Control & management of Itchy critters: Flies, Gnats, and Ticks
Pesticide Applicator Re-Certification
(3 CEU Opportunity)

Coordinator: Dr. Tom Hairgrove
Dr. Mark Matocha
Dr. Don Renchie

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Texas A&M AgriLife Extension

Pastures, Pole Barns, and Pest Control

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An agricultural operation such as a beef cattle ranch or feedlot encompasses a number of different environments, each with their own unique contributions, challenges, and requirements necessary for the success of the operation.

Numerous organisms can be pests across these diverse environments, ranging from general nuisance pests (i.e. filth flies), to pests of the animals themselves (i.e. flies and ticks), pests of the forage crops (i.e. grasshoppers and caterpillars), and pests of feed and other stored materials (i.e. beetles, caterpillars, and rodents).

Participants in this session will be provided information on the following topics:

- The role of beneficial insects in the pasture, forage, rangeland, and feedlot environments
- Filth fly biology and management
- Impacts of insect pest control methods on beneficial insects
- Regulations regarding rodent control

Pesticide Modes of Action

Mark A. Matocha, PhD
Associate Professor and Extension Specialist

The “mode of action” (MOA) describes where and how a particular pesticide acts to affect or kill the target pest. Pesticides with the same mode of action typically produce similar effects or symptoms.

Herbicide mode of action is the biological process or enzyme that the herbicide interrupts, affecting normal plant growth and development. For example, 2, 4-D is a growth regulator mode of action herbicide that affects auxin. Auxins cause bending and twisting of leaves and stems which is evident almost immediately. Delayed symptoms development including root formation on dicot stems, misshapen leaves, stems, and flowers; and abnormal roots.

Many herbicide labels display the mode of action, or herbicide group, prominently. Knowing and understanding each herbicide’s mode of action is an important step in proper herbicide selection but is also important in diagnosing herbicide injury and designing a successful weed management program.

There are several modes of action for commonly used fungicides. Fungicides kill fungi by damaging cell membranes, inactivating critical enzymes of proteins, or interfering with key metabolic processes, e.g., respiration.

Similarly, there are a number of different modes of action for insecticides. Broadly speaking, there are insecticides that affect growth and development, others that have nerve and muscle targets, some that affect respiration, and some insecticides that target the midgut.

Understanding the mode of action of a given pesticide can be beneficial to applicators. Always read and follow all pesticide label directions when making applications and consider potential impacts to neighboring landowners.

Texas A&M AgriLife Extension

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Managing External Parasites of Texas Cattle

Sonja L Swiger

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Contents

The Texas dairy and beef cattle industry is a $12 billion industry and controlling external parasites is an important part of avoiding financial losses.

External parasites, commonly called ectoparasites, cost livestock owners billions of dollars each year. Untreated, these parasites make animals suffer and lose weight. Parasites also lower the quality of animal products by:

- feeding on their hides and hair
- reducing meat and milk production by sucking their blood
- transmitting diseases
- causing cattle to lose energy

Integrated pest management

Efficient pest management requires that cattle operators understand the three components of integrated pest management (IPM) and how they work together. IPM uses cultural, biological, and chemical control methods to more effectively suppress insect pests.

Cultural control

Cultural control focuses on preventing new infestations by minimizing conditions that support insect breeding.

The best way to prevent initial infestations is to check and treat new cattle for lice, ticks, or mites before adding them to existing herds.

Poor sanitary conditions in and around barns/operations encourage insect reproduction. The most effective way to control insect and mite populations, minimize breeding conditions:

- Remove and dispose of carcasses quickly.
- Clean up and dispose of manure and spilled feed—especially if they are wet.
- Keep drainage ditches clear by cleaning out weeds.
- Remove straw or hay that has been defecated and urinated on.
- Clean and dress all wounds on cattle to exclude blowflies and prevent infection.

One pound of moist manure or wasted feed can support the production of up to 1,000 house flies—but larvae cannot survive on manure with less than 30 percent moisture. Remove manure from barns at least twice a week and spread it thin on pastures. Do not pile manure or leave it in clumps. Rotate the pastures to allow manure to dry out and decompose.

Biological control

You must identify insect populations accurately to make pest control decisions and avoid overusing pesticides. Some insects are harmless to humans and animals and can be used to control pest insects through predation:

- Fire ants prey on any available larvae.
- Black dump fly larvae feed on house fly larvae developing in the same manure.
- Small fish and immature dragonflies, damselflies, and mayflies feed on mosquito larvae.

Beneficial insects can also control pest populations through competition:

- Soldier fly maggots eat more manure than horn fly or house fly maggots, leaving competitors short of food and unable to complete development.
- Dung beetles remove manure to house their larvae. This causes the pats to dry faster and become unsuitable for fly development.
- Parasitic wasps lay eggs inside immature horn flies, house flies, and stable flies. The wasp larva then eats the immature flies.

Though wasps can be used to supplement sanitation, parasitic wasps probably will not control pests adequately in an environment that promotes breeding.

For more information, see *http://www.ca.uky.edu/entomology/entfacts/ef502.asp*.

Chemical control

Pesticides should be used only when preventive methods are not effective or available. Use chemical control methods only when pest activity is at its highest.

Safety tips for using pesticides

- Follow all directions and safety precautions precisely. Never deviate from pesticide label recommendations.
- Record every pesticide application; include the common name, trade name, formulation, dilution, application rate, and date of treatment.
- Use a facemask or respirator and protective clothing during spraying. Avoid breathing spray mist or dust. Follow label recommendations regarding personal protective equipment.

- If you spill pesticides on your skin or clothes, wash them thoroughly with soap and water, and change clothes. Wash contaminated clothing separately from household laundry.
- Do not eat, drink, or smoke when handling pesticides.
- Provide adequate ventilation when applying pesticides.
- Follow label application rates to avoid illegal meat and milk residues and possible harm to the animal.
- Never apply pesticides closer to slaughter dates than the number of days listed on the label.
- Avoid wind drift; pesticides can kill fish, wildlife, and crops.
- Do not treat animals that are sick, overheated, or stressed from shipping, dehorning, castration, recent weaning, etc.
- Do not contaminate mangers, feed, water, milk, or milking equipment.
- Do not spread treated manure on pastures or cropland against label recommendations.
- Store pesticides in the original, labeled containers, safely locked away from children, pets, and livestock.
- Dispose of empty pesticide containers promptly and according to specified recommendations.
- If you suspect poisoning, call a doctor immediately. Symptoms include blurred vision, abdominal cramps, diarrhea, excessive salivating, vomiting, tremors, and tightness in the chest.

Livestock pests

Horn fly

Horn flies (*Haematobia irritans*) bite cattle and feed on their blood; they weaken the animal and make it lose weight.

Adult horn flies have piercing mouthparts and each fly feeds 30–40 times per day. The bites are painful and will form a wound that mars animal hides.

Horn fly populations increase from late spring to early fall; they peak in midsummer. They rest on the withers, back, and sides of the cattle, moving to the belly when temperatures exceed 90 degrees F. Cattle react by licking their backs, twitching their flanks, switching their tails, and kicking at their bellies with their hind legs. When flies exceed 250 per side, cattle will lose 15 to 50 percent of their weight.

Horn flies are the same color as house flies and stable flies but are slightly smaller (3⁄16 in.). The females can lay several hundred eggs in their 3-week lifespan. They lay their eggs under the edges of fresh dung pats where they develop in 10–20 days, depending on the temperature.

To control and prevent horn fly infestations:

- Kill adult flies before they harm the cattle or produce offspring.
- Exclude adult flies with screens or other barriers.
- Drag pastures and spread manure in a thin layer to limit breeding grounds.
- Rotate pastures to prevent manure buildup.

Beneficial organisms such as predators, parasitoids and natural competitors will help control insect populations. Predatory mites, beetles and the larvae of certain flies such as *Hydrotaea* spp. or *Muscina* spp. feed on horn fly larvae. Parasitoid wasps such as *Muscidifurax* spp. and *Spalangia* spp. feed on pupae. Dung beetles and the black soldier flies compete with horn flies for cattle dung.

The point at which chemical control measures are economically justified is called the threshold. For horn flies, the threshold is 250 flies per side. Use chemical control once the threshold is reached. Control options include:

- ear tags
- sprays
- pour-on liquids
- back rubs
- injections
- insect growth regulator
- mineral feed products
- boluses
- dust bags

Place self-treatment devices at bottlenecks near water, feed, or mineral sources. It may take 2 –3 weeks before cattle adopt self-treatment devices. Forcing cattle to use these devices can help control lice and will control horn flies more rapidly.

Insecticide-impregnated ear tags can also give excellent control if they are properly attached and the insect is not insecticide resistant. The tag applies a small amount of insecticide to the animal's body over a 2½- to 5-month period. Replace the tag when the insecticide is depleted and no longer controls the flies. Ear tags are an economical way to control horn flies, Gulf Cost ticks, and spinose ear ticks.

Managing pyrethroid- and organophosphate-resistant horn flies

Alternate the type of active ingredients to avoid or minimize insecticide resistance. Treating successive generations of flies with the same types of insecticides promotes insecticide resistance; insects that are susceptible to the active ingredient are quickly killed; those that are not pass on their genes and increase the number of resistant insects.

Horn fly resistance to organophosphates was first recorded in the 1970s; resistance to pyrethroids was confirmed in 1984.

Flies that resist one pyrethroid will resist all other pyrethroid insecticides currently labeled for use in Texas. To reduce resistance, delay treatment until flies reach threshold levels and susceptible flies mate with resistant ones. Periodic application methods (sprays, self-treatment devices, etc.) tend to delay development of resistance more than do continuous release methods such as ear tags.

Treatment options

- Use sprays, dusts, or other formulations with a different mode of action than the ear tag, and treat only when horn fly populations exceed 250 per head.
- Alternate the type of ear tag insecticide each year. Organophosphate (OP) ear tags such as Terminator II, OPtimizer, Patriot, Warrior, or Dominator can be used after a pyrethroid ear tag. Do not use organophosphate ear tags for more than 2 successive years. Organochlorine (Avenger) or macrocyclic lactone (XP 820) ear tags are effective alternatives to pyrethroid or organophosphate ear tags.
- Remove the ear tags when calves are weaned or when the cows are worked in the fall. If there are more than 200 to 250 horn flies per head when the tags are removed, use a spray or dust with a different mode of action to reduce overwintering flies.

