Slide 1

Exotic Ticks

Amblyomma variegatum
Amblyomma hebraeum
Rhipicephalus microplus
Rhipicephalus annulatus
Rhipicephalus appendiculatus
Ixodes ricinus

Slide 2

Overview

- Organisms
- Importance
- Disease Risks
- Life Cycle
- Identification
- Geographic Distribution
- Prevention and Control
- Recommended Actions

In today's presentation we will cover information regarding exotic ticks and the diseases they can transmit. We will also talk about how to identify exotic ticks, and the impact these ticks have had in the past and could have in the future. Additionally, we will talk about how exotic ticks are transmitted and the species they affect. Finally, we will address prevention and control measures, as well as actions to take if exotic ticks are suspected.

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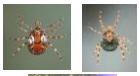
Exotic Tick Species

Tick	Male	Female
Amblyomma hebraeum (bont tick)		
Amblyomma variegatum (tropical bont tick)		
Ixodes ricinus (the castor bean tick)		

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Exotic ticks are ticks that are not found in the United States. These Important tick species (and the diseases they carry) are a risk for introduction into the U.S. These ticks include *Amblyomma hebraeum*, the bont tick (Source: forestry images.org), *Amblyomma variegatum*, the tropical bont tick (Source: Wikimedia Commons), *Ixodes ricinus*, the castor bean tick (Source: sciencedaily.com)…. (continued on next slide)

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Exotic Tick Species

Tick	Male	Female
Rhipicephalus (Boophilus) annulatus (American cattle tick)		
Rhipicephalus (Boophilus) microplus (Southern cattle tick)		
Rhipicephalus appendiculatus (brown ear tick)		

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Rhipicephalus (formerly *Boophilus*) *annulatus*, the American cattle tick (Source: tickapp.tamu.edu),*Rhipicephalus* (formerly *Boophilus) microplus*, the Southern cattle tick (Source: tickapp.tamu.edu), and *Rhipicephalus appendiculatus*, the brown ear tick (Source: Wikimedia Commons).

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Importance

- Tick bites
  - Irritating, painful
  - Secondary infection, infestation
  - Hide damage, anemia
- Exotic disease agents
  - May be carried by exotic ticks
  - Biological vector
  - Mechanical vector

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Tick bites can be irritating and/or painful. They also provide entry points for secondary bacterial invaders or screwworms. Heavy infestations can damage hides and may cause anemia, particularly when the animal is in poor condition. *Rhipicephalus appendiculatus*, the brown ear tick, damages the ears of cattle and other livestock, and some species of ticks cause tick paralysis. However, the most important risk with the introduction of exotic ticks is that they may carry the agents of exotic diseases. The greatest danger is when the tick acts as a biological vector, but pathogens carried mechanically can be introduced if they survive long enough.

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Disease Risks

- *A. variegatum, A. hebraeum*
  - *Ehrlichia ruminantium*
  - *Rickettsia africae*
- *I. ricinus*
  - *Babesia divergens*, louping ill, tick-borne encephalitis virus
- *R. appendiculatus*
  - *Theileria parva* (East Coast fever)
  - Nairobi sheep disease

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A. variegatum and *A. hebraeum* can transmit *Ehrlichia ruminantium* (formerly *Cowdria ruminantium*), the agent of heartwater. These ticks can also carry *Rickettsia africae*, which causes African tick-bite fever, and other disease agents. *I. ricinus* transmits a number of pathogens including *Babesia divergens* (babesiosis), louping ill virus and tick-borne encephalitis virus, which are exotic to the Americas. *Rhipicephalus appendiculatus* can carry *Theileria parva*, the cause of East Coast fever, as well as Nairobi sheep disease virus and other disease agents.

