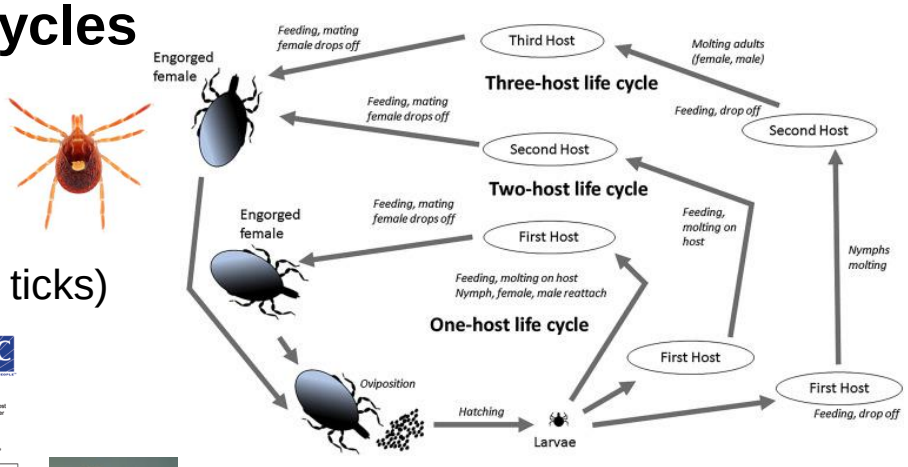
Biology of the Asian Longhorned Tick
Haemaphysalis longicornis

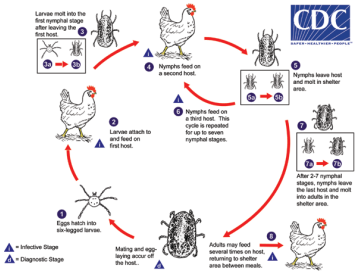
Wes Watson

NC STATE UNIVERSITY College of Agriculture and Life Sciences

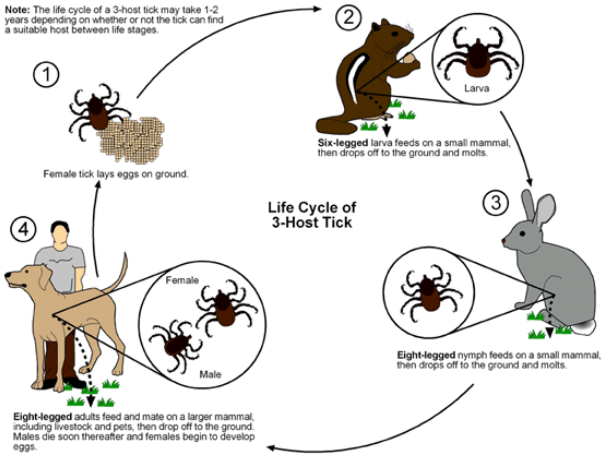
Tick Life Cycles

- Single host
- Two host
- Three host
- Many host (soft ticks)

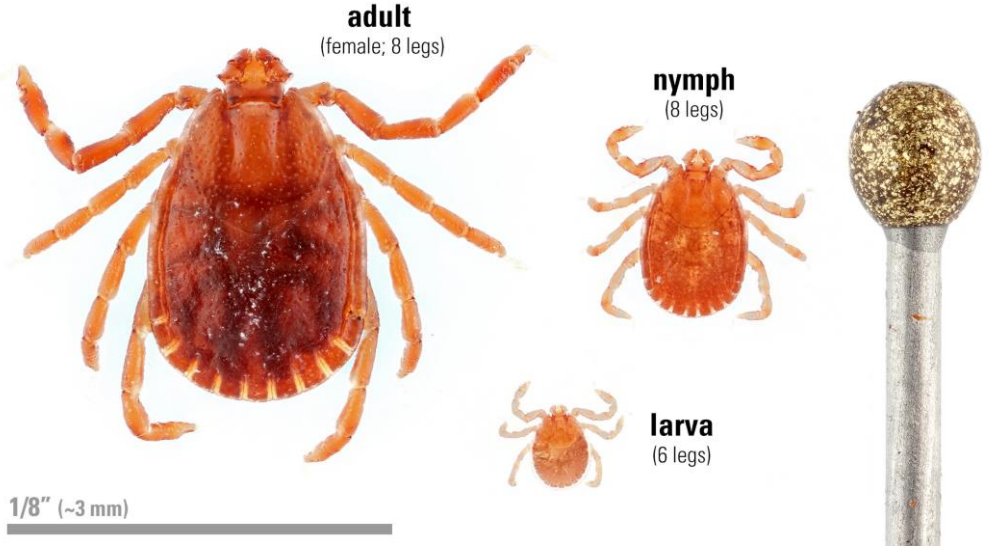




Generic Three-Host Tick Life Cycle



Significantly shorter life cycle for ALT



Hoogstraal et al. 1968. J. Parasitol. 54: 1197-1213

Parthenogenic = reproduces without mating (no males) Ave # eggs = 2024

Developmental Time

Tick Life Stage	Min. Days to Complete	Average days to Complete
Egg	24 days	27.5
Larva (rest & feed)	7 days	8.5
Molting to nymph	14	15.5
Nymph	7	7.5
Molting to adult	12	14
Adult	15	20
Total	79 days (11.3 wks)	89 days (12.7 wks)
First generation		5 months

