1996). These differences can be explained by the general dryness and the scarcity of rain in the investigated region, which prevents the transport of oocysts from land to sea (VanWormer et al. 2016). Furthermore, all cats were free-roaming and sampled from urban areas, where

commercial dry food was the predominant diet, so the probability of becoming infected through the consumption of infected prey is expected to be low (Castillo et al. 2012). The only positive marine otter showed an OD signal of 300%, whereas all the others were negative with 10–12%. The manufacturer considers OD signal above 200% as acute infection.

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