Toxoplasma on U.S. Sheep Operations

Background

Toxoplasma gondii is a protozoan parasite capable of infecting most warm-blooded animals, including humans. It is estimated that 60 million people in the United States are infected with *T. gondii*, although few demonstrate symptoms because their immune system prevents clinical disease. The Centers for Disease Control considers toxoplasma to be a leading cause of death attributed to foodborne illness in the United States.[1] Toxoplasma can be transmitted to people through ingestion of contaminated meat (especially pork and lamb), water, or contact with cat feces contaminated with *T. gondii* oocysts. Cats are the natural reservoir for *T. gondii* and can shed millions of oocysts in their feces for up to 3 weeks after infection.

Toxoplasma is a concern to the sheep industry because it is an important cause of reproductive losses in sheep, resulting in significant economic impacts. Susceptible sheep become infected with *T. gondii* by ingesting the oocysts excreted in cat feces. These oocysts can be found in contaminated feed, bedding, pasture, and water and remain infectious for long periods. Newly infected pregnant ewes may abort or reabsorb their fetuses or may deliver stillborn, mummified, or weak lambs. Ewes infected prior to pregnancy develop an immune response that helps protect against clinical disease during a subsequent pregnancy.

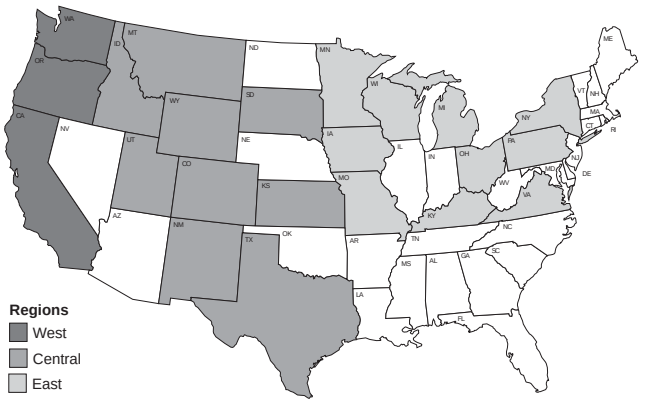
Flocks can experience a variety of lambing outcomes due to *T. gondii*. In a Texas flock of 39 ewes experiencing an abortion storm in 2005, 14 healthy lambs were born, while 53 lambs or fetuses (79.1 percent of lamb crop) were aborted, resorbed, mummified, or stillborn. *T. gondii* antibodies were detected in 94.8 percent of these ewes (Edwards and Dubey, 2013).

The seroprevalence of *T. gondii* varies greatly in world sheep populations, e.g., 15.5 percent of sheep in Mexico's Durango State (Alvarado-Esquivel C, et al., 2012); 61.0 percent of ewes in 198 flocks in New Zealand (Dempster RP, et al., 2011); and 74.0 percent of sheep in 227 flocks in Great Britain (Hutchinson JP, 2011). In the United States, 27.1 percent of slaughter lambs originating from flocks in Maryland, Virginia, and West Virginia were positive for *T. gondii* (Dubey et al., 2008).

Sheep 2011 study

In 2011, the USDA's National Animal Health Monitoring System conducted a study of U.S. sheep operations. The Sheep 2011 study was conducted in 22 of the Nation's major sheep-producing States,[2] which were divided into 3 regions. Operations with more than one ewe met the study inclusion criteria. These operations collectively represented 85.5 percent of the U.S. ewe inventory and 70.1 percent of U.S. farms with ewes.

Sheep 2011 Participating States



[1] CDC-http://www.cdc.gov/parasites/toxoplasmosis

[2] California, Colorado, Idaho, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Montana, New Mexico, New York, Ohio, Oregon, Pennsylvania, South Dakota, Texas, Utah, Virginia, Washington, Wisconsin, and Wyoming.

The Sheep 2011 study focused on sheep health and management and was the first study to estimate the national seroprevalence of toxoplasmosis in U.S. lambs. Interestingly, when asked about familiarity with toxoplasmosis, 54.0 percent of producers had never heard of the disease or knew of it by name only.