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Disease Risks

- *R. microplus, R. annulatus*
  - Babesiosis
    - *Babesia bigemina*
    - *Babesia bovis*
  - Anaplasmosis
    - *Anaplasma marginale*

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R. microplus and *R. annulatus* are particularly important in transmitting babesiosis, which is caused by *Babesia bigemina* and *Babesia bovis*, and anaplasmosis, caused by *Anaplasma marginale*. Babesiosis or "cattle fever" was eradicated from the United States between 1906 and 1943, by eliminating these vectors. *R. annulatus* and *R. microplus* still exist in Mexico and further south, and a permanent quarantine zone is maintained along the U.S./Mexican border to prevent their reintroduction. This image shows the permanent quarantine "buffer" zone between Texas and Mexico—a country where these ticks remain well established. Today, this buffer zone extends over 500 miles from Del Rio, Texas, to the Gulf of Mexico. [Image: USDA APHIS].

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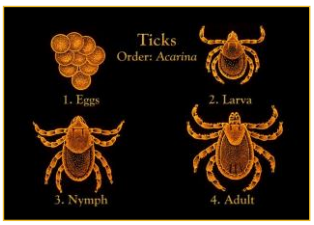
Life Cycle



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Ticks pass through four life cycle stages. Although ticks have host preferences, which may vary with the life stage, most species will feed on a wide variety of wild and domesticated animals, as well as humans.

[Photo: Morphologic features associated with the four life cycle stages through which a tick passes on its way to adulthood. Source: CDC Public Health Image Library.]

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Three-Host Ticks

- Found on host during feeding
- Develop to next stage on ground
- Larvae, nymphs, adults
  - All require blood meal
- Eggs deposited in environment
- Host species
  - Immature ticks: small mammals, birds
  - Adult ticks: large mammals

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Amblyomma variegatum, *A. hebraeum*, *I. ricinus* and *R. appendiculatus* are 3-host ticks. Three-host ticks can be found on the host while they feed, then they drop to the ground to develop to the next stage. Larvae, nymphs and adults all require a blood meal. Once the adult female has fed and mated, she deposits her eggs in the environment. The life cycle for *Amblyomma variegatum*, *A. hebraeum* and *I. ricinus* usually takes more than a year, and up to a few years, to complete. Immature *Amblyomma* spp. and *I. ricinus* tend to be found on smaller mammals, birds and reptiles, while the adult stages usually feed on large mammals including livestock and wildlife. *R. appendiculatus* can complete one to three life cycles in a year, depending on the environment. This tick mainly infests cattle, buffalo and large antelope, but it can occur on other species including sheep and goats. Immature ticks may also be seen on small antelope, carnivores, hares and other species. Adult *R. appendiculatus* prefer to feed in the ears, but some are found on the head. Immature stages feed in the ears, on the head, and on the legs. Large numbers of ticks may be found on an animal, and heavy infestations can damage the ears.

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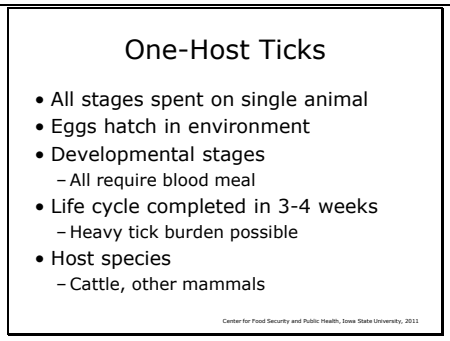

Rhipicephalus microplus and *R. annulatus* are one-host ticks: all stages are spent on a single animal. The eggs hatch in the environment and the larvae crawl up plants to find a host. Newly attached larvae ("seed ticks") are usually found on the underside of the animal, particularly on the softer skin inside the thigh, flanks and forelegs. After feeding, the larvae molt twice, to become nymphs and then adults. Each developmental stage (larva, nymph and adult) feeds only once, but the feeding takes places over several days. Adult male ticks become sexually mature after feeding, and mate with feeding females. An adult female tick that has fed and mated detaches from the host and deposits a single batch of eggs in the environment. *R. microplus* and *R. annulatus* have a life cycle than can be completed in 3 to 4 weeks. This characteristic can result in a heavy tick burden on animals.