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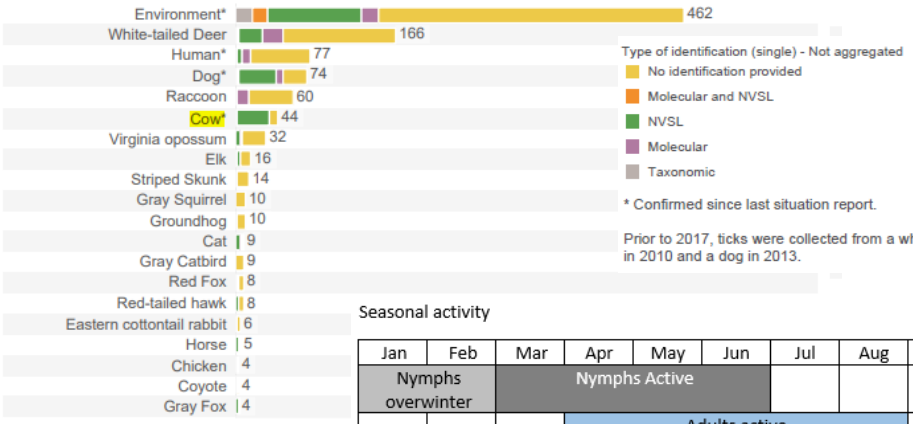
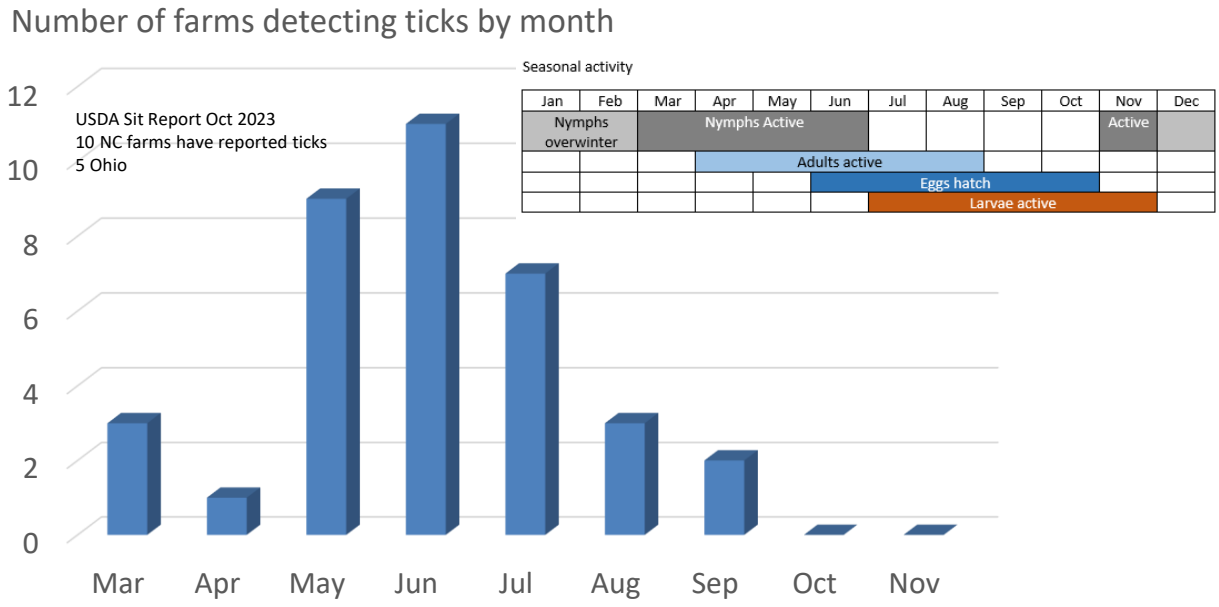
Asian longhorned tick positive hosts information

Number of positive hosts



Seasonal activity

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nymphs overwinter		Nymphs Active								Active	
			Adults active								
					Eggs hatch						
						Larvae active					



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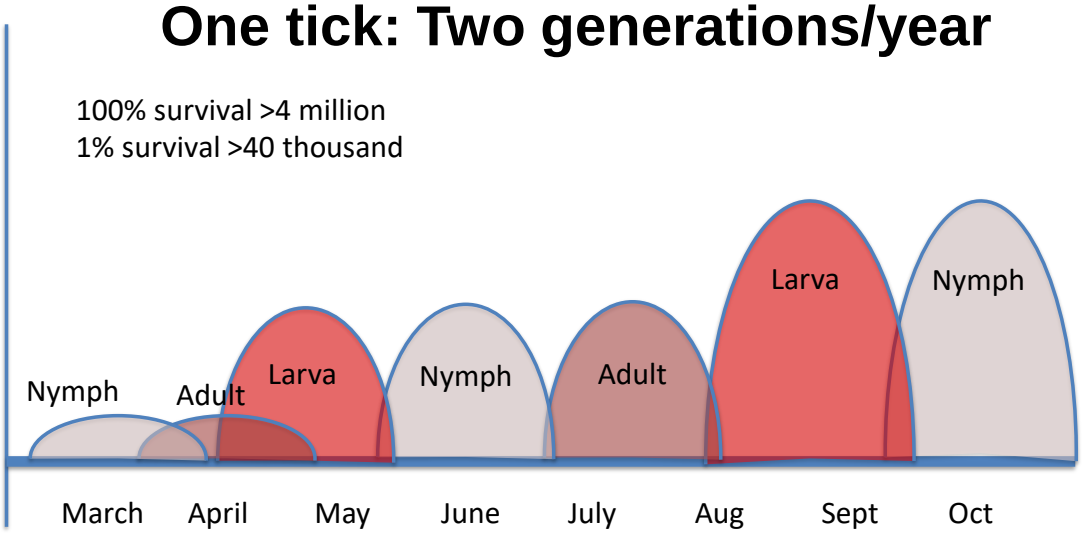
Factors impacting survival

- Available hosts
- Predators, parasites/pathogens
- Desiccation
- Heat
- Drought