Combination ear tags are not recommended because they combine modes of action and can promote resistance to both classes of insecticides at the same time.

House fly

The house fly (*Musca domestica*) is the most abundant insect of confined cattle. This fly breeds continuously in manure and rotting vegetation. Adult house flies are about ¼ in. long and are gray and black with four black stripes on the thorax. The sides of the abdomen are creamy yellow, and distinctly noticeable.

House flies do not bite; they feed on blood, sweat, tears, saliva, and other bodily fluids. Cattle respond by flapping their ears, shaking their heads, and avoiding infested areas. House flies can infest cattle wounds with maggots and spread pathogens (disease-causing organisms) such as *E. coli.*

Sprays, baits, light traps, and adhesive strips can control adult flies in livestock barns. Although, insecticides can keep maggots from developing on manure piles, chemicals alone will not solve the problem. Do not contaminate feed, utensils, or drinking water with insecticides.

Spread manure so heat and drying can kill eggs and larvae. Remove waste and spilled feed regularly.

Stable fly

Stable flies (*Stomoxys calcitrans*) are the US cattle industry's most costly pest. They look like house flies but are smaller (³⁄₁₆ in.) and inflict a painful bite. Unlike horn flies that remain on the animal, stable flies rest on nearby surfaces after feeding.

Although stable flies suck blood only once a day, their irritation inhibits weight gain and milk production. They attack the legs, sides, back, and belly; cattle will stamp, and kick, and switch their tails. They will also bunch in a group, which keeps them from dissipating excess heat when it is hot and humid.

Stable flies congregate near confined animals indoors or out and breed in mixtures of urine, manure and decaying litter. Larvae (maggots) develop in straw bedding, wet hay, and manure accumulations. Eggs develop into adult flies in 3 to 4 weeks; adults can live for 3 weeks.

Stable flies begin to cause economic losses and must be controlled when concentrations reach two to four flies per leg.

Dispose of manure and litter as outlined for house flies to help reduce populations. Discard trampled hay bales and place new ones in another location to reduce larvae development. Predators, parasites, and pathogens that attack horn flies will also help in managing stable flies. Spraying animals and resting areas with approved insecticides will control flies immediately.

Screwworm fly

The primary screwworm fly larvae feed on living tissue but have been eradicated from Texas. The secondary screwworm fly larvae, *Cochliomyia macellaria,* feed on dead tissue and are found throughout the continental United States. The female lays eggs only rarely in wounds on living cattle but often in the natural openings of fresh carcasses. The larvae begin to develop within 10 to 20 hours.

There is always a danger that screwworm-infested animals could be reintroduced into uninfested areas. Inspect livestock for screwworms and report any suspected screwworm cases to your county Extension agent or local veterinarian. Submit any suspect larvae found in animals for identification.

For identification, collect 10 larvae from deep within the wound and place them in alcohol. Send the samples to:

USDA–ARS–KBUSLIRL
Screwworm Research Unit
2700 Fredericksburg Road
Kerrville, TX 78028.

Or

National Veterinary Services Laboratory
Attn: Sample Processing Department
920 Dayton Ave
Ames, IA 50010
(515) 337-7266.

The US Department of Agriculture, Animal and Plant Health Inspection Service international services office at (301) 734-8892 also can provide assistance.

Myiasis

Myiasis is the invasion of a living vertebrate animal by fly larvae. Myiasis can be classified as accidental, facultative, or obligatory:

- Accidental myiasis occurs when an animal ingests food contaminated with fly eggs or larvae; the larvae typically are not parasitic but cause discomfort as they pass through.
- Facultative myiasis is not essential to the life cycle of the parasite, but occurs, for example, when the maggots of blow flies that normally feed on carrion invade an open sore on living cattle.
- Obligatory myiasis is the infestation by a fly species that requires a living host for development. Examples are the primary screwworm and bot flies.

Blow fly

Blow flies are big and metallic green and blue. They seek carrion for their larvae, though maggots are sometimes also found in cattle wounds. Black blow fly larvae often infest dehorning wounds during winter and occasionally infest the navels of newborn animals. Heavy infestations are occasionally fatal.

Blow flies breed and reproduce in decaying animal and bird carcasses, dog manure, and wet garbage. Remove dead animals to prevent heavy blow fly infestations. Clean infested wounds and treat them immediately with a topical pesticide until the larvae are gone.

Cattle grub (Heel fly)

Heel fly larvae are called cattle grubs; they reduce feed efficiency and lower milk production, weight gain, and hide value. They make cattle run wildly with their tails in the air (gadding) or stand in water to protect themselves. Affected animals have poorer carcass trim and lower meat quality.

Female flies lay eggs on the legs and lower body of cattle. Eggs attached to the hairs hatch into tiny larvae that penetrate the skin and migrate through the animal's body. Larvae congregate in the tissues of the esophagus or spinal column, but eventually move to the back in later summer, fall, or winter. Grubs develop a "cyst" or "warble" in the animal just under the skin on the back. After 6 to 8 weeks, grubs cut holes in the hide, fall to the ground, and pupate. Adult heel flies emerge in late winter, spring, or summer.

Cattle grubs can be controlled once they reach the animal's back; but by then, most of the damage is done. Prevention is preferable.

Systemic insecticide sprays, dips, pour-ons, boluses, and injectables are distributed through the animal's body and destroy cattle grubs by contact. To avoid a host/parasite reaction, use systemic insecticides when heel fly activity ceases between May 1 and July 4 but not within six to 7 weeks before grubs appear on the back. Typical host/parasite reaction symptoms include:

- swollen esophagus
- bloat
- profuse salivation
- discomfort
- in extreme cases, death

Organophosphate poisoning symptoms are similar to host–parasite reactions. However, do not use the antidote for OP poisoning, atropine, because it may make the problem worse.

Other biting flies

Horse fly and deer fly

Female horse flies and deer flies are vicious biters and make livestock lose weight. They also can transmit anaplasmosis, anthrax, and other diseases. Horse flies are a serious nuisance to livestock and even a few can significantly reduce production. Most of these flies are found in damp, brushy, or low-lying areas near creeks, streams, or tanks.

The horse fly measures ½–1½ in. long: the deer fly is generally ¼ –⅓ in. long, and readily bites humans.

A female horse fly can lay up to 800 eggs at a time. Though most species lay eggs on vegetation near a water source, some lay their eggs in dry soil or leaf litter.

Female horse flies are not easily deterred or dislodged. Heavy attacks can reduce weight gain, milk yield, and feed utilization, and damage the hide.

Controlling these flies is difficult because one location can have several species that feed at different times. Spraying these flies while on the animal is ineffective because each fly generally feeds for only 4 minutes. No insecticides kill the larvae or pupae.

Moving livestock from infested areas may provide some relief, but shelter or barriers offer the most effective protection. Box traps and canopy traps can limit the number of adult flies in an area.

Biological controls such as ladybird beetles feed on the eggs; wading birds and dragonflies feed on the larvae. Some large solitary wasps attack the adults, and parasitoid wasps rear their young on various stages of horse flies and deer flies.

Mosquito

Photo by Bart Drees

Mosquitoes multiply in water and attack mostly at dusk. Large populations can hinder production and, in some cases, even kill livestock and wildlife by sucking their blood and transmitting diseases.

Mosquito larvae develop in tidal pools, rain pools, or floodwater; in permanent surface water like pools, streams, swamps, and lakes; and in water-holding containers like tree holes, drinking water troughs, and discarded tires.

Female mosquitoes will lay eggs on water or on a surface where water will accumulate. Eggs generally take 2 to 3 days to become larvae but can take up to a week. Most mosquito larvae take 6 days to become a pupa, then 2 days to become an adult.

To control mosquitoes, eliminate standing water to prevent egg laying and larval development.

Natural controls do not significantly reduce mosquito populations. Birds, bats, dragonflies, and fish eat mosquitoes but do not reduce their numbers significantly.

Chemical control is necessary for heavy infestations. Sprays reduce the number of biting females and some products treat standing water. Topical sprays repel biting mosquitoes. Ear tags, back rubbers, or dust bags will protect cattle against mosquito adults without further intervention, but you should monitor water sources for larvae.

Products containing *Bacillus thuringiensis israelensis* (*Bti*) and *B. sphaericus* kill larvae effectively.

Black fly

The black fly is a small humpbacked fly that can irritate and even kill livestock. Black flies depend on flowing water for their larvae and are found along fast-moving rivers, particularly in northeast Texas.

The female black fly lays eggs near a riverbed. The larvae attach themselves to vegetation and filter food from the water. Black fly adults can emerge from their pupal cases in such large numbers that they can suffocate cattle.

Photo by J.V. Robinson

Black flies have a painful bite and can transmit diseases. Black fly swarms can make cattle crash into structures, stampede, and even trample calves.

These flies are best managed at the larval stage by treating the water where they grow. Treating cattle with dusts, ear tags, back rubbers, pour-ons and sprays will limit the number of black fly attacks. For additional protection, use shelter, smoldering fire, permethrin-based repellents and white petroleum jelly on the ears.

Lice

A single cow can harbor more than a million lice. Symptoms include: lameness, dermatitis, hair loss, allergic responses, and skin crusting or scabbing. Lice cause anemia, lower milk production and inhibit feed efficiency and weight gain. They also lower the animal's resistance and increase secondary diseases and mortality.

Photo by Bart Drees

The cattle biting louse (*Bovicola bovis*) feeds on hair and scales and prefers the top line of the animal's back, especially the withers. It can spread to other parts in heavy infestations.

Four species of lice suck blood from cattle:

- The shortnosed cattle louse (*Haematopinus eurysternus*)
- The longnosed cattle louse (*Linognathus vituli*), which occurs in greater numbers on calves than mature cattle; it can be found all over the body but prefers the shoulders, back, neck, and dewlap.
- The little blue cattle louse (*Solenoptes capillatus*), is the smallest of the lice and gets its name from its color at maturity. It is a common species on cattle and clusters on the face. These lice also infest the top of the neck, the dewlap, and the brisket. During heavy infestations, they can be found from the horns to the tail.
- The cattle tail louse (*Haematopinus quadripertusus*), populations peak during the summer. The adults are typically confined to the tail region; the nymphs will be found on the face, neck, vulva, and anus.

