

Kissing bugs and Chagas disease in the southern US: An ecological research approach to improve human and canine health

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Chagas disease and kissing bugs: the basics

The parasite *Trypanosoma cruzi* causes Chagas disease in humans, dogs, and other mammals. The insect vector, commonly known as the kissing bug (Figure 1), can transmit the parasite to hosts by biting and subsequently defecating near the site of the bite. The parasites live in the digestive tract of the bugs and are shed in the bug feces. When infectious bug fecal material



Figure 1. Three species of kissing bugs that can be found in Texas. From left to right: *Triatoma sanguisuga*, *T. gerstaeckeri*, and *T. protracta*. Scale bar, 1 inch. Photo: Dr. Gabriel Hamer.

contaminates the mucous membranes or the site of bug bite on a mammal, transmission of the parasite can occur. While this ‘vector-fecal’ transmission route is thought to be the most common mode of transmission for humans, dogs can also become infected through the consumption of infected bugs. Additionally, the parasite can be transmitted congenitally, through blood transfusion, and through transplantation of infected organs. Chagas disease is endemic throughout central and South America, and is increasingly recognized as both a human and veterinary health concern in the southern US. Chagas disease became a reportable disease in Texas in 2013.

Kissing bugs are nocturnal, blood-feeding insects that are members of the Reduviidae family of insects. Other reduviids that are similar in appearance feed on plants and other insects and can inflict a painful bite when disturbed, however only kissing bugs are known to transmit the Chagas parasite. Kissing bugs are found throughout the Americas. In the US, kissing bugs are established in 28 states (Figure 2). A total of 11 different species of kissing bugs have been documented in the US, with the highest diversity and density in Texas, New Mexico, and Arizona (Bern et al 2011). Previous studies have found that, on average, 50% of kissing bugs are infected with the Chagas parasite. Kissing bugs develop onto adults after a series of immature life stages called nymphs, and both nymphs and adults engage in bloodfeeding behavior. Bugs feed on diverse wild and domestic animals including wild rodents, other wild mammals, and domestic dogs. Many of the species of animals upon which kissing bugs feed can serve as a source of parasite infection to the bug, and the *Trypanosoma cruzi* parasite has been found

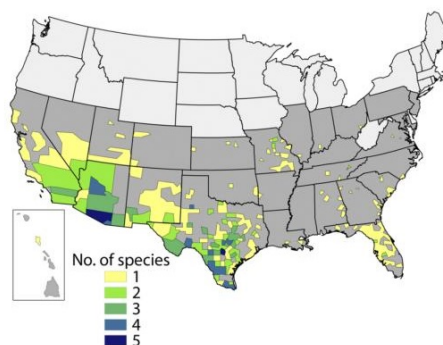


Figure 2. Distribution of kissing bugs throughout the United States. From Bern et al. 2011.

to infect domestic dogs, humans, opossums, woodrats, armadillos, coyotes, mice, raccoons, skunks, and foxes (Bern et al. 2011). Therefore, Chagas disease emerges at the intersection of wildlife, domestic animals, humans, and vector populations.

A growing concern for human health

The public health burden of Chagas disease in the US is largely unknown, because most states are not required to keep track of the number of confirmed human cases. Estimates of human cases of Chagas disease in the US range from 300,000 to over 1 million, with particular concern for those living in the US/Mexico border regions. In addition to documented cases in immigrants who were infected in central and South America, there are increasing reports of human cases of Chagas disease acquired in the US.

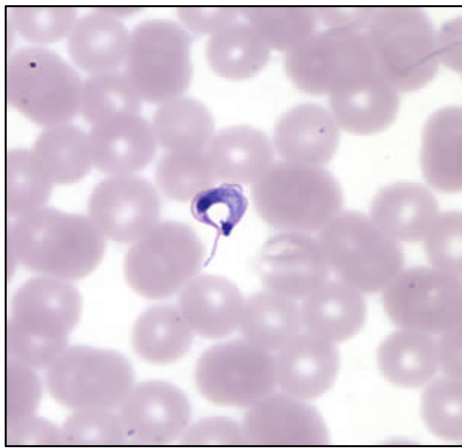


Figure 3. *Trypanosoma cruzi*, the parasite that causes Chagas disease, in blood. Photo: Centers for Disease Control.

In humans, Chagas disease manifests in two phases: acute phase and chronic phase. After becoming infected with the parasite (Figure 3), the acute phase can last for a few weeks or months. This phase can be symptom-free or difficult to diagnose because the symptoms are common for many types of sicknesses, including fever, fatigue, body aches, headache, rash, loss of appetite, diarrhea, and vomiting (CDC Chagas General Info). Of those who are infected with the parasite, approximately 30% are at risk of developing chronic Chagas disease. Chronic Chagas disease includes cardiac complications and/or intestinal complications, and these signs may not be apparent until decades after the initial infection. Cardiac signs include enlarged heart, heart failure, altered heart rate, and/or cardiac arrest. Intestinal signs include an enlarged esophagus or colon, which can cause difficulties with digestion. Concerned individuals should discuss testing options with their physicians. Treatment of Chagas disease can be difficult, and drugs are available only through the CDC after consultation with a physician.