One tick: Two generations/year



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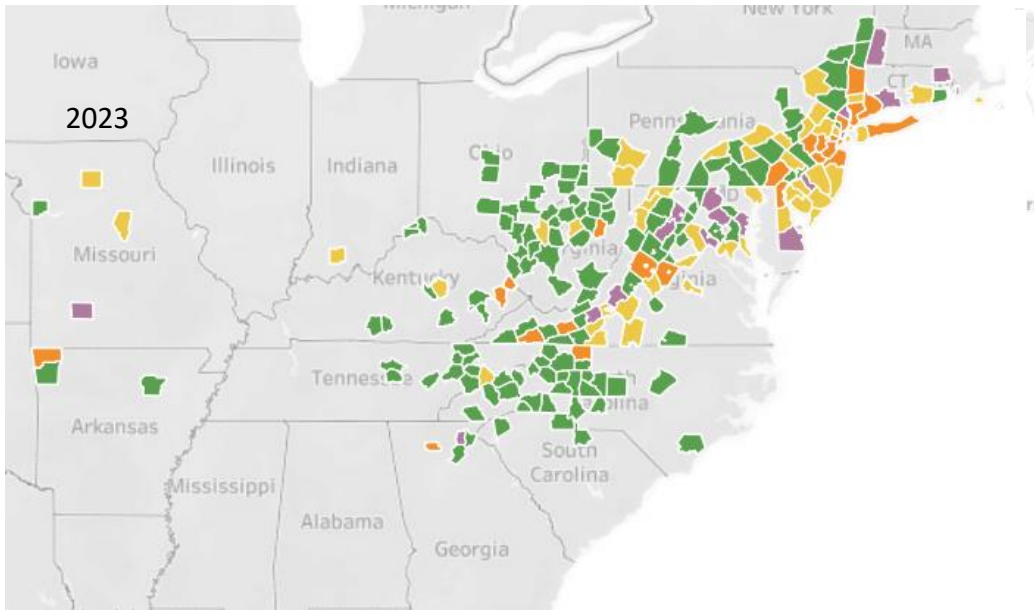
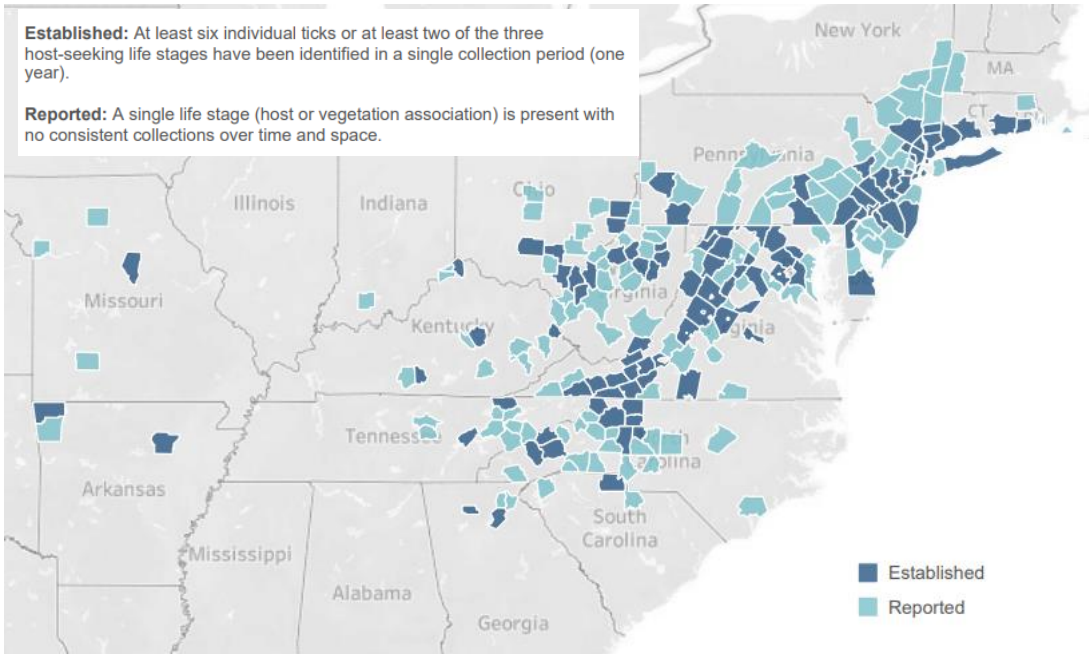
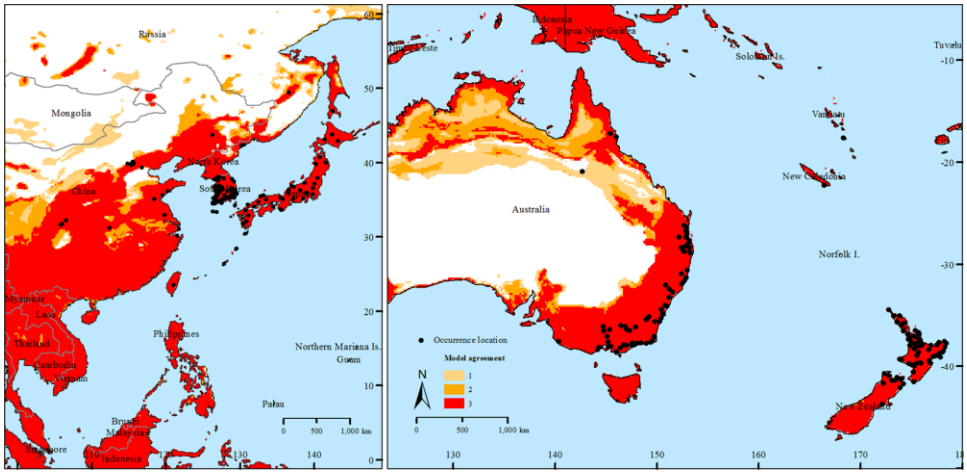
Spread of the Asian Longhorned Tick


2023
Iowa
Illinois
Indiana
Missouri
Arkansas
Mississippi
Alabama
Georgia
South Carolina
MA
CT


Established: At least six individual ticks or at least two of the three host-seeking life stages have been identified in a single collection period (one year).
Reported: A single life stage (host or vegetation association) is present with no consistent collections over time and space.
New York
MA
CT
Illinois
Indiana
Missouri
Arkansas
Mississippi
Alabama
Georgia
South Carolina
Established
Reported