Lice spread in cattle by direct contact and can heavily infest animals that are sick, very young, or very old. Heavy infestations can be debilitating and cause restlessness and anemia. Sucking lice can also spread bovine anaplasmosis.

In temperate regions, lice are typically more abundant during winter and spring, so treat cattle in the late fall and early winter. Control methods include:

- spot treatments
- quarantine of infested individuals
- dust
- powders
- sprays
- dips
- ear tags
- boluses
- pour-ons
- lotions and
- injectables

Systemic pour-ons, injectables, and oral products are effective and popular treatments. Do not use systemic products on grub-infested animals in winter because reactions can be lethal.

Heavily infested cattle are a major source of reinfestation for a herd. Cull these animals to protect the rest of the herd.

Mites

Mange mites tunnel into the skin and deposit their eggs inside. Scab mites deposit their eggs at the bases of hairs or in the skin. They initially irritate the skin and cause scabs that enlarge as feeding continues. Left untreated, they will fully occupy the skin or hair follicles. Problems include:

- persistent dermatitis
- mite-induced allergies
- transmission of microbes and metazoan parasites
- intermediate parasites (tapeworms)
- invasion of respiratory passages, ear canals, and internal organs

On stressed, pregnant or lactating cows, the cattle follicle mite (*Demodex bovis*) causes nodules under the skin that can be felt but not easily seen. Heavy infestations can cause lesions on the neck, shoulders, and udder and between the forelegs and body.

Nodules will form over a 1-month period, and then gradually disappear and be replaced by other nodules. The smallest sores are the size of a pinhead, the largest as big as a chicken egg. The nodules eventually rupture and exude a pus-like substance full of mites causing defects to the hides.

Scabies, psoroptic, and chorioptic mites (*Sarcoptes scabiei, Psoroptes bovis, Chorioptes bovis*) must be reported under state law. If you suspect these mites, contact the Texas Animal Health Commission, Box 12966, Austin, Texas 78711, 1 (800) 550-8242.

Scabies mites are spread by direct contact. The adult females burrow in the upper skin layers, where the mites live. Cattle react to fecal deposits in the burrows 3 weeks after scabies mites first infest. Lesions occur first in areas with thin hair (such as on the head) but quickly spread over the entire body and cause generalized mange. Progressive infestations make the skin thicken and crust; scratching and rubbing will cause secondary infections. Because mites are difficult to collect, infestations are usually diagnosed by clinical signs and positive responses to acaricide treatments.

The psoroptic scab mite causes mange that spreads rapidly by contact with another animal or indirectly from an infested object such as a fencepost or stall. These mites are more prevalent in the winter and feed by abrading the skin. The host responds by developing swelling and dermatitis around the blood vessels.

The chorioptic scab mite causes mange that is irritating and develops crusty lesions. Chorioptic scab mites feed primarily on the legs and feet and generally go unnoticed as cattle spread them. Cattle typically react to them only when infestation reaches into the thousands and mange develops. Chorioptic mange is also referred to as foot mange, leg mange, or itchy heel.

Reportable Diseases

Report any suspected foreign or emerging animal disease to the Texas Animal Health Commission immediately. Texas law requires that specific livestock and fowl diseases (a complete list can be found at *http://info.sos.state.tx.us/fids/200904288-1.html*) be reported to the TAHC within 24 hours of diagnosis. This requirement applies to veterinarians, veterinary diagnostic laboratories, and people who manage animals.

Ticks

Photo by Bart Drees

Several tick species attack livestock. Ticks can spread protozoan, viral, bacterial, and fungal pathogens and also injure cattle by feeding on their blood. Tick damage to cow hides reduces their value.

Ticks are classified as hard or soft. A hard tick has a prominent plate on its back known as a scutum. This plate is hard and its color varies according to species. The mouthparts of hard ticks extend from the front of the head, and they feed only once between each stage of development. Female hard ticks also lay eggs only once.

Hard ticks differ according to the number of hosts they use during their lifecycle:

- A one-host tick stays on a single host from egg through adult; after the female's final feeding, it drops from the host, lays eggs, and dies.
- A two-host tick completes the larval and nymphal stages on a smaller host such as a rabbit, then moves to a larger host such as a cow for the adult stages. After the adult female feeds, it drops from the host, lays eggs, and dies.
- The three-host tick begins as a larva on a small host such as a squirrel, where it takes a blood meal, and then moves to an intermediate host such as a rabbit. The nymph feeds once on the intermediate host and then detaches. The adult attaches to a large host such as a deer or a cow, where it feeds once, detaches, lays its eggs, and dies.

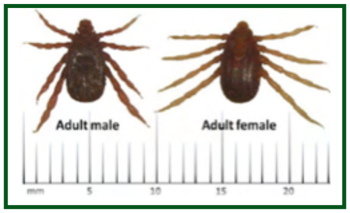
Soft ticks have no scutum and appear more rounded. The mouthparts are located beneath the body. Soft tick females can take multiple blood meals as adults and lay multiple batches of eggs.

Common Texas ticks

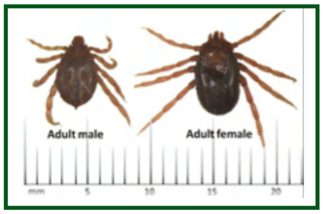
The following tick images were contributed by O.F. Strey and P.D. Teel, http://tickapp.tamu.edu , Tick Research Laboratory, Texas AgriLife Research, College Station, TX 77843.

Texas cattle fever disease was eradicated in the US in the early 1900s. However, since 2009, *Boophilus* tick populations have reentered South Texas.

Two species of this tick, *B. annulatus* and *B. microplus,* spread the protozoans that cause Texas cattle fever. This disease causes animals to develop a high temperature, stop feeding, and become anemic. The animal will eventually become lethargic, lapse into a coma, and possibly die. Heavily infested cattle that do not develop cattle fever disease will still gain less weight and produce less milk.



Boophilus annulatus

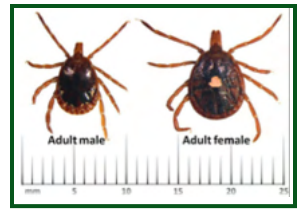


Boophilus microplus

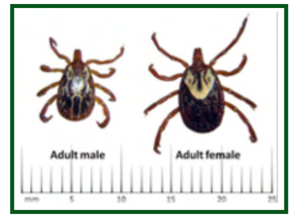
The Texas Animal Health Commission and the USDA are working together to prevent Boophilus ticks from spreading beyond South Texas and the quarantine zone.

The Lone Star tick (*Amblyomma americanum*), is aggressive, will attach to many types of hosts, and transmits several pathogens. This tick prefers wooded or brushy areas during spring and summer. It is most abundant in Central Texas and has killed white-tailed deer.

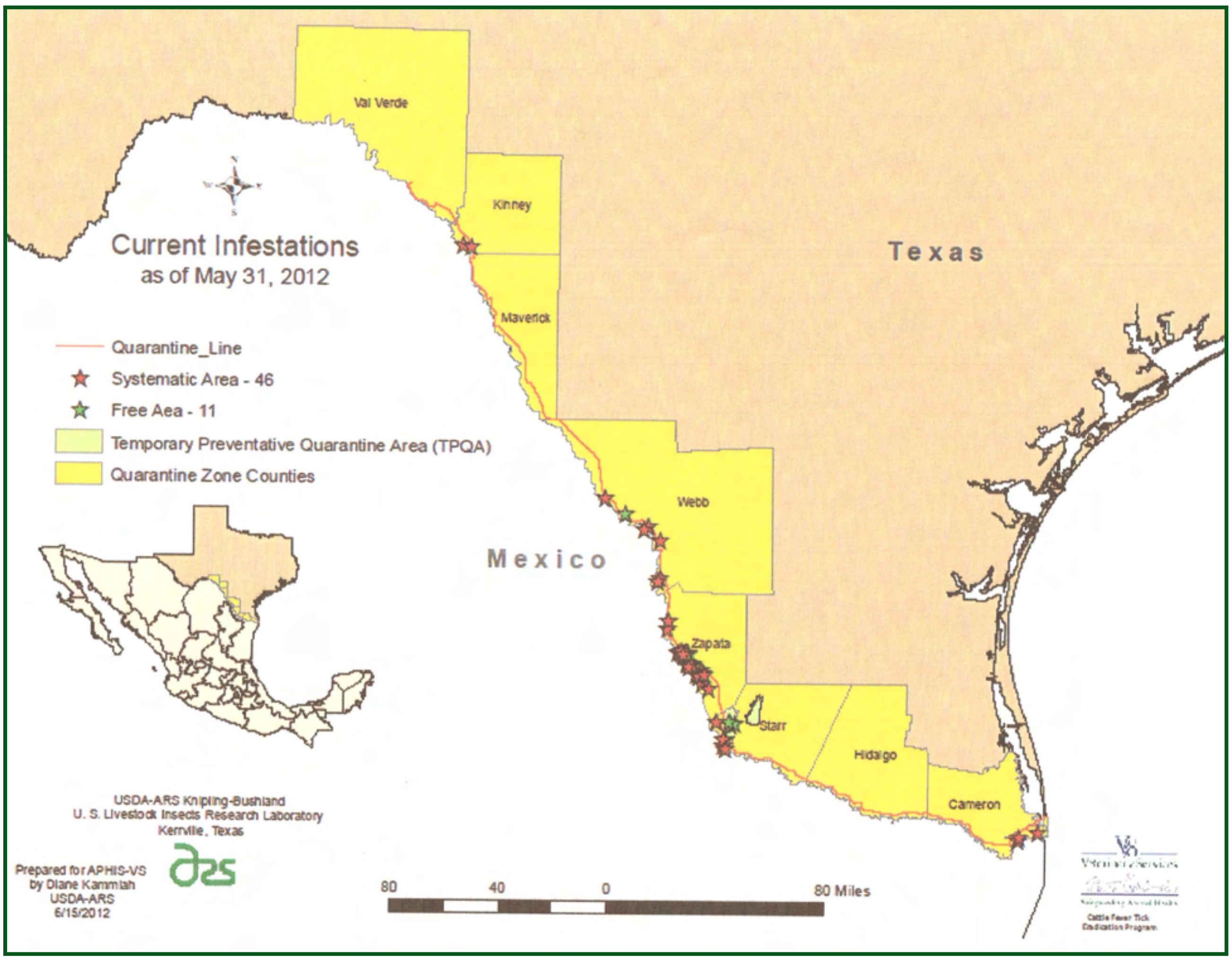
The Gulf Coast tick (*Amblyomma macula-*



Amblyomma americanum



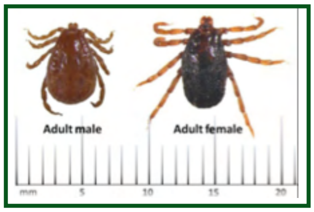
Amblyomma maculatum



Fever Tick Quarantine Zone, USDA-APHIS

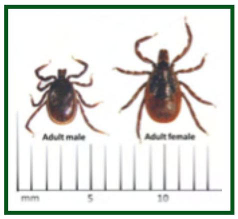
tum) ranges from the Texas Gulf Coast to central Oklahoma. In Texas, populations peak in late summer and early fall. Adults attack cattle mainly around the ears, eyes, and poll. Heavy infestations can injure the skin and often render the hides useless.