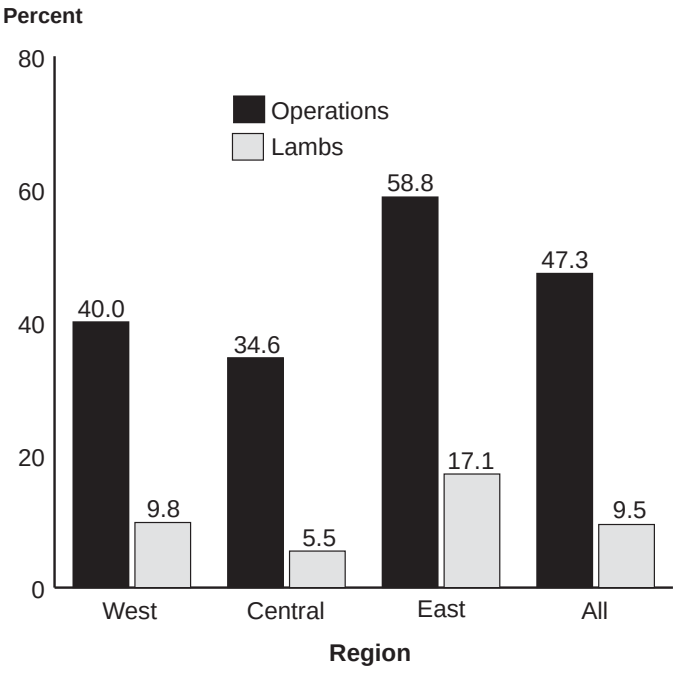
During the study, data and samples relevant to the causes of abortion storms in sheep were collected. In total, blood samples from 3,967 lambs from 353 participating operations were tested for *T. gondii* antibodies at the Beltsville Agriculture Research Service using the modified agglutination test. *T. gondii* antibody seroprevalence indicates an animal has been previously exposed to *T. gondii.* Estimates were weighted within size strata and State, adjusting for nonresponse.

Toxoplasma prevalence in U.S. lambs

Flock-level prevalence

At least one lamb was seropositive for *T. gondii* on 47.3 percent of operations. A higher percentage of operations in the East region (58.8 percent) than the Central region (34.6 percent) had lambs seropositive for *T. gondii* (fig. 1).

Figure 1. Percentage of operations and percentage of lambs seropositive for toxoplasma, by region



There was no substantial difference in the percentage of operations seropositive by management type (fig. 2) or by flock size (fig. 3). For flocks with at least one seropositive animal, the average within flock prevalence was 28.9 percent (data not shown).

Figure 2. Percentage of operations and percentage of sheep seropositive for toxoplasma, by management type

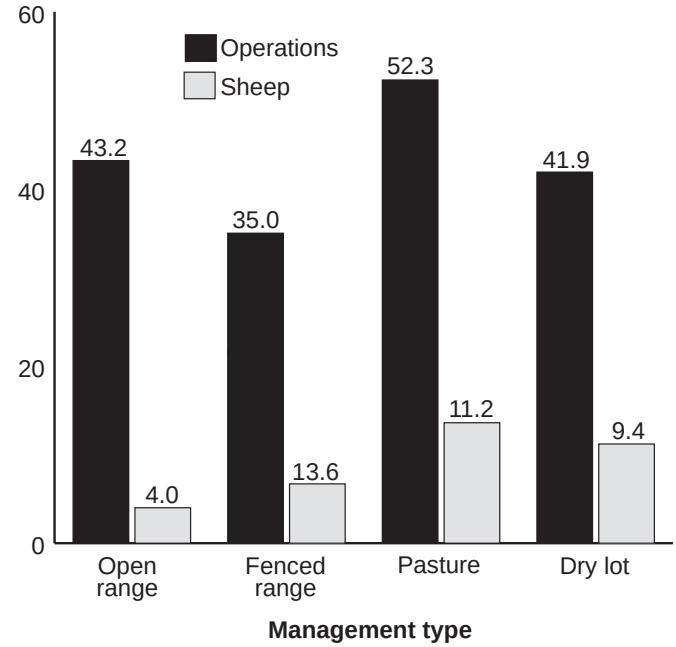
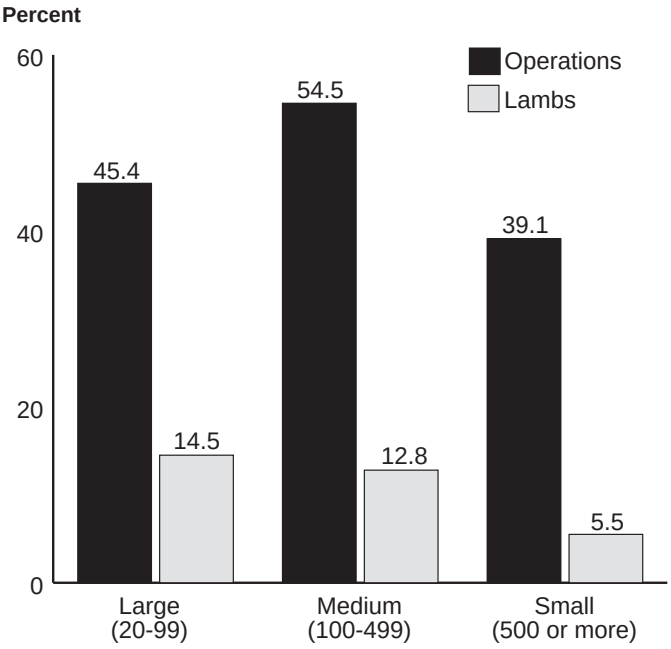