Cattle are the preferred hosts for *R. annulatus*. This tick is also found occasionally on other mammals, particularly large animals but also capybaras and other species. It rarely feeds on sheep and goats. *R. microplus* mainly infests cattle, deer and buffalo, but it can also be found on many other hosts including horses, donkeys, goats, sheep, pigs, dogs and wild animals.

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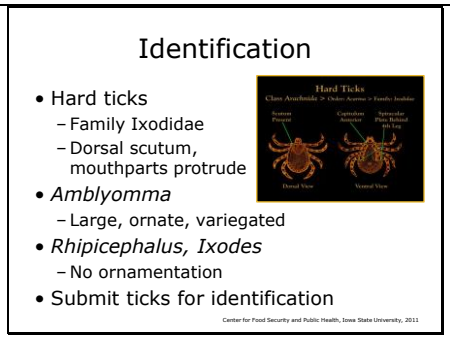

A. variegatum, A. hebraeum, R. microplus, R. annulatus, R. appendiculatus and I. ricinus are all members of the family Ixodidae (hard ticks). Hard ticks have a dorsal shield (scutum) and their mouthparts (capitulum) protrude forward when they are seen from above. *Amblyomma variegatum* and *A. hebraeum* are large, ornate, variegated ticks with long, strong mouthparts. The bodies of female *A. variegatum* are brown, but the males are brightly ornamented with orange. When they are engorged, adult female *A. variegatum* are about the size of a nutmeg. *Rhipicephalus* spp. and *Ixodes* spp. have no ornamentation and are less distinctive, but they may be identified at least to the genus level using tick keys. Tick identification to the species level can be difficult, and ticks should be submitted to an expert for identification or confirmation. Ticks that are submitted in 70% ethanol can be examined morphologically, and if necessary, tested by PCR. Both male and female ticks, and ticks from different life stages, should be submitted if they can be found.

[Photo: This drawing depicts an *Ixodidae* hard tick from the dorsal and ventral perspectives revealing its morphologic features. Source: CDC Public Health Image Library.]

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Geographic Distribution

- Tropics and subtropics
  - *A. variegatum, A. hebraeum*
  - *R. annulatus, R. microplus*
  - *R. appendiculatus*
- Widely distributed
  - *R. annulatus, R. microplus*
- Cool, humid areas (Europe)
  - *I. ricinus*

A. variegatum, A. hebraeum, R. annulatus, R. microplus and *R. appendiculatus* are found in the tropics and subtropics. *Amblyomma variegatum, A. hebraeum* and *R. appendiculatus* are endemic in Africa. *A. variegatum* has also been found in southern Arabia, and in the Caribbean and on some other islands. An eradication program is in progress in the Caribbean. *R. annulatus* and *R. microplus* are more widely distributed. *R. annulatus* is endemic in parts of Africa and Asia, the southern regions of the former U.S.S.R., the Middle East, the Mediterranean, Mexico and parts of South and Central America. *R. microplus* occurs in large areas of Asia, as well as in Madagascar, Latin America including Mexico, the Caribbean, and parts of Africa and Australia. *R. annulatus* and *R. microplus* have been eradicated from the U.S., but they can be sometimes found in Texas or California, in a buffer quarantine zone along the Mexican border. In contrast, *I. ricinus* is restricted to cool, relatively humid, shrubby or wooded areas. In addition to deciduous and mixed forests, this tick can be found in more open areas when the vegetation is dense and rainfall is abundant. It is endemic in most of Europe (with the exception of the Mediterranean region, which has a warm, dry climate). *I. ricinus* also occurs as far south as the Caspian Sea and northern Iran, as well as in northern Africa.