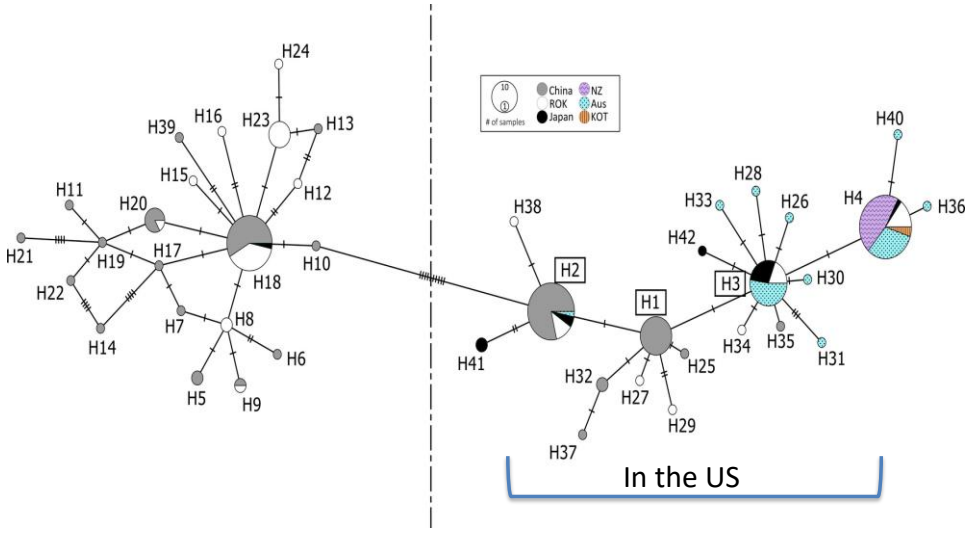
Previously Known Distribution

Native: China, Japan, Korea, Russia, & Taiwan
Invasive: Australia & New Zealand



Known occurrence locations (black dots) from Raghavan et al. 2019

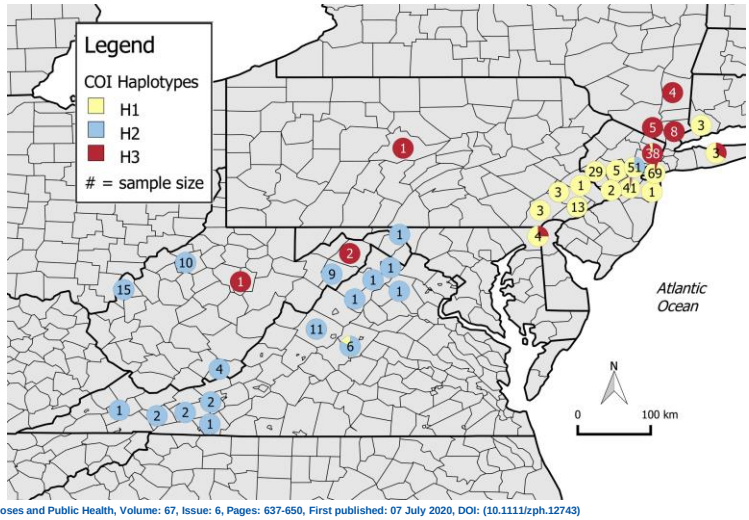
Egizi, A., Bulaga-Seraphin, L., Alt, E., Bajwa, W.I., Bernick, J., Bickerton, M., Campbell, S.R., Connally, N., Doi, K., Falco, R.C. and Gaines, D.N., 2020. First glimpse into the origin and spread of the Asian longhorned tick, Haemaphysalis longicornis, in the United States. *Zoonoses and public health*, *67*(6), pp.637-650.



Sequencing of mitochondrial cytochrome C oxidase (cox 1)

Potential sources
H1, H2, H3 in US
H4 in Aust & NZ
H1, H2 in China & Korea
H3 Korea, Japan, Aust & Tonga

Egizi, A., Bulaga-Seraphin, L., Alt, E., Bajwa, W.I., Bernick, J., Bickerton, M., Campbell, S.R., Connally, N., Doi, K., Falco, R.C. and Gaines, D.N., 2020. First glimpse into the origin and spread of the Asian longhorned tick, Haemaphysalis longicornis, in the United States. *Zoonoses and public health*, *67*(6), pp.637-650.



Zoonoses and Public Health, Volume: 67, Issue: 6, Pages: 637-650, First published: 07 July 2020, DOI: (10.1111/zph.12743)

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US Disease transmission by ALT

Disease	Detected in tick	Human	Animal	Transovarial	Transstadial	Trans Potential
Heartland virus	Y	Y	N	Y	Y	High
Rock Mt. Spotted Fever	Y	Y	Y	Y	Y	High
Lyme Dis	Y	N	N	N	N	Low
Human Anaplasmosis	Y	N	N	N	Y	Low
Theileria	Y	N	Y	N	Y	High

https://fonseca-lab.com/research/global-health-the-tick-that-binds-us-all/

Theileria orientalis

- Clinically like Anaplasmosis
  - Anemia, lethargy, fever, jaundice, ventral edema
- Sept to Nov and Apr to June
- Persistent infection
- No approved treatment in the US

Kevin Lahmers, VT

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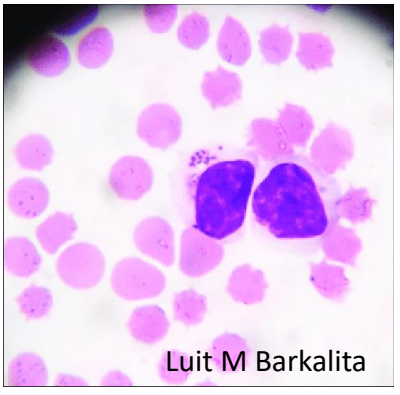
Theileria genotypes



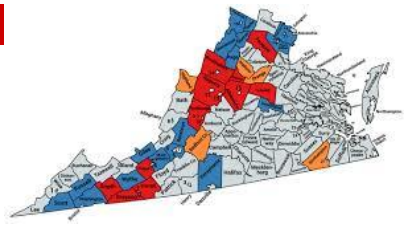
Luit M Barkalita

- *T. orientalis* Ikeda, Chitose, Buffeli
- Agent of infectious bovine anemia
- Australasia origin
- Economically important $20 mil/yr Australia
- Transmitted by ALT, needles, lice and biting flies

Clinical Signs of Disease

- Weakness, reluctance to walk, abortion
- Pallor, fever, elevated heart and respiration rate
- Blood smear reveals parasite
- Acute anemia
  - 1-5% mortality (calving, heat stress, poor nutrition)
  - Late term abortions
- Infected within 3 wks of arrival on infested pasture
- Naïve cattle and calves more susceptible

Theiliera orientalis



- M. Yabsley (Southern Coop. Wildlife Disease Study)
  - Testing ALT from a Virginia with Theiliera positive cows.
  - 118 ticks collected environment
    - 15 positive for *T. orientalis*
  - A subset were positive for *T. orientalis* IKEDA strain
  - All positives were nymphs
  - No lone star ticks were positive

Treatment limited

- Tetracyclines
  - Inconsistent results
- Buparvaquone
  - Not registered in US
- Minimize stress
  - Limit handling
  - Good nutrition
  - B vitamins
  - Water

LIQUAMYCIN® LA-200®

OXYTETRACYCLINE INJECTABLE SOLUTION

LIQUAMYCIN® LA-200® (*oxytetracycline injection*) is a sterile ready-to-use solution for the administration of the broad-spectrum antibiotic oxytetracycline (TERRAMYCIN®) by injection.

