Human–Wildlife Interactions 6(1):169–177, Spring 2012

Techniques

Excluding feral swine, javelinas, and raccoons from deer bait stations

J. Mathews Pound, USDA, Agricultural Research Service, Knipling-Bushland U.S. Livestock Insects Research Laboratory, 2700 Fredericksburg Road, Kerrville, TX 78028-9184, USA *mat.pound@ars.usda.gov*
Kimberly H. Lohmeyer, USDA, Agricultural Research Service, Knipling-Bushland U.S. Livestock Insects Research Laboratory, 2700 Fredericksburg Road, Kerrville, TX 78028-9184, USA
Ronald B. Davey, USDA, Agricultural Research Service, Cattle Fever Tick Research Laboratory, 22675 N. Moorefield Road, Building 6419, Edinburg, TX 78541, USA
Liza A. Soliz, USDA-APHIS, Wildlife Services' Cattle Fever Tick Research Laboratory, 22675 N. Moorefield Road, Building 6419, Edinburg, TX 78541, USA
Pia U. Olafson, USDA, Agricultural Research Service, Knipling-Bushland U.S. Livestock Insects Research Laboratory, 2700 Fredericksburg Road, Kerrville, TX 78028-9184, USA

Key words: deer, exclusion, feeder, feral, human–wildlife conflicts, javelina, raccoon, swine, tick control

In a campaign lasting from 1907 to the present, cattle ticks (*Rhipicephalus* [*Boophilus*] *annulatus*) and southern cattle ticks (*R.* [*B.*] *microplus*) collectively referred to as cattle fever ticks (CFT), were eradicated from areas in the United States (Pound et al. 2010). These ticks transmit *Babesia bovis* and *B. bigemina*, which are the causative agents in cattle of the potentially fatal protozoan disease commonly known as Texas fever, cattle fever, or bovine piroplasmosis. The ticks are a 1-host species that attach themselves to an individual host as larvae and feed on the host's blood, molt to nymphs that feed again, and, subsequently, develop to adults. Adults mate on the host, then, females engorge with blood, detach, and drop to the ground where they lay a clutch of several thousand eggs. The eggs hatch into larvae that attach themselves to host animals, and the life cycle continues. These ticks are host-specific (Sonenshine 1993) and will feed successfully only on large ruminants (Sonenshine et al. 2002), including cattle, cervids, and equines (e.g., horses and mules). While individual ticks occasionally are found attached opportunistically to swine, canines, felines, ovines, caprines, and other nonruminants, they are unable to feed and develop sufficiently to produce gravid females. Therefore, the only hosts that were initially considered to be important in the tick eradication effort were cattle, horses, and mules (George 1990). It was not until eradication efforts failed because of high densities of white-tailed deer (*Odocoileus virginianus*) in South Florida that deer were considered to be important alternative hosts. Cattle ticks were finally eradicated in Florida, but only after extensive depopulation of deer herds.

During early years of the eradication campaign, deer were rare to virtually nonexistent throughout most southeastern states because of over-harvesting. Also, newly born fawns often were lost to New World screwworms (*Cochliomyia hominivorax*) that infested the open umbilicus. Without significant populations of deer serving as untreatable alternative hosts, the eradication campaign successfully pushed the ticks south and west to the border with Mexico by 1943. This successful eradication effort was accomplished as a result of governmentally mandated restrictions on the movement of livestock and systematic dipping of all cattle and horses in acaricide-filled plunge vats. Since 1943, the eradication program has maintained a buffer zone along the Mexican border where intense efforts are made to prevent tick-infested cattle and deer from straying across the border and reinfesting border regions in the United States. The program also monitored for the presence of cattle fever ticks on all cattle within the buffer zone and re-eradicating outbreaks. In recent years, however, populations of white-tailed deer have increased to the point that they now are seriously compromising efforts of the USDA, Animal and Plant Inspection Service (APHIS)-Cattle Fever Tick Eradication Program (CFTEP) and the Texas Animal Health Commission (TAHC) to maintain eradication (Pound et al. 2010).