The winter tick (*Dermacentor albipictus*), is a one-host tick that attacks during the winter and late fall. Heavy infestations of this tick cause blood loss that can lead to anemia or even death.



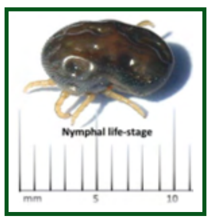
Dermacentor albipictus

The black-legged tick (*Ixodes scapularis*), is prevalent in the eastern half of Texas during spring and winter. It is most commonly found on white-tailed deer and is the primary carrier of Lyme disease. The winter tick readily feeds on humans.



Ixodes scapularis

The spinose ear tick (*Otobius megnini*), though limited in Texas, often infest livestock and domestic and wild ruminants. The larvae and nymph stages feed on blood; the adult does not. These ticks attach deep within the ears and cause intense irritation, wax accumulation, and excretions that can lead to ear infections.



Otobius megnini

Pesticides known as acaricides are used commonly to prevent and control mite and tick infestations. Clearing or burning dense vegetation will also help reduce tick populations.

Insecticide application methods

Sprays

Prepare only enough solution for the number of animals you plan to treat. Do not store mixed insecticides. Emulsifiable concentrates or soluble formulations are well suited for use in small sprayers. For wettable powders, sprayers should have a high-volume piston pump with a suitable agitator. Apply sprays at a pressure of 250 to 350 pounds per square inch.

For ticks, lice, and mites, use enough water to cover the animal thoroughly. When spraying systemic insecticides to control cattle grubs, be sure to wet the animals to the skin.

Dips

Dip vats are effective and, when properly maintained, can be used several times a year. The initial cost is high, but many animals can be dipped during the season with little additional expense. Vat treatments ensure good coverage by wetting the animal thoroughly. Vats are the most effective way to treat for *Boophilus* ticks.

Follow label directions when filling or recharging a dipping vat; use only products labeled for dipping animals. Do not mix different products unless specified on their labels. Stir the vat thoroughly before dipping animals.

Pour-ons

Apply pour-on insecticides directly to the center of the backlines of animals. The chemical is absorbed and then circulates through the animal's system. Backline pour-on treatments control horn flies for up to 30 days.

Spot-ons

This method uses specially designed applicators to apply a small amount of pesticide to a single spot on the animal's backline. Spot-on pesticides are best used for cattle grubs and lice.

Dusts

Dusts are applied with hand shakers or self-treatment dust bags. They are most valuable against horn flies and lice on large animals.

Injectables

Avermectin and milbemycin treatments for beef cattle are formulated for subcutaneous injection and are also labeled for internal parasite control.

Feed and mineral insecticide additives

Some insecticides may be administered as feed or mineral additives. These control specific fly species whose maggot stages develop in animal manure.

Insecticide-impregnated ear tags

Ear tags are plastic devices that dispense insecticide to control ear ticks and horn flies. They control ear ticks for 4 to 5 months and horn flies for 2½ to 5 months. Ear tags also help control most biting insects, such as stable flies, mosquitoes, and lice.

Baits

Baits help control house flies that congregate around feedlots, dairies, and livestock barns. Baits are made of dry sugar, syrup, or other substances that attract house flies. A small amount of insecticide is added to kill flies that eat the bait.

Boluses

Boluses are administered orally and slowly release chemicals in the animal's second stomach. These chemicals pass out into the manure and disrupt the development of maggots.

Read and follow label directions

The Environmental Protection Agency establishes tolerances for pesticide residues in agricultural commodities intended for human consumption. Follow the manufacturer's label recommendations label concerning safety restrictions, dosage, and application. Observe all label-specified withdrawal intervals to avoid illegal residues in meat or milk.

Dilution Chart for Mixing Sprays or Dips

Amount of insecticide concentrate in 100 gallons and 5 gallons of total mixture												
	1% mix		0.5% mix		0.25% mix		0.60% mix		0.03% mix		0.01% mix	
Insecticide concentrate	**100 gal**	**5 gal**	**100 gal**	**5 gal**	**100 gal**	**5 gal**	**100 gal**	**5 gal**	**100 gal**	**5 gal**	**100 gal**	**5 gal**
5.7% EC	1.75 gal	7.0 pt	8.8 gal	3.5 pt	4.4 gal	28.0 oz	1.0 gal	6.7 oz	4.2 pt	3.4 oz	1.4 pt	1.1 oz
10% EC	10.0 gal	2.0 qt	5.0 gal	1.0 qt	2.5 gal	1.0 pt	4.8 pt	3.8 oz	2.4 pt	1.9 oz	0.8 pt	0.63 oz
11% EC	9.0 gal	3.6 pt	4.5 gal	1.8 pt	2.3 gal	14.5 oz	4.4 pt	3.5 oz	2.2 pt	1.7 oz	0.73 pt	0.57 oz
11.6 ELI	8.6 gal	3.4 pt	4.3 gal	1.7 pt	2.2 gal	13.8 oz	4.1 pt	3.3 oz	2.1 pt	1.6 oz	0.70 pt	0.55 oz
25% WP	33.4 lb	1.6 lb	16.7 lb	13.3 oz	8.3 lb	6.7 oz	2.0 lb	1.6 oz	1.0 lb	0.8 oz	0.33 lb	0.27 oz
25% EC	4.0 gal	25.6 oz	8.0 qt	12.8 oz	1.0 gal	6.4 oz	1.9 pt	1.5 oz	1.0 pt	0.8 oz	0.33 pt	0.26 oz
40% WP	20.8 lb	1.0 lb	10.4 lb	8.3 oz	5.2 lb	4.1 oz	1.3 lb	1.0 oz	10.0 oz	0.5 oz	3.34 oz	0.17 oz
40% WP	2.5 gal	1.0 lb	5.0 qt	0.5 pt	2.5 qt	4.0 oz	19.2 oz	1.0 oz	9.6 oz	0.5 oz	3.20 oz	0.17 oz
50% WP	16.7 lb	13.3 oz	8.3 lb	6.7 oz	4.2 lb	3.4 oz	1.0 lb	0.8 oz	0.5 pt	0.3 oz	0.17 oz	0.10 oz
57% EC	7.0 qt	11.2 oz	3.5 qt	5.6 oz	3.6 pt	2.8 oz	13.4 oz	6.7 oz	6.7 oz	0.3 oz	2.20 oz	0.11 oz

WP = Wettable powder
EC = Emulsifiable concentrate
ELI = Emulsifiable liquid insecticide
WDL = Water dispersible liquid

Fluid conversion for EC only:
1 gallon (gal) = 4 quarts (qt)
1 gallon = 128 fluid ounces (oz)
1 quart (qt) = 2 pints (pt)
1 fluid ounce (oz) = 2 tablespoons (tbsp)
1 tablespoon = 3 teaspoons (tsp)

Formulas and Examples

For wettable powders (WP), use the following late formula to determine the number of ounces of powder to mix in the spray tank.

$$\frac{A \times S \times 8.345}{WP} \times \frac{A \times S}{16 \text{ oz} = \text{amount of WP in ounces}}$$

Where: A = amount finished spray (gallons)
S = % spray mix desired
WP = % wettable powder

Example: To make 5 gallons of a 0.06% spray mix from a 25% WP:

$$\frac{5 \text{ gal} \times 0.06 \text{ \% spray} \times 8.345}{25\% \text{ WP}} \times 16 \text{ oz} =$$

$$\frac{2.5}{25} \times 16 \text{ oz} = 0.1 \times 16 = 1.6 \text{ oz}$$

For EC, ELI, or WDL, use the following formula to calcu- the number of liquid ounces to mix in the spray tank.

$$C \times 128 \text{ oz} = \text{quantity of liquid in ounces}$$

Where: A = amount finished spray (gallons)
S = % spray mix desired
C = % concentration liquid product

Example: To make 100 gallons of a 0.06% spray mix from a 12% EC:

$$\frac{100 \times 0.6}{12} \times 128 = 0.5 \times 128 = 64 \text{ oz or 4 pints}$$

MANAGING ANAPLASMOSIS IN BEEF CATTLE

Thomas B. Hairgrove, DVM, Ph.D., DABVP (Beef Cattle Practice)

Anaplasma marginale, an obligate intracellular gram-negative rickettsial bacterium, causes bovine anaplasmosis. Globally *A. marginale* is the most prevalent tick-borne infection and negatively affects livestock production in tropical and subtropical regions (Palmer, 2009). The disease is found on all six continents, is diagnosed in most states in the United States, and is endemic in tropical and subtropical areas of the world. This noncontagious pathogenic bacterium is transmitted biologically by some 20 species of ticks, mechanically transmitted by biting flies and blood-contaminated instruments, and transmitted vertically from an infected dam to her fetus (Aubry and Geale, 2010). *Anaplasma marginale* invades and replicates in ruminant erythrocytes. It also replicates in the midgut and salivary cells of certain ticks, making them efficient biological vectors. The infected cattle's erythrocytes become phagocytized by the reticuloendothelial system, which causes the production of anti-erythrocyte antibodies, the release of acute-phase inflammatory agents, and accompanying anemia and fever (Constable et al. 2017). Cattle that survive acute infection remain persistently infected for life but do not show clinical disease unless immunosuppressed by factors such as malnutrition, stress, or extreme pathogen load. Persistent infection allows animals to maintain immunity and resistance to clinical disease through "sequential antigenic variation." As the number of circulating bacteria increases, they trigger a host's antibody response, diminishing infected circulating bacteria. As the bacteria decline, their major surface proteins alter, allowing them to evade the host's immune response until the changes are recognized, and the immune system begins to clear the pathogen again. This cycle results in a bimonthly variation in the concentration of infected erythrocytes varying from 10^3 to 10^5 infected cells/mL of blood, lower than 10^9 infected cells/mL seen in acute infection (Constable et al. 2017).

