USDA-ARS Grand Challenge: Integrated Approaches for the Control of Ticks and Tick-borne Diseases of Livestock

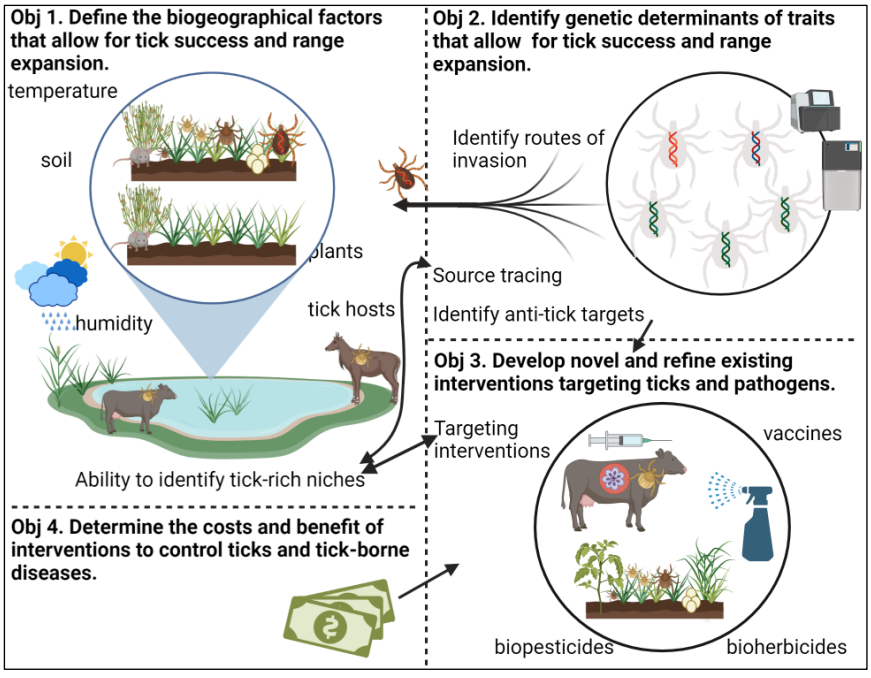
Ticks and tick-borne diseases pose a threat to human and animal health. The pace of geographic shifts in tick populations and the diseases they transmit are likely to increase due to climate change, altered land use, and ease of transportation. Introduction or expansion of ticks and the pathogens they transmit into areas with naïve animal populations, poses a great risk of catastrophic disease outbreaks. **Integrated and predictive approaches targeting invasive ticks and tick-borne pathogens of livestock are not available for informed management of pastures and herds at an individual, regional, national and international scale.** The goal of this Grand Challenge project is to address this gap.

Cattle fever ticks (CFT) are aggressive and invasive ticks that are abundant throughout Latin America and occur along the southern border of the US. These ticks transmit the pathogens that cause bovine babesiosis (cattle fever), a nearly 100% fatal disease in naïve cattle, which decimated the US cattle industry in the late 1800 to early 1900s. Because of the severity of the problem at that time, the Cattle Fever Tick Eradication Program (CFTEP) was established and resulted in the eradication of cattle fever ticks and bovine babesiosis from the US by the early 1940s. Unfortunately, cattle fever tick incursions into Texas are becoming more frequent and widespread, posing an increasing risk for re-establishment of these ticks in the US. Of additional concern, the invasive Asian Longhorned Tick was recently intercepted in New Jersey in 2017. Thousands of these ticks can be found at one time in pastures and on animals. This tick has now spread as far south as Georgia and west to Missouri and Arkansas. The Asian Longhorned Tick transmits *Theileria orientalis*, which destroys red blood cells in cattle.

More robust and integrative approaches to control invasive ticks and prevent disease are sorely needed. However, the determinants of success of tick populations and the pathogens they transmit in a changing environment are complex, poorly understood. In the case of ticks and tick-borne pathogens of livestock, these drivers include the off-host environments in which ticks spend much of their lifespan, the genomic variability of the tick and pathogen, and the socioeconomics of livestock production.

The synergistic goal of this Grand Challenge project is to use cattle fever ticks and bovine babesiosis as a model to inform strategies to prevent or mitigate future incursions of invasive tick species in the US.

To meet this goal we will: 1) Define the biogeographical factors that allow for tick success and range expansion; 2) Identify genetic determinants of traits that enable adaptation by tick populations; 3) Develop novel and refine existing interventions targeting ticks and cattle pathogens; and 4) Determine the costs and benefits of various interventions to control ticks and tick-borne diseases.



Through this work we will develop a better understanding of complex systems that drive the introduction and establishment of invasive ticks and tick-borne diseases. New knowledge and discoveries will enable innovative use of research outputs. Further, it will allow for the development of decision support tools and strategies to control tick populations and prevent tick-borne diseases. These tools will include: *1) predictive models for tick distribution and abundance and probability for disease outbreaks, including interactive maps; 2) direct interventions to control tick populations and the pathogens they carry in the environment and on the animal; and 3) economic models to inform intervention strategies and resource allocation.*