White-tailed deer cannot be gathered and dipped or sprayed to control ticks as is done with livestock. Thus, passive self-treatment technologies that draw deer to bait, usually whole-kernel corn, for treatment have been developed. A systemically active method (Pound et al. 1996) involves ivermectin-medicated corn that is fed to deer. The endectocide enters the blood stream, and, as ticks imbibe the ivermectin-contaminated blood serum, the chemical interferes with the neural control of the ticks' feeding process, and the ticks cannot complete engorgement. A topically active method of tick control utilizes paint-roller applicators placed adjacent to specially designed food ports (Pound et al. 2000*a*) of bait stations. The applications cause small quantities of acaricide to be wiped onto the head, neck, and ears of the deer as they feed. Later, as the deer groom themselves, small amounts of acaricide are transferred to the flanks and underside of the animals, thus, controlling ticks attached around in these areas (Pound et al. 2000*b*). Currently, these are the only methods to control ticks on deer that are available for use in the eradication program, and both require deployment of deer feeders containing corn that attracts not only deer, but also birds, feral swine (*Sus scrofa*), javelina (*Pecari tajacu*), and raccoons (*Procyon lotor*). While birds and raccoons are detrimental to the treatment effort by consumption of significant quantities of corn, feral swine and javelina not only consume large quantities of corn but also damage or destroy the plastic feeders. To maximize efforts to treat deer, we developed an exclusion fence that selectively permits deer to access the treatment devices but excludes raccoons, feral swine, and javelina.

Design, materials, and assembly

Basic design

The exclusion fence is a 0.61-m-high by 9.14-m-diameter circle made of welded wire utility panels held vertically in place by metal T-posts driven into the ground at the junctures of the panels. A single electric fence wire is attached around the exterior of the fence with plastic insulators; it extends 3 loops around the

Figure 1.This feral swine, javelina, and raccoon excluder surrounding a feed-tube type deer feeder was one of two erected near the edge of Falcon Lake on the Rio Grande River located on the Texas and Mexico border north of Zapata, Texas. Note the placement of insulators on each T-post. Because of intense pressure from large populations of feral swine and javelina, an extra set was installed in the middle of each panel. Also note the attachment of the electric fence charger to the inside of the excluder near a T-post.

fence, and terminates at a fence charger. The top loop is installed below the top of the fence, the bottom loop is above the ground, and the middle loop is approximately centered between the top and bottom loops. A garden hose is split along 1 side and placed over the top edge of the fence and is held in place with plastic cable ties (Figure 1).

How to build the exclusion fence

Welded wire panels. Purchase 3 welded-wire utility panels that are 1.52-m × 4.88-m with 10.2-cm-square mesh. With a bolt cutter, divide each panel into 0.61-m × 4.88-m sections by removing the 2 center horizontal bars and the 10.2-cm spikes on each side. Next, cut each of these 6 sections into 2.34-m lengths by removing the center bar and 10.2-cm spikes on each side, thus, forming 12 finished panels.

T-posts. Purchase 6 metal T-posts 1.68-m long, remove the spades, and cut the posts in half to produce 12 posts 0.84-m. It is advisable to cut several extra posts of this size or shorter to use as stakes to help straighten bowed or bent panels that might be touching the electric wire along the straight runs between the ends of the panels and to support additional insulators, as needed.

Garden hose and cable ties. Purchase a moderately priced, but relatively good quality, garden hose with a minimum length of 30 m. Remove the metal ends, and cut the hose into 12 pieces, each approximately 2.3 m long. Next, carefully split the hose pieces on 1 side in a straight line along the entire length. Spread the hose pieces at the split and place them over the top edges of the panels, securing them in place with ≥6 UV-resistant (usually black) cable ties per panel. Clip the excess tie flush with the ratchet catch.

Insulators, electric fence wire, and fence charger. Purchase a minimum of 36 standard length, plastic electric fence stand-off insulators designed for use on T-posts to place at the junctures of the panels, plus several more that may be needed along bowed or bent panels to keep the electric wire from shorting out to the panel. Also, purchase approximately 92 m of aluminum electric fence wire. A small, compact, battery-powered fence charger is preferable over a solar-powered unit to prevent deer from contacting and compromising a solar panel that would need to be attached on or near the fence or feeder. There are several chargers on the market, but the best one, in our experience, has been Speedrite by TRU-TEST (model AN90), also called a Viper. This or similar units are readily available for purchase off the Internet.

Miscellaneous items. It also is convenient to have a sledge hammer, or, preferably, a dedicated T-post driver for driving the posts into the ground, a bolt cutter to cut apart and trim the panels, utility wire to attach the panels to the T-posts, and wire-cutting pliers to cut and twist attachment wires and to remove excess lengths of cable ties holding the garden hose to the tops of the panels. A short, rubber bungee cord may be used to attach the charger to the fence.