Animals infected before six months of age seldom exhibit clinical disease, and cattle infected before 20 months may show clinical signs but rarely die. Mortality rates of 29% to 49% are not uncommon in naïve adult cattle experiencing acute anaplasmosis. Acute infection results in fever (103^0 F-106^0 F) that subsides within a day, dropping to normal or subnormal. There is muzzle dryness, suppression of rumen activity, and often constipation (Palmer, 2009). Cattle can become aggressive, and cows abort due to cerebral hypoxia associated with severe anemia. Mature cattle recovering from acute anaplasmosis are reservoirs for transmission of anaplasmosis to naïve cattle. Definitive diagnosis of acute *A. marginale* requires identifying the organism and a significantly low hematocrit. Differential diagnoses include babesiosis, bacillary hemoglobinuria, leptospirosis, and other liver conditions producing icterus (Palmer, 2009). In 2017 the Asian longhorned tick *Haemaphysalis longicornis* was detected in the United States. A subset of these ticks was PCR-positive for *Theileria orientalis* Ikeda. The Asian longhorned tick discovered in the U.S. is a competent vector for *T. orientalis* Ikeda, which clinically can mimic bovine anaplasmosis (Dinkel et al. 2021).

Reports in the literature associate the carrier state with cattle production loss; however, according to Palmer, 2009, "persistent infection is not associated with any disease or decrease in production status; therefore, no basis exists for a diagnosis of "chronic anaplasmosis." In a 1999 report to the International Livestock Research Institute, Nairobi, Kenya, surveying Africa, Asia, and

Australia, the general finding was that "Tick Worry" negatively affected production, not cattle persistently infected with *A. marginale.* My presentation will include a case report involving a Panamanian dairy that indicates cattle persistently infected with *A. marginale* had no production losses after addressing "Tick Worry" (McLeod and Kristjanson, 1999).

Treatment for acute bovine anaplasmosis centers on the parenteral use of injectable oxytetracycline. Continuous feeding of Chlortetracycline (CTC) can control active infection caused by *A. marginale* (Aubry and Geale, 2010). Therefore, continuous feeding of CTC to cattle for anaplasmosis control during the vector season is considered standard practice. However, continuous feeding of CTC can result in chemo sterilization, making infected animals susceptible to infection (Reinbold et al., 2010). There is also concern that strains of *A. marginale* may develop resistance to CTC. Therefore, a cookie-cutter program for control of *A. marginale* is unrealistic. Working with their veterinarians, Livestock producers need to develop control programs specific to their operation.

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Bovine Anaplasmosis

- Thomas B. Hairgrove
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Bovine anaplasmosis *A. marginale*

- Is this disease obsolete?
- Is the disease coming back, did it leave?
- Why the concern?
- How accurate are the antibody tests?
- Efficacy of Vaccination program?

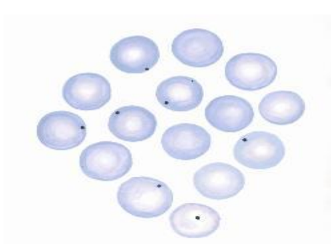
- Why does the disease appear to cycle?
- What is the value of feeding chlortetracycline?
- How do seedstock producers deal with anaplasmosis (If they are in endemic area, or if not and selling into an endemic area).
- How does ranching in an area where anaplasmosis is endemic affect production parameters?
- What is a cookie cutter program producers can adopt to control this disease?

Economic impact ?

- Often reported $300 M in United States. Do we know the economic impact?

What is *A. marginale*?

- Bacterial Rickettsia that infects and destroys red blood cells of cattle.



Clinical signs

- Causes anemia, fever, jaundice, and immune disorders.
- Young can be infected but not show disease-why??

Clinical signs

- **Results in abortions, death of adults and development of carrier cattle.**
- **<u>Carrier animals tend to recover and not show clinical signs.</u>**
- **<u>Effects of carriers on production.</u>**

How cattle become infected?

- **Transfer of red blood cells.**
- ***<u>Mechanical vector transfer.</u>***
- ***<u>Biological vector transfer.</u>***
- **Vertical transfer dam to calf.**
- **Incubation period variable.**

Ticks are Important

- **American Dog Tick**

- **Winter Tick**

- **Fever Tick**

Cattle and bovine anaplasmosis →

<u>Biological Vector ticks</u>
Number of ticks
3 host tick
1 host tick

<u>Mechanical Vectors</u>
Tabanid Flies
Needles
Surgical instruments

Cattle and Texas cattle fever (babesia) →

<u>Biological Vector ticks</u>
Number of ticks
1 host ticks

<u>Mechanical Vectors</u>
Not an issue

Asian Longhorned Tick

- *Haemaphysalis longicornis*
- Formerly in Southeast Asia, Asia and Australasia
- Found in Arkansas, Kentucky, New Jersey, New York, North Carolina, Virginia, West Virginia, Pennsylvania, Maryland and
- Not in Texas
- It is a parthenogenic (no males needed) three host tick with numerous hosts
- Tolerates a wide range of temperatures, dry periods and is long-lived
- Transmits several blood diseases
- Tags, injectables, and pour-on not as effective?

Theileria orientlis
Ikede

→

<u>Biological Vector ticks</u>
Asian Longhorn Tick
3 host tick
Parthenogenic development
produce all females
<u>Mechanical Vectors</u>
Tabanid Flies
Needles
Surgical instruments

People and flies are mechanical vectors, ticks are biological vectors

- The organism is maintained in the tick.
- Infuses organism when feeding tick waste in injected into the animal.

Tabanid flies

Horse flies-deer flies

- Horse flies

- Deer flies

Mouth parts

16 gauge needle

Producers, veterinarians

Importance of carrier state

- How animals become carriers.
- Mechanism of carrier state.
- Why important to understand?

How much is too much?

- In the initial disease 10-90% of RBCs can be parasitized.
- At least 15% RBCs parasitized before you see clinical signs.

Cyclic nature of bovine anaplasmosis

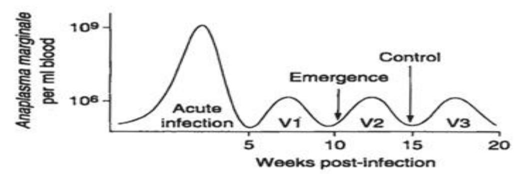


FIG. 2. The high *A. marginale* levels in acute rickettsemia (>10^9 ml^{-1}) are resolved after the development of a primary immune response, but the emergence of antigenic variants results in persistent infection. Persistence is characterized by sequential rickettsemic cycles, occurring at approximately 5-week intervals, in which new MSP2 variants replicate to a peak of >10^6 ml^{-1} and are then controlled by a variant-specific immune response. Variants arising in three sequential rickettsemic cycles are shown and are designated V1, V2, and V3. The points of variant emergence and variant control are designated for V2. (Reprinted from reference 125 with permission of the publisher.)

Kocan , K.M. et al, 2003

Need to understand the diagnostic tests

- Sometimes this is a disease of convenience?
- In animals showing clinical signs a blood smear is important?
- What is the accuracy of cELISA test?

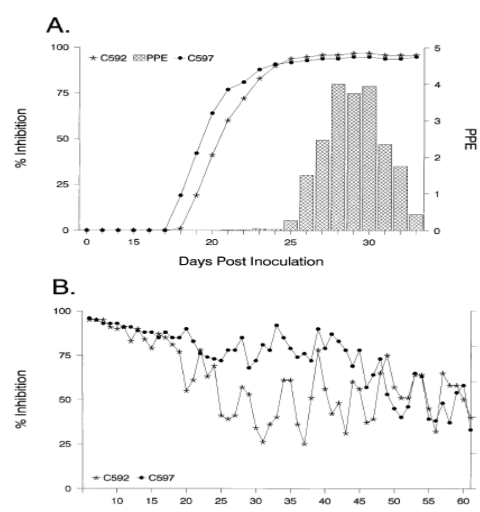
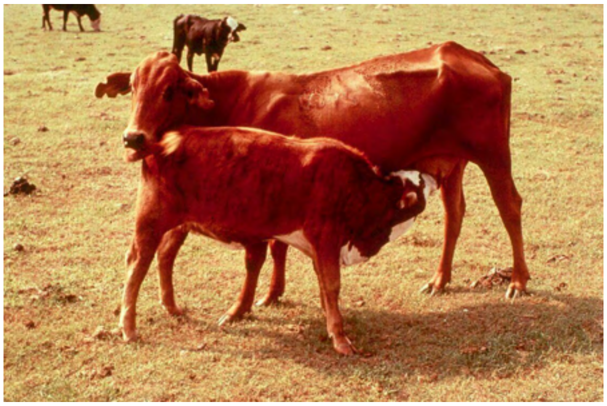


FIG. 3. Kinetics of anti-MSP5 antibody development in calves C592 and C597 over a 35-day period after exposure to infected *D. andersoni* ticks (A) and persistence of anti-MSP5 antibodies during weeks 6 through 61 (B). PPE data shown are means for C592 and C597 for each day.