[Therapeutic efficacy of buparvaquone (buparvon) in cattle with theileriosis]

[Article in Turkish]
Bariş Saruhan [1], Serdar Paşa

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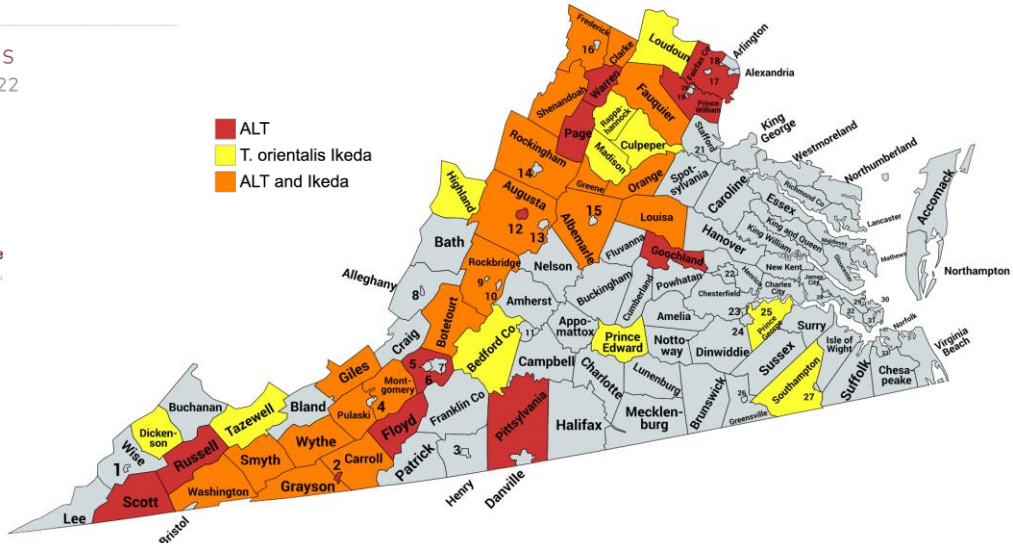
Theileria orientalis in US Cattle