Assembly

Panel and T-post installation. First locate a circular area approximately >12.2 m in diameter that is smooth, flat, level, free of woody brush, and having penetrable soil to allow insertion of T-posts. Temporarily mark the approximate center with a stake driven a few centimeters into the ground. Measure approximately 4.6 m out from the center post, and position a T-post with the knobs facing outward away from the center of the circle. Drive each post into the ground so that the top of the post is even with or slightly below the top of the first panel. Temporarily wire the panel to the post, then adjust the other end of the panel so that it is the same 4.6 m from the center stake, and install a second post. The ends of the panel should be in the angle formed by the back of the knobbed surface and the base blade of the post that points toward the center of the circle so that the knobbed surface is not covered by the panels, thus, allowing for unencumbered attachment of the insulators. Place another panel against the opposite side of this post and securely wire the 2 panels to the post. While maintaining similar measurements from the center, continue in sequence until the dodecagon is complete. If a panel has an obvious outward bow or bend in it, install it so that it bows inward toward the center of the circle. If the panel is severely bowed, attempt to straighten it, or, if necessary, add an extra T-post to help straighten it. To prevent deer from snagging and cutting themselves on the exposed ends of the posts, drive them below the top level of the panel. When the structure is nearly complete, it may be necessary to readjust

Figure 2. An electric fence charger was attached near a T-post and on a panel that is curved to the outside, requiring additional insulators to keep the wires from grounding out to the fence.

the last or next-to-last posts to permit the last panel to meet securely with the first post. Finally, ensure that all posts are driven down to, or just below, the height of the panels and that all panels are securely wired to the posts.

Electric fence installation. To install the electric wire on the excluder panels, first place 3 T-post insulators on the outward facing knobbed surfaces of each T-post. The lower insulator should be placed with its center approximately 19 cm above ground. The middle insulator should be placed with its center approximately 35.6 cm above ground, and the upper insulator approximately 50 cm above ground. These heights are approximate because the knobs on the T-posts vary in distance from the end of the posts, making precise placement of insulators difficult. If a knob is not in position for the desired placement of the insulator, attach the insulator below the knob or lower on the post rather than higher. Mount the fence charger on the inside of the excluder at the top of a T-post that joins 2 panels (Figure 2). A short rubber bungee cord stretched over the charger and attached to the panel on both sides, works well to hold it in place. Scratch off or otherwise remove the paint from a small area on the T-post and securely attach the ground wire from the charger, assuring good wire-to-metal post contact. The other lead wire on the charger can be attached after installation of the fence wire to the panels. At this point, double check to see that the charger is in the off position.

Begin installation of the electric fence wire by first attaching the end of the wire to the left hand side of the bottom insulator on the same T-post to which the charger is mounted and grounded. While continually taking up all slack, string the wire clockwise attaching it to the bottom insulators around the excluder and ending at the same insulator from which it was started. Pull the wire tight and wrap it around the right side of this insulator, not allowing the 2 wires on opposite sides of the same insulator to touch. Next, string the wire upward, wrap it around the right side of the middle insulator, and string it around the excluder in a counter-clockwise direction. Upon returning to the initial insulator, pull the wire tight and wrap it around the left side of the insulator before stringing it up to the top insulator. At the top insulator, wrap it around the left side, continue around the excluder in a clockwise direction, pull it tight, wrap it around the right side of the top insulator, and once again tie it off without allowing it to touch the wire on the left side of the insulator. With this installation, the pathway is essentially a single wire without intermediate contacts along the circular loops. Clip or otherwise attach the hot wire from the charger to the end of the fence wire on the right side of the top insulator or extend the wire from the insulator to the hot terminal on the charger. Both the ground and hot wires should be tied close to the panel to prevent animals from chewing or pulling on them.

Finally, carefully inspect the entire enclosure to ensure that the wire is not touching anything except at the insulators. If there are unwanted contacts, drive one of the extra T-posts in near the area to push the panel inward and add additional insulators to the post. It may be necessary to untie and loosen it somewhat to be able to install it on the extra insulators, and, if so, avoid unnecessary bending or crimping of the wire. Ensure that all T-posts are driven just below the upper level of the fence. Assure that the batteries are inserted properly into the charger, then, turn on the power switch, and avoid touching the hot wires.