Don't blame *A. marginale*



Common Reasons for Disease/vaccine failure

- *Poor nutrition program/protein/ energy/ minerals/water*
- Stressed/thin cows/*internal parasites*
- Water quality (increase pathogen load, runoff problems, blue green algae)

Often over diagnosed

- **Cows in poor body condition??**
- **Blood sample from carrier cow.**
- ***IMPORTANT*** **carrier cows can become acutely infected if immune system not functioning.**

Bovine anaplasmosis project

- **Three research questions**
- **1. Producer perceptions (As a rule anaplasmosis low on producer's radar in 2010).**
- **2. State prevalence.**
- **3. Herd prevalence.**

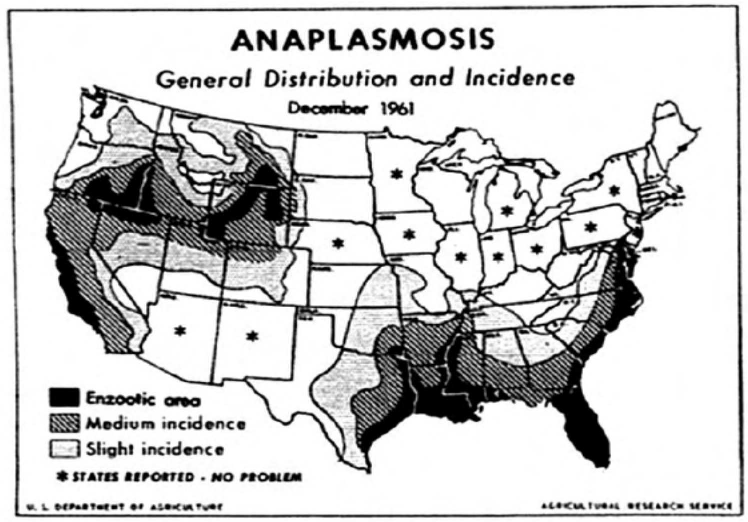
State Prevalence Study

- **Cooperation of Texas State Veterinarian.**
- **Thirty auction markets.**
- **July 2011, Last month first point testing for Brucellosis**
- **12,000 samples.**
- **2,000 random.**

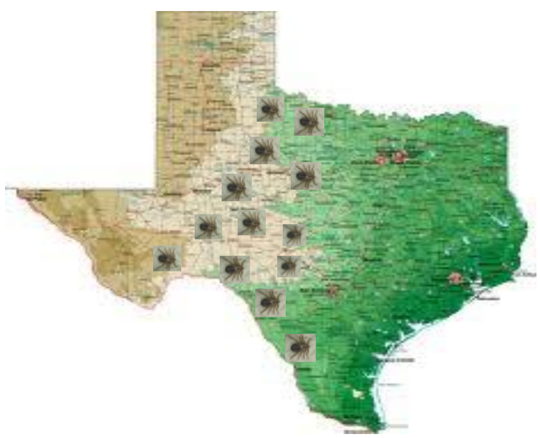
Market location

State Prevalence

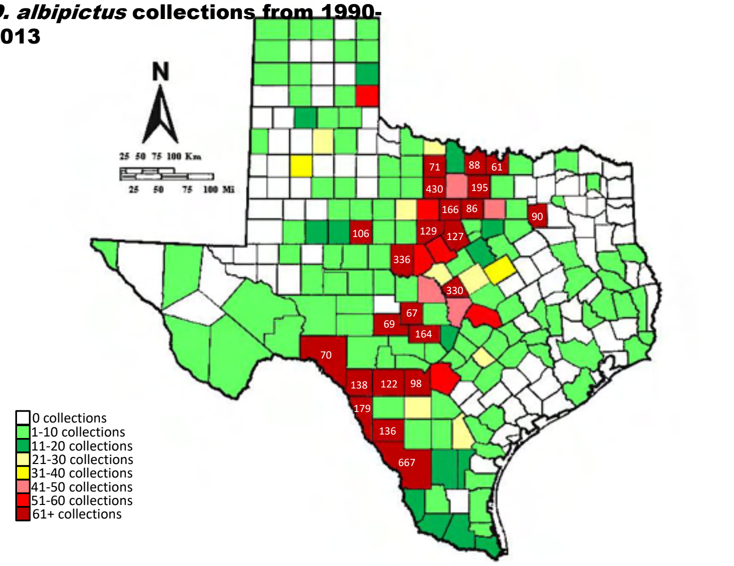
- Over-all 16%
- Rolling plains and Edwards Plateau 30-40%
- East Texas 7%
- A lot different than 1961



Winter tick range



D. albipictus **collections from 1990-2013**



Preliminary data

- **Higher prevalence west of I-35.**
- **Higher prevalence in bulls??**
- **Winter Tick (*D. albipictus*) appears important.**

In herd prevalence

- **Investigated in-herd prevalence very similar to livestock markets.**
- **Interestingly much higher prevalence (90%) in bulls than cows (25-30%)?**
- **Developed new PCR, testing alongside cELISA results demonstrated very high correlation between tests.**
-

Aids in control

- Know the status of your area, is Anaplasmosis common.
- Utilize oral tetracycline (CTC) during vector season.
- Tick control applied in the fall (Winter Tick in Texas).

Control continued

- VFD impacts control, 350 mg/calf/day <700#, .5 mg/pound/day in pasture animal > 700#
- How about vaccines? Provisional Mississippi Strain

Herd investigation in Central America

- Dairy 750 cow dairy.
- Importing cattle from North America, deaths began when began to export heifers >20 Months?

- They were treating animals in quarantine to clear the organism.
- Treating all cows as infected (Imidocarb).
- Significant mortality on some cattle (13% and 15% mortality).
- Genetic sequencing indicate *A. marginale* Brazilian strain.

- Prevalence of *A. marginale* 97.5% (200 cows).
- Major vector *R. microplus.*
- Prevalence of *Babesia bovis and B. bigemina* 84% (100 samples).
- Ultimately tick control using Cuban vaccine.

Other Tick Diseases Foreign or Emerging

- *Anaplasma phagocytophilum.*
- Bovine babesiosis.
- Equine babesiosis.
- Heart Water (Caribbean)
- *Theileria orientlis* Ikede

Questions/Comments

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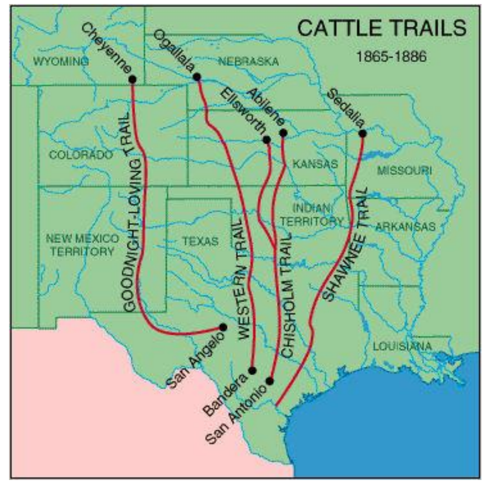

Courtesy Dr. Pete Teel

Integrated Tick Management - from Biosecurity to Control: The Value of "An Ounce of Prevention"

Samantha R. Hays and Pete D. Teel
Department of Entomology, Texas A&M AgriLife Research, College Station, TX

External parasites have been estimated to annually cost the US beef cattle industry $2.4 billion [8, 10] through the direct effects of parasitism, and an even greater cost when animal handling and tick treatment expenses are included. Direct production costs that accrue from tick parasitism include irritation, blood loss, weight loss, loss of body condition, and reduced reproductive capacity [4, 19, 23]. Additional indirect costs can accrue from the transmission of pathogens that result in tick-borne diseases. More than ten species of ticks with different seasonal activities provide year-round risk of tick infestation in the Southern Region [http://tickapp.tamu.edu; 20].

Most tick species that attack grazing cattle have either a three-host or one-host life cycle (Figure 1) in which the pattern of periods of blood-feeding (lasting days to weeks) on a host is followed by very long periods (months to years) off-host in rangeland habitats for molting, egg laying, and waiting for the next host encounter. There are several key features from these life cycles important to the prevention and/or management of ticks. The long periods of blood-feeding (days to weeks) provide opportunities for ticks to be transported to new locations. The off-host period of the life cycle can be greater than 95% of the entire tick generation time. Tick survivorship and population dynamics are affected by many factors including habitat types, host availability, and precipitation. Hot-dry weather patterns tend to suppress tick survivorship while cooler and/or wet weather patterns tend to increase tick survivorship. Most tick species produce one generation per year. Thus, tick abundance at a given time, is the result of cumulative factors occurring through the previous year.

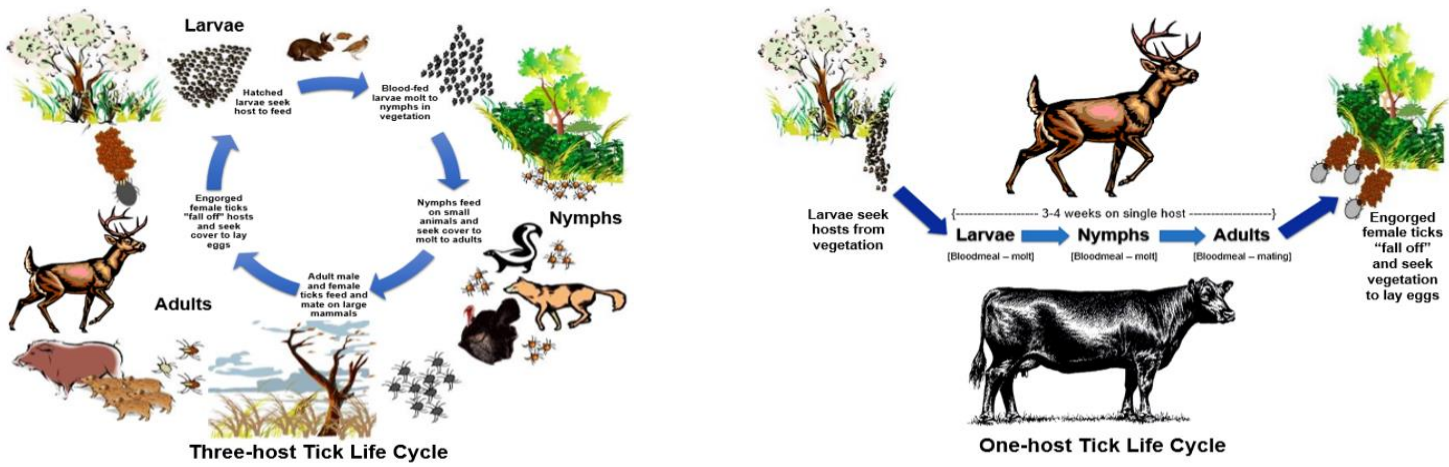

Figure 1. Left: Typical three-host tick life cycle exhibited by the Lone Star tick, Gulf Coast tick, American Dog tick, and Blacklegged tick. Right: Typical one-host tick life cycle exhibited by the Winter tick. From more information, please visit http://tickapp.tamu.edu/

Integrated Tick Management

Integrated management strategies have been developed for ticks [5, 23] that consider holistic approaches [17, 21] to the entire tick system and can be practiced in harmony with best practices for land stewardship, sustainability, and animal health. The holistic approach is based upon five parts: 1) biosecurity, 2) habitat/brush management, 3) forage/pasture management, 4) wildlife management, and 5) on-animal application of acaricides [5, 23]. Tick prevention starts in the environment and is aided with on-animal control methods [25].