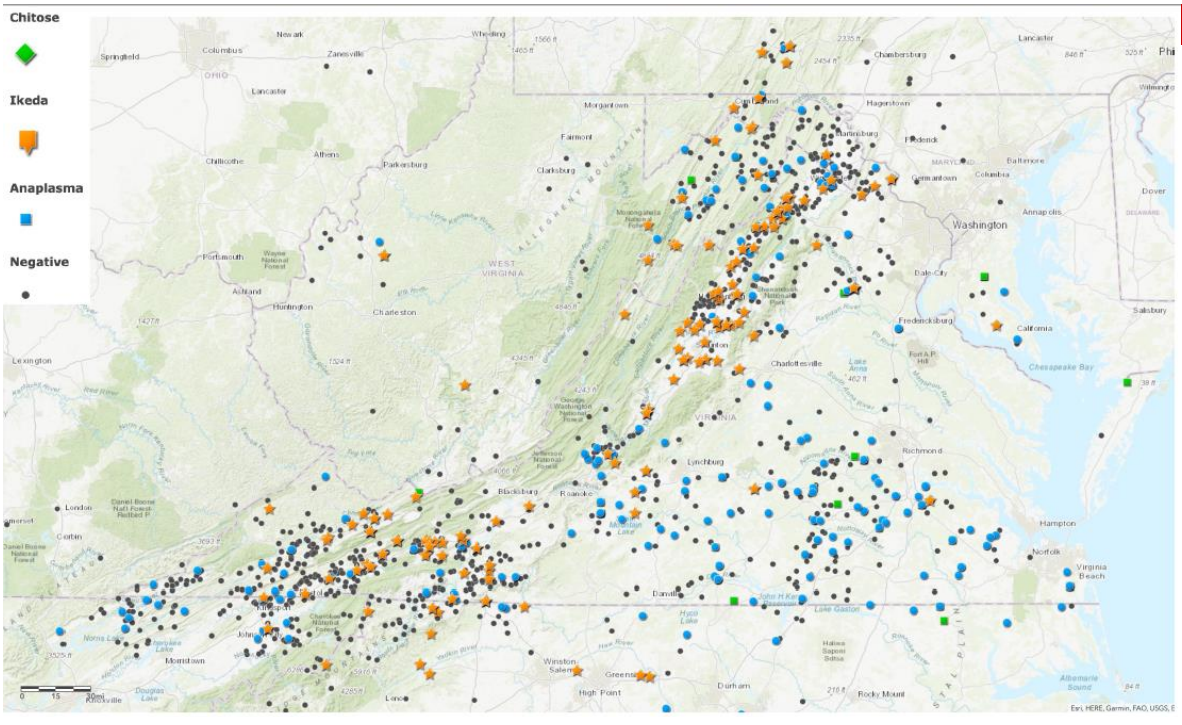
KEVIN LAHMERS
AUGUST 22, 2022

Virginia-Maryland College of Veterinary Medicine



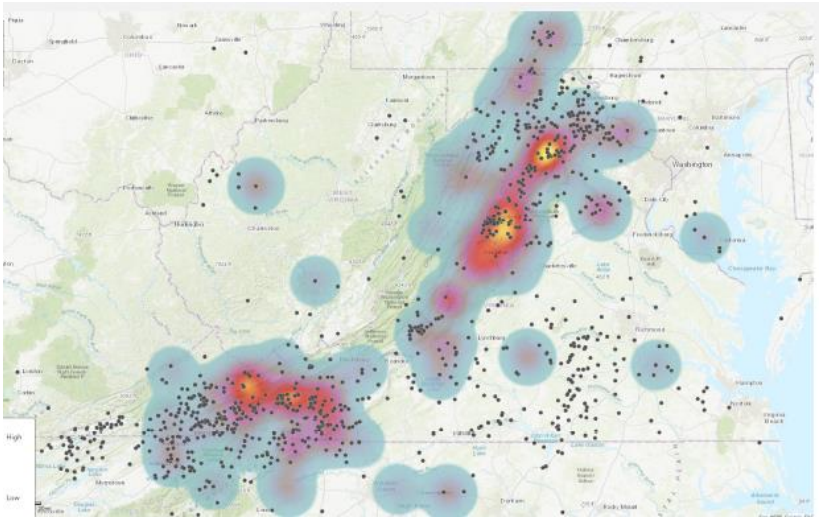
Surveillance (Kevin Lahmers)

- Clinical submission to Virginia Dept. of Agriculture
- Active sample of cattle markets
- Prison herds in VA
- Target herd sampling
- WV State Vet
- Collaborations in TN, PA, KY, NC, NY, OH and TX



Zone Management (Kevin Lahmers)

- Zones
  - Endemic
  - Fringe
  - Free
- Prevent disease in free zones
- Manage disease in endemic zone



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Control Guidance for Asian Longhorned Tick

Environmental Monitoring

Flagging

Dragging

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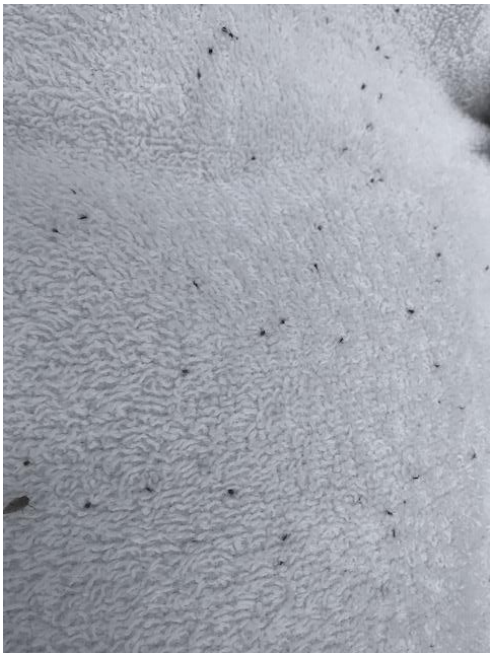

ALT nymphs on a towel
Flannel cloth or corduroy work well

Examining Animals

Look and touch

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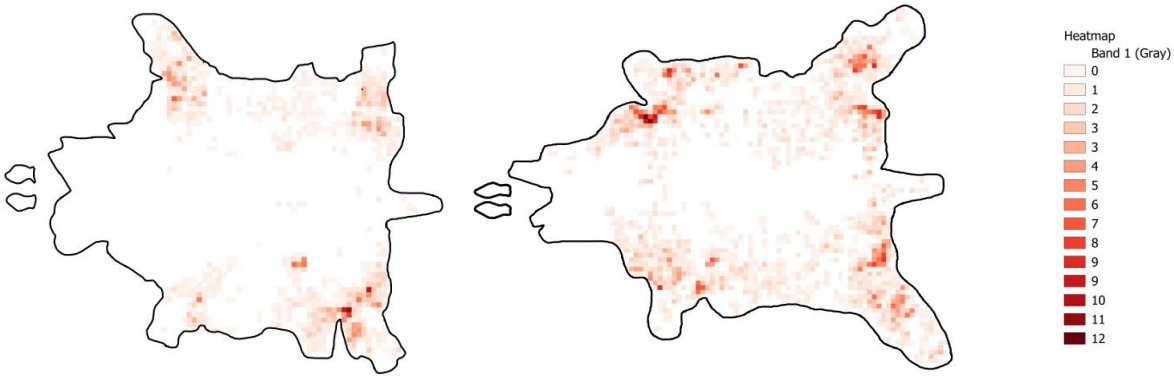
Tick Distribution on Cattle: Cattle fever tick model
Brandon Lyon, Pete Teel, Phil Kaufman TAMU



Larval distribution

Nymphal distribution

Examining animals

Check the udder, scrotum and perianal region.
Ticks are difficult to see on darker animals

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Examining cattle

- Ears
- Perianal region
- Scrotum
- Udder
- Axillary regions

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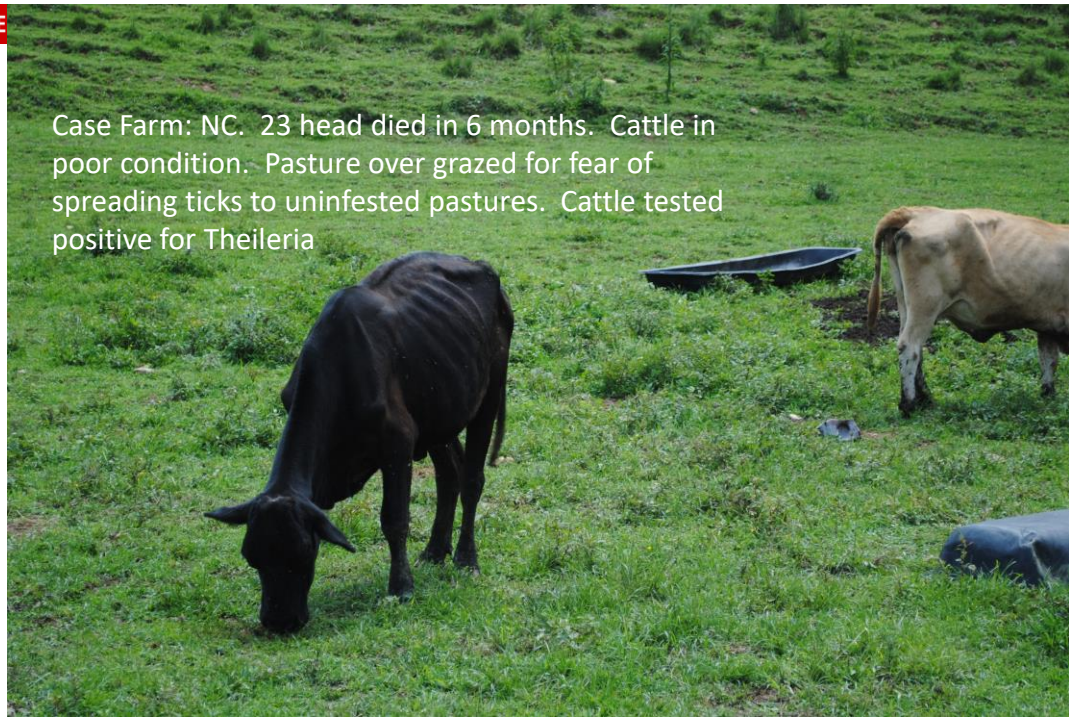