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Prevention and Control

- Exclude exotic ticks
  - Pre-export inspection of animals
  - Animals certified-free of ectoparasites
  - Quarantine upon entry
- Acaricide treatment
- Three-host ticks
  - Difficult to eradicate
  - Environmental control

Measures used to exclude exotic ticks from a country include pre-export inspection and certification that the animals are free of ectoparasites, quarantines upon entry, and treatment with acaricides. Three-host ticks spend at least 90% of their life cycle in the environment rather than on the host animal, and can be very difficult to eradicate once they have become established. [Photo: Feedlot cattle. Source: Renee Dewell/CFSPH.]

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Prevention and Control

- USDA APHIS Cattle Fever Tick Eradication Program
  - "Tick riders"
  - Cattle, horses
    - Inspection prior to being moved from the quarantine zone
    - Precautionary acaricide treatment
- Infested farms/ranches
  - Quarantined for 6 to 9 months

R. microplus and *R. annulatus*, which are one-host ticks, have been successfully eliminated from some countries. Eradication programs are based on animal identification and periodic acaricide treatment of livestock, as well as public education, surveillance, quarantines and movement restrictions. In the U.S., *R. microplus* and *R. annulatus* incursions are controlled by USDA APHIS Cattle Fever Tick Eradication Program personnel, including mounted inspectors called "tick riders." Tick riders patrol the Rio Grande river, inspect ranches in the quarantine zone, and apprehend stray and smuggled livestock from Mexico. Before being moved from the quarantine zone, cattle and horses must be inspected and given a precautionary treatment with acaricides. Farms and ranches with *R. microplus* or *R. annulatus* infestations are placed under quarantine for 6 to 9 months, depending on the time of the year.

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Prevention and Control

- Treatment options
  - Dip cattle
    - Intervals for 9 months
  - Treat until "tick free"
    - Two consecutive acaricide treatments
    - Remove animals from infected pastures
    - Pasture must remain free of livestock for 6 to 9 months

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A single acaricide treatment can destroy all of the ticks on an animal, but will not prevent reinfestation. There are two options for treating infested and exposed cattle. These animals may be dipped at regular intervals for nine months. Alternatively, they may be treated until they are "tick free" before two consecutive acaricide treatments, then removed from the infected pasture. The infested pasture must remain free of all livestock for 6 to 9 months or longer, to break the tick life cycle. [Photo: Cow walking through acaricide dip. Source: Scott Bauer/USDA]

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Prevention and Control

- In endemic areas
  - Acaricide treatment
    - Does not prevent reinfestation
  - Pasture rotation
  - Environment modification
  - Biologic and chemical control strategies
- Resistant breeds

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In regions where *A. variegatum, A. hebraeum, R. microplus, R. annulatus, R. appendiculatus* or *I. ricinus* are already endemic, control methods include acaricide treatment, pasture rotation, environmental modification, and integrated biologic and chemical control strategies. Acaricides can eliminate the ticks from the animal, but they do not prevent reinfestation and must be repeated periodically. Ticks can become resistant to these chemicals. The use of resistant breeds is an important means of tick control in some countries. European (*Bos taurus*) breeds of cattle usually remain fairly susceptible to ixodid ticks, even after multiple exposures. However, some cattle such as zebu (*Bos indicus*) or zebu crosses can become resistant to *B. microplus* after exposure. Vaccines against *R. microplus* may be available in other countries. [Photo: Cattle. Source: Megan Smith/CFSPH]

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Recommended Actions

- IMMEDIATELY notify authorities
- Federal
  - Area Veterinarian in Charge (AVIC)
    http://www.aphis.usda.gov/animal_health/area_offices/
- State
  - State veterinarian
    http://www.usaha.org/stateanimalhealthofficials.aspx
- Quarantine

If you suspect exotic ticks, state or federal authorities should be notified immediately. Animals suspected infested with exotic ticks should be isolated, and the farm should be quarantined until definitive diagnosis is determined.

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Additional Resources

- Center for Food Security and Public Health
  - www.cfsph.iastate.edu
- USAHA Foreign Animal Diseases ("The Gray Book")
  - www.aphis.usda.gov/emergency_response/downloads/nahems/fad.pdf

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Acknowledgments

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