1) **Biosecurity** – prevent introduction. This involves the isolation and/or treatment of new animals that were purchased to add to or rebuild a herd, or animals moved to other property locations and returned to main operation, as they can potentially introduce ticks and tick-borne pathogens into the home property and herd. These measures should include treating newly purchased animals for internal and external parasites and even quarantining them before introducing them into the existing herd [18, 21]. New animals should be quarantined for 21-30 days before introduction into the existing animal herds [27]. This can help prevent the introduction of ectoparasites like ticks, endoparasites, potential illnesses to your existing animal herd, even invasive plants. During the quarantine period, new animals should be checked for ticks and then treated with an acaricide. Isolation and/or treatment also includes native farmed wildlife or exotics being brought onto the property where cattle operations are located. If possible, all wildlife and exotics should be quarantined and examined for ticks and other external and internal parasites before being placed onto the property.

2) **Habitat/brush management** is often performed to increase forage production and control undesired woody species [2, 18]. Mowing grasses in pastures and reducing forbs eliminates suitable sites for ticks to search for hosts. Clearing the undergrowth of woody patches will allow increased air flow under larger woody species, decreasing humidity, which can help dry ticks out and kill them. This practice can also reduce tick populations by limiting vegetation habitats that support tick development and survivorship. Because ticks are susceptible to drying out, they are typically not found in sunny areas with lower cut grass; they are more often encountered in areas with higher canopy cover and decreased sunlight penetration through the canopy.

   Three main types of brush management:

   1) <u>Herbicides:</u> herbicide applications targeting woody plants can decrease the abundance and distribution of undesirable brush species thus, opening canopy and inherently reducing the off-host survival of some tick life stages [20, 22].
   2) <u>Mechanical removal:</u> mechanical removal of brush reduces vegetation density, helping reduce tick habitat and populations. Also, trimming tree branches and shrubs allows more sunlight into the environment which can reduce suitable tick habitats and tick survival.

3) Prescribed fire: also known as prescribed burning, is a recognized method of controlling some tick species and internal parasites [7, 11, 16, 20, 24]. When a prescribed burn is implemented, ticks can be killed directly through incineration [16]. Prescribed burns that are slow moving can generate temperatures necessary to physically damage or kill ticks on improved pastures and rangelands [20]. Prescribed fire is also known to influence how cattle use a landscape [1]. Additional benefits of prescribed fire as a management tool include the removal of undergrowth, leaf-litter, and shrub vegetation which renders the soil-vegetation interface less hospitable for tick survival while off the host [20, 24].

3) **Forage/pasture management** should include grazing or pasture rotations, fencing, and strategic placement of supplemental feed and water [18, 23]. Grazing or pasture rotations change availability of animal hosts to ticks actively searching for a host. Fencing can be used to prevent or limit access by stray animals and certain wildlife species onto properties that can serve as tick hosts [9]. Moving fence lines 10 feet from the edge of the woods and keeping vegetation in those corridor areas mowed short and free of debris can prevent tick movement toward pastured animals. Eliminating brush and woody debris like fallen branches from the perimeter of pastures can reduce small mammal habitat, which in turn reduces immature tick hosts. Pasture modifications can be made to reduce contact animals have with wooded perimeters where ticks are often found. It is not necessary to chemically treat pastures for ticks [25]. However, if pastures include wooded edges, these areas can be treated with acaricides to reduce tick presence [25]. Locations of water and supplemental feed can modify the spatial aspects of cattle use and selection (cattle distribution, forage utilization, and travel patterns) [3, 6, 12, 13, 14]. These spatial modifications can influence the exposure of cattle to ticks and how infested cattle redistribute ticks in a landscape. Additionally, weather can influence the use and selection of patches within a landscape. Cattle are more likely to seek out shade (resting site) during the heat of the day, while in the early mornings or late evening they will be found grazing (feeding site). Temporal changes in pasture site use and selection can be as short as within an hour, to a whole day, or longer in duration when periods of drought exist and can vary greatly from season to season. Each landscape is different and thus cattle usage and selection in space and time will vary from property to property. Knowing how cattle use and make selections within a landscape both spatially and temporally can help in the development of targeted grazing and pasture management practices.

4) **Wildlife management** in cattle grazing systems includes managing wildlife diversity and populations at levels that minimize contributions to tick populations. Avoid overabundance of native and/or exotic hoofstock in cattle grazing systems. Recognize that native and exotic hoofstock serve as hosts to both immature and adult ticks, all contributing to sustainability and/or increase in tick populations. There are no practical acaricide applications for wildlife. Be sure to check animals for ticks right after harvest to avoid transporting ticks with the harvested animals to another location. Ticks will detach and leave a dead host as the body cools.

5) **Acaricide application** for treatment of infested livestock focuses on tick suppression during that brief period of the tick life cycle when seasonally active ticks are obtaining a blood meal. Remember: *Treating livestock with acaricides only attacks a small window of the tick's life cycle (<2%)!!* Acaricide applications should not be used as a cure-all solution for tick control and management. It is important to always read and follow the manufacturer's label recommendations concerning safety restrictions, dosage, and application when working with acaricides. Frequent and continuous application of chemicals on animal hosts is not sustainable on disease, environmental, or economic grounds [15]. Acaricides for beef cattle application can be found in Table 1.

Important decisions to be considered to achieve maximum value in tick suppression using acaricides:

1) Choice of acaricide chemical class (active ingredient):
   - Organophosphates (e.g., chlorphenvinphos, coumaphos, diazinon, dioxathion)
   - Carbamates (e.g., carbaryl)
   - Pyrethrins/synthetic Pyrethroids (e.g., permethrin, decamethrin, deltamethrin, cyhalothrin, cyfluthrin, and flumethrin)
2) Formulation and Method of Delivery:
   - Sprays and Dips
   - Ear Tags
   - Dusts and Dust Bags
   - Backrubbers and Facerubbers
   - Pour-on and Spot-on
   - Aerosol Spray
   - Environment
3) Timing of Application:
   - The timing of application relies on what tick species needs to be controlled and when that tick species is seasonally active (obtaining a bloodmeal from the host = approximately 2% of a tick's life cycle).
4) Preferred feeding sites of ticks on animal hosts (important to concentrate control and for inspection):
   - Head: nostrils/muzzle, eyes, ears (in and around the ears), poll.
   - Body: throat, dewlap, breast/brisket, belly, scrotum flank, tail head and down to udder region.
   - Legs: forearms/armpits, between toes or hooves.

Table 1. Labeled acaricides for tick control in beef cattle operations. ***Mention of a product is not an endorsement by the authors or by Texas A&M AgriLife***

Application Type	Instructions	Acaricide
Sprays and Dips	Sprays: Treat with hand pump sprayer or large mounted sprayer. Use enough water to cover the animal thoroughly to run-off. Does not provide long-term control. Have no residual effect and need to be applied weekly to be effective. Dips: Effective and ensure good coverage by wetting the animal thoroughly.	Co-Ral 6.15%
		Permectrin II
		GardStar 40% EC
		Atroban 11% EC
		Permethrin EC Spray
		Starbar E-Pro (36.8%)
		Permectrin CDS 7.4%
		Prolate/Lintox HD
		Ravap E.C. Spray
		Permectrin S 1.0%

Ear-Tags	Plastic device in animal's ear. Dispenses acaricide over time.	XP820 Insecticide Cattle Ear Tag
		Corathon Insecticide Cattle Ear Tag
		CyLence Ultra Insecticide Cattle Ear Tags
		OPtimizer Insecticide Ear Tag
		Patriot Insecticide Ear Tag
		Warrior Insecticide Ear Tag
		Saber Insecticide Ear Tag
		Permethrin Insecticide Ear Tag
		Gard Star Plus
		Dominator Insecticide Ear Tag
		PYthon Magnum Insecticide Ear Tag
		Tri-Zap Insecticide Cattle Ear Tag
Dusts and Dust Bags	Hand shakers or self-treatment dust bags. Non-invasive. Placement for self-use essential.	Permethrin 0.25% Dust
		Co-Ral Livestock Dust, ProZap Zipcide Dust 1%
		PYthon Dust 0.075%
Backrubbers and Facerubbers	Self-treatment. Non-invasive. Placement for self-use essential.	Permectrin II
		Co-Ral Fly and Tick Spray
Pour-on and Spot-on	Applied down animal's backline. Chemical absorbed through skin and circulated through animal's system.	Atroban DeLice 1% Pour-on
		Brute Pour-on 10%
		Ultra-Boss Pour-on 5%
		Permectrin S
		Permectrin CDS
		Clean-Up II
Aerosol Spray	Spray onto ticks in/outside of ear.	Prozap Screw Worm Ear Tick Aerosol
Environment	Follow label instructions for pasture and rangeland applications, including precautions for pollinators such as bees.	Seven SL
Information in this table was collected from: https://tickapp.tamu.edu ; https://livestockvetento.tamu.edu/tick-insecticides/ ; http://agrilife.org/livestockvetento/files/2010/10/Managing-External-Parasites-of-Texas-Cattle.pdf ; https://www.veterinaryentomology.org/vetpestx ; https://extension.uga.edu/content/dam/extension/programs-and-services/integrated-pest-management/documents/handbooks/2022-comm-chapters/Animals.pdf		

FOLLOW THE LABEL DIRECTIONS! Acaricides must be used in the manner prescribed or consistent with the label instructions.

Store pesticides safely. Keep acaricides locked up and beyond the reach of children and animals. Keep acaricides in their original packaging with the label securely affixed. Storage areas should be clearly marked and locked. Do not store pesticides with food, feed, veterinary supplies, or personal protection equipment. Do not store pesticides in areas exposed to excessive heat (summer) or cold (winter). Unused acaricides should be stored in their original container or package.

Always wear the proper personal protection equipment (PPE) described on the acaricides label. This is a legal requirement and greatly reduces your personal risk of exposure from mixing or applying pesticides.

Measure pesticides carefully. Mix no more pesticide than you need.

Dispose of acaricide waste properly. Refer to the acaricide label for proper disposal protocols.