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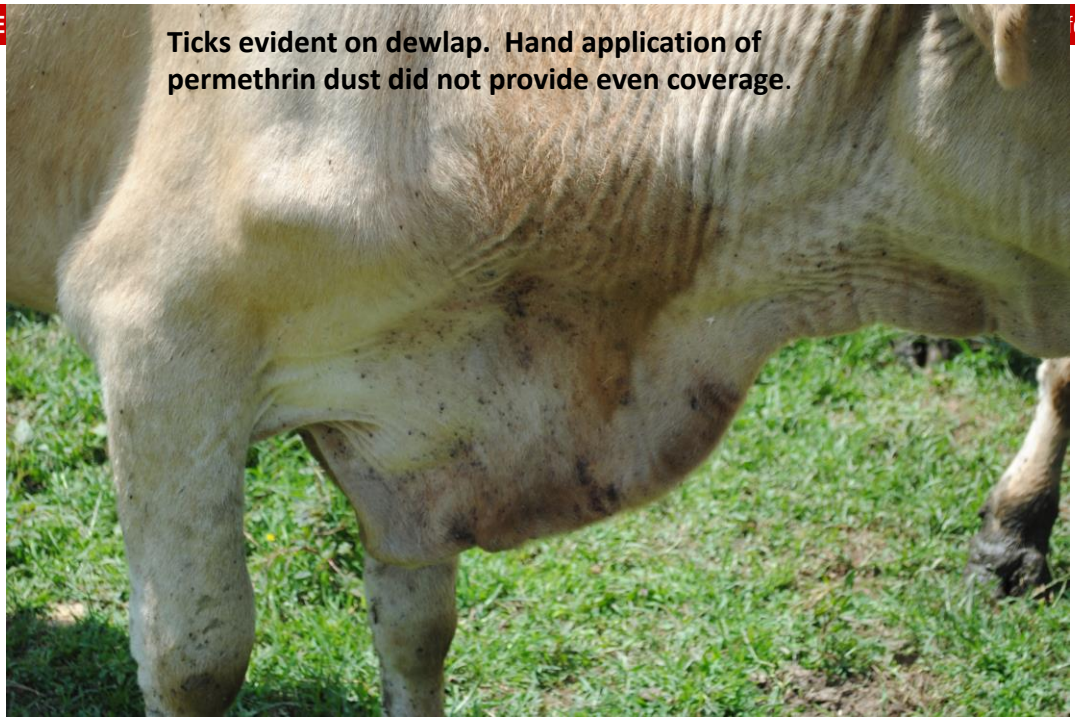
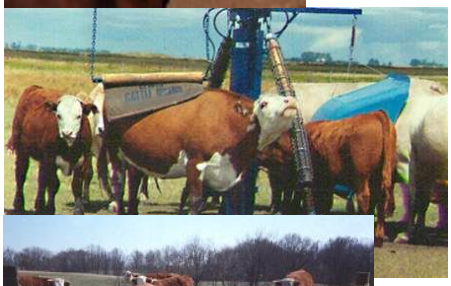
Spots are where ticks were attached before treatment. The animal's hair coat has recovered.


Ticks evident on dewlap. Hand application of permethrin dust did not provide even coverage.

Can this be contained?

- Wildlife carry the tick
- People and pets can move the tick around
  - Personal protection: Use a repellent, dry your cloths
  - Flea & tick products for pets
- Livestock commerce encourage spread
  - Equipment can transport ticks
- Few treatment options
    - 68 insecticides registered in the US for ticks
    - 56 are pyrethroids
    - ALT is currently susceptible to pyrethroids



Application Ease

- Full coverage is key
- Ear Tags and pour-ons
  - May not give full coverage
- Dust bags, oilers and backrubbers
  - Frequent use
- Sprays

Appendix 1. List of Approved Insecticides for On Animal treatment of Cattle for Tick Infestations.

Label & Product Name (kellysolutions.com/NC/)	EPA Reg. No.	Active Ingredient	Form.	Company
CO-RAL FLY & TICK SPRAY	11556-115	Coumaphos	Spray	Elanco
Y-TEX OPTIMIZER INSECTICIDE CATTLE EAR TAGS	39039-3	Diazinon	Tag (aids control)	Y-Tex
ECOVET FLY REPELLENT	87663-8-89942	Fatty Acid Organic	Spray	EcoVet
ELANCO RABON 50 WP INSECTICIDE	11556-156	Tetrachlorvinphos	Spray	Elanco
ELANCO RAVAP E.C. LIVESTOCK, POULTRY & PREMISE INSECTICIDE SPRAY	11556-162	Tetrachlorvinphos +vapona	Spray	Elanco
ELANCO CATRON IV	11556-171	Permethrin	Aerosol	Elanco

Trade Name	Mean Tick Mortality		
	0 hr	1 hr	24 hr
Y-Tex Brute (permethrin)	0	100%	100%
Y-Tex Guardstar EC (permethrin)	0	100%	100%
Martin's flyban (permethrin +PBO	0	100%	100%
Martin's 1% Permethrin	0	100%	100%
Martin's 1% Permethrin + PBO	0	100%	100%
Starbar E-Pro (permethrin)	0	100%	100%
Prolate Lintox (phosmet)	0	44%	100%
Control	0	0	0

Adapted from Butler, Chandler, Vail, Holderman, and Trout Fryxell, 2021. Spray and pour-on acaricides killed Tennessee field-collected Haemaphysalis longicornis nymphs in laboratory bioassays. *J Medical Entomol*, *58*(6), pp.2514-2518.