Behavioral rationale for the design

The excluder is designed to maximize access, use, repeated visitation, and treatment of white-tailed deer at bait stations, while

Figure 3. This nonelectrified exclusion fence was lifted and entered by feral swine that not only pulled the T-posts out of the ground and damaged the fencing, but also turned over and damaged the feeder and consumed the bait.

excluding nontarget animals, especially feral swine, javelina, and raccoons that consume large quantities of corn, intimidate deer as they attempt to feed, and may severely damage the bait stations (Figure 3). Physical and behavioral characteristics of both deer and these nontarget animals were evaluated and considered in the design.

Those who have captured and handled white-tailed deer recognize the dangerous situations and potential injury to the deer that may result from the animals' nervous and impulsive nature should they be startled while physically confined in small containment areas. Loud or unexpected sounds may cause them to bolt headlong into fences, buildings, posts, or other objects, injuring or breaking their necks, thus, causing debilitating and often fatal injuries. To minimize the sense of physical confinement, the exclusion fence is circular to avoid corners that are present in rectangular enclosures, the height is limited to only 0.6 m, and all supporting T-posts are driven below the upper level of the panels to prevent deer from snagging or impaling themselves. The limited height and non-protruding T-post design also obviate the need for a gate to facilitate entry and exit by maintenance personnel, who may readily step over the fence.

If startled, deer are able to retreat directly away from the bait station and jump perpendicularly over the fence from the enclosure, increasing the probability of safe and simultaneous clearance of both front then both back legs over the fence. Perpendicular entry and exit are inherently safer and less obstructive for deer. Also, when deer are entering the exclusion arena to access the centrally located bait station, the circular design allows them to jump in perpendicularly to the fence from any direction, whereas, by design, a square or rectangular enclosure allows them to jump in perpendicularly to the fence and in the direction of the bait station only at the centers of the 4 flat sides.

To allow deer sufficient landing area between the fence and the bait station when jumping in, the structure is 9 m in diameter, allowing approximately 3.8 m of flat unobstructed ground between the fence and the bait station. This diameter is sufficient for ≥6 deer to enter and feed simultaneously, and the low height of the fence permits adults and yearlings to easily jump inside. We compared fence diameters of 6.1, 9.1, and 12.2 m. The 9.1-m diameter was preferred because it would reduce cost, minimize material waste, minimize the area needed to be prepared for installation, maximize ease of entry and exit, provide sufficient landing room between the fences and bait stations, and minimize crowding of deer while feeding.

The split, garden hose attached to the tops of the panels serves several functions. First, as deer or nontarget animals approach, it serves as a visual cue to the presence and upper limit of the fence. Next, as deer approach with their heads positioned at or above the hose, its rubbery smell acts as an olfactory cue that usually draws them in to sniff it. The hose confirms the upper limit of the fence, and deer usually will jump in without further hesitation. Most importantly, their directed preoccupation with the visual and olfactory cues at the top of the fence prevents them from exploring downward where they might contact the upper electric fence wire and be repelled from entering. After the deer are accustomed to the excluder, they will jump in without hesitating. In addition to acting as an upper limit and olfactory cue, the hose also offers the deer protection from the sharp protrusions on the top edge of the utility panels that remain as a result of cutting the panels with bolt cutters.

Nontarget animals also are attracted to the visual and olfactory cues of the hose, but the prognathous (i. e., foreward-projecting) heads of both feral swine and javelinas increase the likelihood of them exploring downward on the level of or just beneath the hose and contacting the upper electric fence wire. Feral swine and javelinas are less prone to jumping than are deer, and once they identify the hose as the upper limit of the fence, they will explore downward looking for a way under the fence. This exploration usually includes contact with the middle or bottom electric fence wires, and they are repelled by the shock. Raccoons approach the exclusion fence from the side and contact the electric fence wires as they explore for an entrance beneath the fence or attempt to climb the outside. While exclusion of squirrels (*Paraxerus* spp.) would be desirable, they are easily capable of jumping directly to the hose and on to the inside without being shocked. Therefore, this excluder may not be effective against squirrels.

Efficacy of the design demonstrated from field trials in Texas

Several excluders have been built and deployed in a variety of environments from the Hill County of South Texas to the southern border regions of Texas and Mexico. From 1994 to the present, the deployment of 9 excluders has resulted in no feral swine, javelinas, or raccoons entering the exclusion arena while the electric fence charger was active. The most recent, and perhaps, the most strenuous test for the technology occurred between February and July 2011.