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Ticks as Vectors of Livestock Disease Pathogens

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Agents that cause disease among animals are called pathogens. Some pathogens can be transmitted through direct contact between animals, such as respiratory viruses. Other pathogens need the help of a vector to move infected blood, tissue, or other material from a donor carrier animal to a non-infected animal. Ticks, biting flies and mosquitos commonly visit multiple animals and are recognized as vectors. We divide vectors into two groups based upon the type of pathogen transmission. Vectors that transfer pathogens directly from one animal to another without the pathogen undergoing growth or transformation are known as *Mechanical Vectors*. Vectors that transmit pathogens following infection and multiplication in the vector are known as *Biological Vectors*. Ticks are recognized as effective and significant biological vectors of disease pathogens affecting livestock, wildlife, companion animals and humans. Ticks may acquire a pathogen when feeding on an infected host at any developmental stage (larva, nymph, or adult), the tick then falls off the host when completing the bloodmeal, during the molt transition the pathogen multiplies, the tick completes molting to the next stage and gets on the next host ready to transmit the pathogen. Adult ticks that became infected through feeding as nymphs may survive in the environment more than one year in optimal habitat. Adult ticks can acquire pathogens during blood feeding which survive through the egg stage to infect the next generation of tick larvae which then vector the pathogen to hosts of the next tick generation. The number of tick species involved as biological vectors and routes of transmission of a particular tickborne pathogen varies.

Example 1: Bovine anaplasmosis, causal agent *Anaplasma marginale*. Within the 5-state area of the Beef Cattle Short Course, the most important tick vectors of *A. marginale* are *Dermacentor variabilis*, called the American dog tick, and *Dermacentor albipictus*, the winter tick. As noted in Table 1, *D. variabilis* is a 3-host tick active from spring to fall and *D. albipictus* is a 1-host tick active fall-winter-spring. Within the region there are areas with overlapping populations of both tick species and where *A. marginale* is present. Transmission of *A. marginale* by *D. variabilis* is primarily through transstadial transmission and potentially by infected adult male ticks that move from host to host. Transmission by *D. albipictus* can be through infected ticks dislodged (groomed off) from their initial host and subsequently attach to a second non-infected host. Transmission by host-to-host movement of infected adult male ticks is also possible. Management of tick vectors should be part of overall herd management for bovine anaplasmosis. Management should also include best practices to prevent infections resulting from fomites (e.g., needles, ear tag applicators, tattoo applicators, dehorning devices, nose tongs and castration equipment).

Example 2: Bovine theileriosis, causal agent *Theileria orientalis* Ikeda. The only recognized tick vector of this pathogen to-date is *Haemaphysalis longicornis*, the Asian longhorned tick. It has spread to 19 states since its discovery in 2017, including detection in two counties in NW Arkansas. Cases of *T. orientalis* Ikeda in the US have now been detected in eight states (VG, WV, NY, KY, KS, NC, PA, MD). Transmission is accomplished by transstadial tick transmission. Note from Table 1 that *H. longicornis* is a 3-host tick, and that the population of this tick in the USA does not contain males (parthenogenic reproduction). Tick activity extends from spring to fall. *H. longicornis* has a wide host range and can build high populations quickly. Tick control is a key part of management of both ticks and theileriosis. Cattle have been detected with co-infections of *A. marginale* and *T. orientalis* in areas where bovine anaplasmosis was already endemic. *H. longicornis* is not a vector of *A. marginale*, thus co-infections result from complex multiple tick sources of infection.

Example 3: Bovine babesiosis, causal agents *Babesia bigemina* and *B. bovis*. The only vectors of these pathogens are the two 1-host cattle ticks, *Rhipicephalus (Boophilus) annulatus* and *R. (B.) microplus* (Table 1). The US Cattle Fever Tick Eradication Program eliminated the threat of these pathogens by removing the threat of the two vectors (there are no anti-babesia drugs or vaccines available for use in the USA). However, both tick species and pathogens remain endemic to Mexico with constant risks of becoming re-established in the USA.

Vigilance of the cattle industry and state-federal regulatory programs is essential to sustain the national benefits of eradication. Transmission of these pathogens can be by transstadial transmission, by transovarial transmission to the next tick generation, and by movement of infected male ticks between cattle. These ticks are active year-round and will complete their life cycle on cattle, equine, white-tailed deer and nilgai antelope. To-date, cattle are the only host to become infected with these pathogens. Tick infested cattle and property are subject to quarantine and eradication procedures under state-federal regulation.

Best Practices for Prevention & Management of Ticks and Tickborne Diseases:

1. Prevent the spread of tick infested and/or tickborne disease-infected animals (livestock or wildlife).
    a. Recognize that moving animals (livestock & wildlife) between properties of any distance risks likelihood of moving ticks.
    b. Recognize that purchase and introduction of new animals also poses risks for introductions.
    c. Practice temporary quarantine of animals for inspection and treatment before mixing into main herds.
    d. Prevention is critical to the biosecurity and economic sustainability of any cattle enterprise.
2. Actively manage integrated control of ticks and tick populations on your premises and animals.
    a. Integrated Tick Management will be the focus of a companion presentation and proceedings article by Samantha Hays & Pete Teel.
3. Learn which species are present, their host range and cattle impacts.
    a. Routinely inspect animals for ticks.
    b. Routinely collect ticks for identification.
        i. When needed, seek assistance from Texas A&M AgriLife or Texas Animal Health Commission offices for assistance with identification.
    c. Identify Integrated Tick Management practices that fit into your enterprise to prevent and control ticks.

Climates of the region encompassing Arkansas, Louisiana, New Mexico, Oklahoma, and Texas are highly variable and range from the Gulf Coast inland to the Ozarks, to the high plains and west to the Rocky Mountains. At least one or more tick species is prevalent in these states whose existence is supported by the patterns of weather, environmental conditions, and hosts (both livestock and wildlife). The interactions of ticks-hosts-habitat-climate provide the basis for the spread and sustaining support of tick populations in traditional and new areas. In the last few decades, we have observed changes in tick distributions that can be attributed to shifts in wildlife patterns, spread of invasive feral swine, among other factors.

In a separate proceedings paper, we cover in detail the life cycle types of ticks, their importance to cattle production, health and well-being and aspects of Integrated Tick Management that can be considered to prevent bringing ticks into an operation, and to control ticks affecting an operation that are in harmony with land stewardship, sustainability, and animal health best practices.

A general summary of common ticks that can be found in this region is provided in **Table 1**. This is not intended to be location specific, but to provide a guide to the common and invasive species of ticks known to attack cattle in each state, and to provide information with respect to risks associated with livestock and wildlife across the region. Our session presentation will provide an updated overview of tick species specifically related to the transmission of the pathogens causing bovine anaplasmosis, babesiosis and theileriosis.

Ranchers and others who work on rangeland landscapes are reminded to be aware of the risks of tick bite and tick-borne diseases of humans, recognize the importance and practice of tick bite prevention, and what signs mean seek medical help if a tick-borne disease is suspected (Ticks | Ticks | CDC ; The TickApp for Texas and The Southern Region - Home (tamu.edu)).

Table 1. Summary of generalized characteristics of common and invasive ticks that attack cattle in the region of Arkansas, Louisiana, New Mexico, Oklahoma and Texas.

Common Name and Scientific Name	Distribution by State	Life Cycle Type	Parasitic Stage Found on Cattle	Primary Body Areas	Typical Season of Tick Activity
Lone Star Tick *Amblyomma americanum*	AR, LA, OK, TX	3-Host	Larvae, Nymphs, Adults	Dewlap, brisket, belly, scrotum/udder, escutcheon, tailhead, leg auxiliaries	Spring-Summer-Early Fall
Gulf Coast Tick *Amblyomma maculatum*	AR, LA, OK, TX	3-Host	Adults	Ears, poll, eyes	AR-TX-LA – May to September OK – March to June
Cayenne Tick *Amblyomma mixtum*	TX	3-Host	Larvae, Nymphs, Adults	Dewlap, brisket, belly, scrotum/udder, escutcheon, tailhead, leg auxiliaries	Year round – southern TX
Winter Tick *Dermacentor albipictus*	AR, LA, NM, OK, TX	1-Host	Larvae, Nymphs, Adults	Dewlap, brisket, belly, scrotum/udder, escutcheon, tailhead, leg auxiliaries	Fall-Winter-Spring (October to March)
American Dog Tick *Dermacentor variabilis*	AR, LA, NM, OK, TX	3-Host	Adults (immatures unknown)	Dewlap, brisket, belly, scrotum/udder, escutcheon, tailhead, leg auxiliaries	Spring-Summer-Early Fall
Asian Longhorned Tick *Haemaphysalis longicornis*	AR	3-Host Parthenogenic Reproduction	Larvae, Nymphs, Adult Females	Dewlap, brisket, belly, scrotum/udder, escutcheon, tailhead, leg auxiliaries, head	Spring-Summer-Fall
Blacklegged Tick *Ixodes scapularis*	AR, LA, NM, OK, TX	3-Host	Adults	Dewlap, brisket, belly, scrotum/udder, escutcheon, tailhead, leg auxiliaries	Fall-Winter-Spring (October to March)
Spinose Ear Tick *Otobius megnini*	AR, LA, OK, TX	Modified 1-Host	Larvae, Nymphs 1 & 2	Inner cavity of outer ear	Year round
Cattle Tick* *Rhipicephalus annulatus**	TX – At risk AR, LA, OK	1-Host	Larvae, Nymphs, Adults	Dewlap, brisket, belly, scrotum/udder, escutcheon, tailhead, leg auxiliaries, head	Year round
Southern Cattle Tick* *Rhipicephalus microplus**	TX – At risk AR, LA, OK	1-Host	Larvae, Nymphs, Adults	Dewlap, brisket, belly, scrotum/udder, escutcheon, tailhead, leg auxiliaries, head	Year round
Brown Dog Tick *Rhipicephalus sanguineus*	AR, LA, NM, OK, TX	3-Host	Adults (immatures unknown)	Dewlap, brisket, belly, scrotum/udder, escutcheon, tailhead, leg auxiliaries	Spring-Summer-Early Fall

*Discovery of the Cattle Tick and/or Southern Cattle Tick subject infested animals and land to quarantine and eradication procedures as implemented in the US Cattle Fever Tick Eradication Program (See: Cattle Fever Ticks Fact Sheet (texas.gov) and bro-cft-treatment-options.pdf (usda.gov))

Further Reading:

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