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Environmental Treatments

- Cultural control
  - Bush hogging the pasture + animal treatment
- When to treat the environment with insecticide
  - High tick densities (hundreds)
- Environmental concerns
  - Streams and rivers (100 ft buffer zone)
  - Non-target insects (bees)
  - Frequency of use

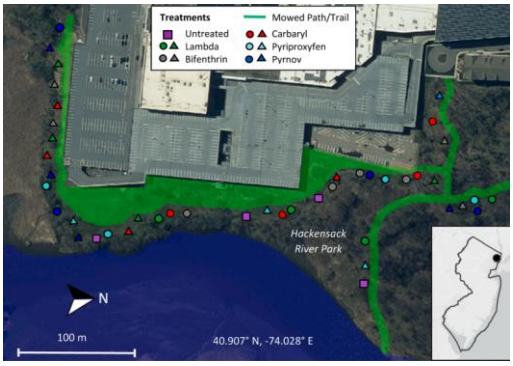
Environmental treatments

Original article

Field applications of granular and liquid pyrethroids, carbaryl, and IGRs to control the asian longhorned tick (*Haemaphysalis longicornis*) and impacts on nontarget invertebrates

Matthew Bickerton [a,b,c], Ilia Rochlin [b,c], Julia González [b,c], Kathryn McSorley [a], Alvaro Toledo [b,c,*]

Hackensack River Park, Bergen NJ
Test Products
Demand CS Lambda cyhalothrin
Bifen LP Bifenthrin (Granule)
Carbaryl DG (Granule)
Tekko Pro (IGR combination product)



Can it be used in pastures?

- Demand CS (lambda-cyhalothrin) : Do not apply to pastures
- Bifen LP (bifenthrin): Labeled for gardens, parks, lawns and grounds
- Tekko Pro (novoluron/pyriproxifen): Labeled for lawns, not pastures
- Carbaryl DG (Carbamate): Not labeled in NC
  - Carbaryl 4L is labeled for pastures (14 d grazing restriction)

Loveland PRODUCTS

GROUP 1A INSECTICIDE

CARBARYL 4L

INSECTICIDE
INTENDED FOR AGRICULTURAL OR COMMERCIAL USE

ACTIVE INGREDIENTS:
Carbaryl (1-naphthyl N-methylcarbamate) ..... 43.00% by Wt.
OTHER INGREDIENTS: ..... 57.00% by Wt.

(Contains 4 pounds Carbaryl per Gallon)

KEEP OUT OF REACH OF CHILDREN

CAUTION

For MEDICAL And TRANSPORTATION Emergencies ONLY Call 24 Hours A Day 1-866-944-8565.
For PRODUCT USE Information Call: 1-888-574-2878.
For Additional Precautionary Statements, Complete First Aid, Directions for Use, Storage and Disposal and Other Use Information, See Inside This Label Booklet.

EPA REG. NO. 34704-447
EPA EST. NO. 086555-MO-001
NET CONTENTS 2.5 GAL (9.46.L)

091916 V1D 09Y16

ENVIRONMENTAL HAZARDS

This product is extremely toxic to aquatic invertebrates. For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Discharge from rice fields may kill aquatic and estuarine invertebrates. Do not apply when weather conditions favor drift from area treated. Drift and runoff may kill aquatic invertebrates in water adjacent to treated areas. Do not contaminate water by cleaning equipment or disposal of wastes. Do not contaminate water when disposing of equipment washwaters.

BEE CAUTION: MAY KILL HONEYBEES AND OTHER BEES IN SUBSTANTIAL NUMBERS. This product is highly toxic to bees exposed to direct treatment or residues on crops or weeds in bloom. Notifying beekeepers within 1 mile of treatment area

TICKS WHICH MAY VECTOR LYME DISEASE

To kill juvenile and adult ticks which may vector Lyme Disease, apply in sufficient volume for thorough coverage*. Will kill only pests that are present at the time of application and directly contacted by product.

All crops on this label; Pastures; Forested Areas; Wasteland, (Rights-of-Way, Hedgerows, Ditchbanks, Roadsides, Set-Aside and Conservation Reserve Program Acreage); Ornamental Trees and Plants; Turfgrass.**

PEST	QUARTS OF THIS PRODUCT PER ACRE	SPECIFIC DIRECTIONS
Ixodes spp. (Deer tick, Bear tick, Black legged tick) *Amblyomma* spp. (Lone star tick)	1.0 qt per acre (0.75 fl oz per 1000 ft^2)	To kill juvenile ticks, apply in late spring or early summer. To kill adult ticks, apply in late summer to fall. Treat entire area and perimeter areas where exposure to ticks may occur. Ticks may be reintroduced from surrounding areas on host animals. Retreat as necessary to maintain low population levels.

RESTRICTIONS: TICKS WHICH MAY VECTOR LYME DISEASE

- Do not make more than 4 applications per year for ticks.
- *Refer to individual site listings elsewhere on this label for use limitations and restrictions. Do not use rates higher than listed for the site or exceed other use restrictions. If product is used to kill ticks on any use site listed on this label, the use rate must not exceed 1.0 quart/A (0.75 fl oz /1,000 ft^2). Observe all use restrictions. **Broadcast applications to turfgrass are permitted only on golf courses, sod farms, cemeteries, and commercial landscapes. Applications to all other lawns or turf (residential settings) are limited to spot treatments.
- DO NOT ENTER OR ALLOW OTHERS TO ENTER TREATED AREA UNTIL SPRAYS HAVE DRIED.

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Contact Information

- Area Livestock Agent
  - Abby Whitaker avwhitak@ncsu.edu
- Your Veterinarian
- NCDA&CS Veterinary Division, Dr. Michael Martin
- Alexis Barbarin alexis.barbarin@dhhs.nc.gov
- Carolyn Young cyoung6@ncsu.edu