Discussions with APHIS-CFTEP and TAHC personnel during January of 2011 revealed that large numbers of feral swine and javelina were breaking through exclusion fences erected around deer treatment bait stations, overturning and damaging the feeders and consuming the whole kernel corn used as bait for the deer. Therefore, these animals were seriously compromising efforts to treat and control ticks feeding on deer (Figure 3). Because the premises were infested with CFT, state law mandated that deer must be treated; therefore, the CFTEP and TAHC needed more robust feral swine and javelina excluders that would allow for unobstructed entry and exit of adult and juvenile deer to maximize treatments. To minimize cost, the CFTEP exclusion fences were of 0.86-m-high standard, field, cattle, or hog fence wire held in place by T-posts driven into the ground. They were either circular or rectangular, and varied in dimensions and shape according to the size of the area cleared around the feeders.

To enhance exclusion of swine, 2 circular utility panel excluders were fortified with 3 strands of electric fence wire and installed on February 6, 2011, within a rectangular fever tick infested premises of approximately 404.69 ha. The premises were bordered on 3 sides by 2.4-m-high game fence and on the fourth side by Falcon Lake that is an impoundment on the Rio Grande bordering Mexico. Both sites previously had been prepared with a bulldozer and were flat, level, and free of vegetation. On February 8, 2011, an infrared motion sensor digital camera (Reconix, Inc., Holmen, Wis.) was placed on a T-post located outside of each exclusion fence at a distance sufficient to view the excluders fully. On March 2, 2011, a second camera was installed within each arena to provide detailed recording of feeding activity closer to the bait stations. From the initial installation of cameras outside of the exclusion arena in February and inside the arena in March, 26,476 and 101,851 photos were taken by the motion sensing cameras, respectively. These 128,327 photographs were reviewed as data for this study.

The first deer pictured within Excluder 1 was on February 10, 2011, about 4 days after fence construction, and the first deer pictured near Excluder 2 was on February 9, 2011, about 3 days after construction. However, the first deer seen within Excluder 2 was not until March 2, 2011, after about 24 days. The first deer seen feeding at the bait stations were on February 12, 2011, at Excluder 1 and on March 2, 2011, at Excluder 2. The 24-day delay at Excluder 2 may have been related to recurring mechanical problems with the camera located outside the arena. This is evidenced by deer first being seen feeding at Excluder 2 on the same day that a second camera was installed inside the arena. Once acclimated to the excluders and bait stations, deer readily entered and exited without stopping to sniff the fence. During the trial,

Figure 4. This, infrared photo taken at night shows a minimum of 6 white-tailed deer that gained access to the bait station by jumping or stepping over the electrified exclusion fence. The oval area was computer enhanced to better reveal the deer within the excluder.

Figure 5. These feral swine were unwilling to enter the electrified exclusion fenced arena, although they explored the exterior.

Figure 6. This group of javelinas did not enter the electrified excluder, although a large quantity of corn had been spilled beneath the feeder. The javelina on the far side of the arena is on the outside of the arena as well.

Figure 7. This group of ≥4 raccoons attempted to enter the electrified exclusion arena but was expelled by the excluder. The oval area was computer enhanced to better reveal the raccoons.

Figure 8. The electrified exclusion fence does not effectively exclude bird species, as evidenced by this flock of black-bellied whistling ducks feeding on the spilled corn. Note the deer within the arena and ducks perched on the nonelectrified split, garden hose attached to the top of the fence panels.

the maximum number of deer photographed within an excluder simultaneously was six (Figure 4), and the largest number pictured in a single frame was eight, with six inside and two outside. While bucks and does generally fed separately, an occasional doe was observed feeding with bucks. Overall, similar numbers of both sexes were observed entering and feeding within the exclusion arenas.

In addition to deer, a variety of other animals were photographed near or adjacent to the areas around the outsides of the excluders. These included feral swine (Figure 5), javelinas (Figure 6), raccoons (Figure 7), jackrabbits (*Lepus californicus*), cottontail rabbits (*Sylvilagus floridanus*), bobcats (*Lynx rufus*), armadillos (*Dasypus novemcinctus*), great-tailed grackles (*Quiscalus mexicanus*), bobwhite quail (*Colinus virginianus*), black-bellied whistling ducks (*Dendrocygna autumnalis*; Figure 8), mourning doves (*Zenaida macroura*), white-winged doves (*Zenaida asiatica*), red-eared sliders (*Trachemys scripta elegans*), turkey vultures (*Cathartes aura*), red-winged blackbirds (*Agelaius phoeniceus*), green jays (*Cyanocorax yncas*), and cardinals (*Cardinalis cardinalis*).