Figure 3. Percentage of operations and percentage of lambs seropositive for toxoplasma, by flock size



Animal-level prevalence

Overall, 9.4 percent of lambs tested positive for *T. gondii* antibodies. Similar to flock-level results, a higher percentage of lambs in the East region than the Central region were seropositive (17.1 and 5.5 percent, respectively). Although there was no substantial difference between management types at the operation level, a higher percentage of lambs managed primarily on pasture were seropositive for *T. gondii* compared with lambs managed primarily on open or fenced range (figure 2). A higher percentage of lambs on small operations than large operations tested seropositive (14.5 and 5.4 percent, respectively) [fig. 3].

Abortions on U.S. Sheep operations

Of operations with more than one ewe, nearly half (43.8 percent) had ewes that aborted in 2010. Nearly three-fourths of these operations (73.8 percent) indicated that the cause of abortion was unknown. Just 3.4 percent of operations indicated the suspected cause of abortions was due to toxoplasmosis. A low percentage of these operations (6.9 percent) indicated that the diagnosis was confirmed by a veterinarian or laboratory.

Presence of cats

Cats are a known risk for *T. gondii* transmission to sheep. Newly infected cats typically excrete large numbers of oocysts in their feces and can contaminate bedding, unprotected hay, feed bins, water, and pastures. Nearly all operations (96.2 percent) had some type of cat[3] present during 2010. The majority of operations had domestic cats with outside access (80.1 percent) or feral/stray cats (77.9 percent). Rodents persistently infected with *T. gondii* are an important source of infection for cats that hunt them. Birds can also be a source of infection for cats.

Conclusions

Nearly half of U.S. sheep operations were seropositive for *T. gondii*, confirming recent or past exposure to this parasitic infection. Flock management, size, and geographic location appear to impact the percentage of operations and lambs seropositive for toxoplasma antibodies.

Sheep operations can reduce the likelihood that their animals will become infected with *T. gondii* by following good biosecurity practices and by eliminating known risk factors. Such practices might include preventing cats from accessing sheep and feed storage areas and reducing rodent populations. Previously infected mature cats are less likely to shed *Toxoplasma*.

To reduce the risk of human infection, lamb should be thoroughly cooked before eating, and good hygiene should be practiced when changing cat litter boxes or working with potentially contaminated soil.

References

Alvarado-Esquivel C, et al., 2012. Seroprevalence of *Toxoplasma gondii* infection in domestic sheep in Durango State, Mexico. J Parasitol 98(2); 271–273.

Alvarado-Esquivel C, et al., 2013. Seroprevalence and correlates of *Toxoplasma gondii* infection in domestic sheep in Michnoacan State, Mexico. Prev Vet Med 112(3-4); 433–437.

Behymer DE, et al., 1985. Epidemiologic study of toxoplasmosis on a sheep ranch. Am J Vet Res 46(5); 1141–1144.

[3] Outdoor domestic or indoor with outside access; feral or stray; or wild or exotic).

Dempster RP, et al., 2011. Serological survey of *Toxoplasma gondii* and *Campylobacter* fetus in sheep from New Zealand. New Zeal Vet J 59(4); 155–159.

Dubey JP, et al., 2008. High prevalence and abundant atypical genotypes of *Toxoplasma gondii* isolated from lambs destined for human consumption in the USA. Intl J Parasitol 38(8–9); 999–1006.

Dubey JP, 2010. Toxoplasmosis of Animals and Humans, 2nd ed. CRC Press, Taylor & Francis Group, Boca Raton, FL.

Edwards JF, Dubey JP, 2013. *Toxoplasma gondii* abortion storm in sheep on a Texas farm and isolation of mouse virulent atypical genotype *T. gondii* from an aborted lamb from a chronically infected ewe. Vet Parasitol 192(1–3); 129–136.

Hutchinson JP, 2011. Survey to determine the seroprevalence of *Toxoplasma gondii* infection in British sheep flocks. Vet Rec 169; 582.

Tumurjav B, et al., 2010. Serodiagnosis of ovine toxoplasmosis in Mongolia by an enzyme linked immunosorbent assay with recombinnt *Toxoplasma gondii* matrix antigen 1. Jap J Vet Res 58(2); 111–119.

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