Increasing recognition for canine disease

In dogs, infection with the Chagas parasite can cause severe heart disease, however many infected dogs may remain asymptomatic. There is variation in the degree of complications that likely relate to the age of the dog, the activity level of the dog, and the genetic strain of the parasite. Cardiac rhythm abnormalities and sudden death may occur, as well as bloat due to reduced cardiac function and inability to properly pump fluids throughout the body. Testing for canine Chagas disease is in the form of a blood test, and is available through the Texas Veterinary Medical Diagnostic Laboratory. Blood is screened for antibodies to the *T. cruzi* parasite, and a positive result indicates that the dog

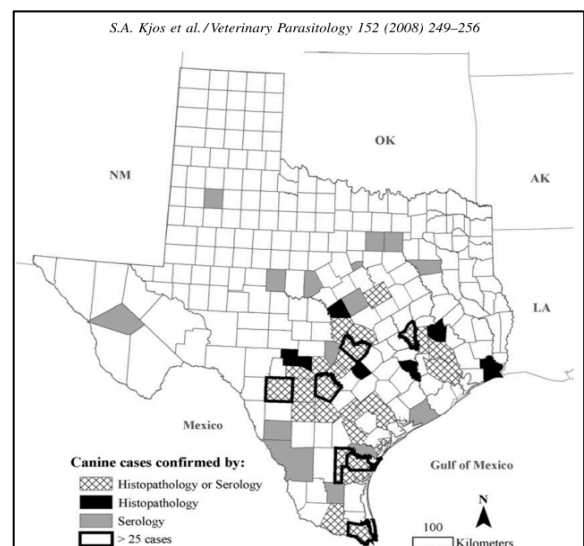


Figure 4. Distribution of canine Chagas disease in Texas (Kjos et al. 2008)

has been exposed at some time in past. Unfortunately, treatment options are not readily available, although some research teams are developing new treatment approaches that are promising. There is currently no vaccination that protects against Chagas disease for either dogs or humans. A recent veterinary study documented Chagas disease in domestic dogs throughout many counties in Texas (Figure 4). As awareness of Chagas disease grows and more cases are confirmed, we can expect many more counties to be added to the current map.

The kennel environment as a hotspot for Chagas disease transmission?

Dog kennels are environments that may be particularly suitable for the establishment of Chagas disease transmission cycles. High densities of dogs in confined areas are associated with heat and carbon dioxide that attract kissing bugs that seek bloodmeals. Furthermore, dogs may easily consume kissing bugs in kennels. Kissing bug control can be difficult in kennels, particularly in areas where human development is relatively recent and kennels are surrounded by natural habitats where wildlife occur. Adult kissing bugs engage in nocturnal flights to search for mates and mammals for blood-feeding. Because adult bugs fly towards lights, we recommend that lights be turned off at night around kennels. Some insecticides are effective against kissing bugs when sprayed around the kennel area. However, because kissing bugs can fly in from many yards away or from nearby wildlife habitats, new colonization of treated areas can easily occur.

New research efforts at Texas A&M University- we need your help!

Our research team combines experts in veterinary medicine, parasitology, entomology, ecology, and public health. We are taking a 'One Health' approach to study the ecology and epidemiology of Chagas disease in the southern US. With this approach, we are combining studies of vector populations, wildlife reservoirs, domestic dogs, parasite genetic strains, laboratory animals, and human risk. We are engaged in field collections of kissing bugs using diverse trapping

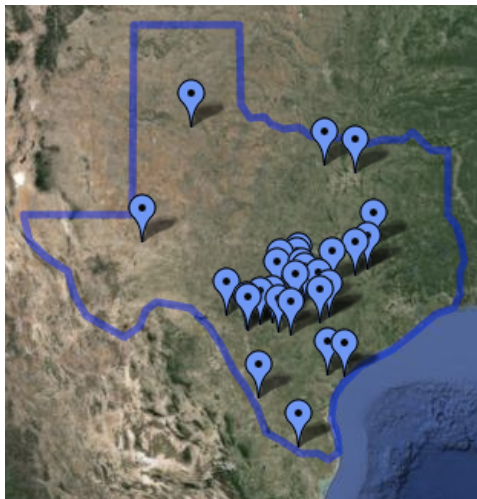


Figure 5. Our 'citizen science' approach has resulted in access to kissing bugs collected in diverse ecoregions in Texas. Through boosting the sample size of kissing bugs we can analyze in our laboratory, the impact of our science is much broader than otherwise would be possible.

techniques across private and public lands. We have established a state-wide public outreach effort through which we are inviting citizens to submit kissing bugs to our laboratory for identification and testing. This 'citizen science' approach is allowing us to obtain samples from many ecoregions of the state and has broadened the impact of our research (Figure 5). Furthermore, through this effort we are also educating veterinarians and physicians to be aware of Chagas disease and its status in Texas. Our wildlife studies involve live trapping and release of diverse small mammal species and solicitation of blood and tissue samples from hunter-harvested wild animals. We have established a network of seven animal shelters in the state, and we are assessing the burden of Chagas disease in shelter dogs to provide an index of local risk. In the laboratory, we are identifying bugs to the species level and testing bugs and wildlife samples for *T. cruzi*. We are particularly interested in using genetic approaches to determine the strains of parasite that circulate in different regions, because different strains are associated with different disease outcomes in humans and

animals. We are complementing our studies of natural populations in the field with an experimental model of animal infection using mice in the laboratory. These studies are broadly ecological in nature, focusing on the interaction of species in their natural environments. We expect that our data will provide critical information useful in efforts to predict and reduce *T. cruzi* infection in human and animal populations.

If you are interested in submitting kissing bugs for testing, we are currently accepting carefully collected and well-labeled samples from diverse geographic areas across the southern US. Prior to submission, please email us so we may provide details on safe collection methods and shipping instructions. We look forward to developing strong relationships with dog owners throughout Texas and the southern US to better understand the ecology and epidemiology of Chagas disease as a critical prerequisite for the development of treatments, vaccinations, and risk reduction measures.

For bug submission inquiries or questions about Chagas disease, please contact our Texas A&M Research Team at KissingBug@cvm.tamu.edu.

References

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