While the electrified exclusion fences described here are somewhat more expensive and require more effort to build and set up than nonelectrified field fences or cattle-panel fences, the added cost and time is offset by the increased efficiency in excluding feral swine, javelinas, and raccoons and by maximizing the efficacious treatment of deer. The low height of the fence permits adult and yearling deer to enter and also facilitates the safe and unhindered entry and exit of persons servicing the deer treatment bait stations within. In conclusion, from February through July of 2011, no raccoons, feral swine, or javelinas were observed within either of the exclusion fences, and no damage was caused to either the exclusion fences or bait stations. Therefore, the demonstrated efficacy of this design thus far has been 100% effective.

Acknowledgments

The authors wish to thank C. A. LeMeilleur, G. R. Earl, R. W. Ryan, and the late C. M. Santos for assistance in designing, constructing, deploying, and maintaining the excluders over a period of several years. The authors also thank R. W. Ryan for cataloging, enumerating, reviewing, and selecting photographs, and M.A. May for preparation of photographs for publication. This paper reports the results of research only. Mention of a commercial or proprietary product in this paper does not constitute an endorsement by the U.S. Department of Agriculture. This research adhered to protocol approved by the USDA-ARS Animal Welfare Committee through APHIS registration #74-F-0004. The protocol is on file at the USDA-ARS, Knipling-Bushland U.S. Livestock Insects Laboratory, Tick Research Unit, Kerrville, TX 78028.

Literature cited

George, J. E. 1990. Wildlife as a constraint to the eradication of *Boophilus* spp. (Acari: Ixodidae). Journal of Agricultural Entomology 7:119–125.

Pound, J. M., J. E. George, D. M. Kammlah, K. H. Lohmeyer, and R. B. Davey. 2010. Evidence for role of white-tailed deer (Artiodactyla: Cervidae) in epizootiology of cattle ticks and southern cattle ticks (Acari: Ixodidae) in reinfestations along the Texas/Mexico border in South Texas: a review and update. Journal of Economic Entomology 103:211–218.

Pound, J. M., J. A. Miller, and J. E. George. 2000*b*. Efficacy of amitraz applied to white-tailed deer by the '4-poster' topical treatment device in controlling free-living lone star ticks (Acari: Ixodidae). Journal of Medical Entomology 37:878–884.

Pound, J. M., J. A. Miller, J. E. George, and C. A. LeMeilleur. 2000*a*. The '4-Poster' passive topical treatment device to apply acaricide for controlling ticks (Acari: Ixodidae) feeding on white-tailed deer. Journal of Medical Entomology 37:588–594.

Pound, J. M., J. A. Miller, J. E. George, D. D. Oehler, and D. E. Harmel. 1996. Systemic treatment of white-tailed deer with ivermectin-medicated bait to control free-living populations of lone star ticks (Acari: Ixodidae). Journal of Medical Entomology 33:385–394.

Sonenshine, D. E. 1993. Biology of ticks. Volume 2. Oxford University Press, New York, New York, USA.

Sonenshine, D. E., R. S. Lane, and W. L. Nicholson. 2002. Ticks (Ixodida). Pages 518–558 *in* G. Mullen and L. Durden, editors. Medical and veterinary entomology. Academic Press, San Diego, California, USA.

J. Mathews Pound is a senior research entomologist with the USDA, ARS, Knipling-Bushland U.S. Livestock Insects Research Laboratory in Kerrville, Texas. During his >27-year tenure, he has led efforts to develop technologies to control ticks feeding on white-tailed deer and other wild ungulates in efforts to reduce the risk of livestock, wildlife, and humans contracting a variety of tick-borne diseases.

Kimberly H. Lohmeyer is a research entomologist with the USDA, ARS, Knipling-Bushland U.S. Livestock Insects Research Laboratory in Kerrville, Texas. Her research focuses on managing tick and biting fly pests of cattle, wildlife, and humans.

Ronald B. Davey is a senior research entomologist at the USDA, ARS, Cattle Fever Tick Research Laboratory in Edinburg, Texas, with 35 years of experience.His area of research specialization is the biology, ecology, and development of control technologies associated with cattle fever ticks. He is an author or co-author on 127 published articles appearing in national and international journals.

Liza A. Soliz is a wildlife biologist with research interests in deer biology, wildlife disease, and epidemiological modeling.

Pia U. Olafson is a research molecular biologist with the USDA, ARS, Knipling-Bushland U.S. Livestock Insects Research Laboratory in Kerrville, Texas. Her research interests include the identification of antigens for development of anti-tick vaccines and the immunological response of white-tailed deer to tick infestation.