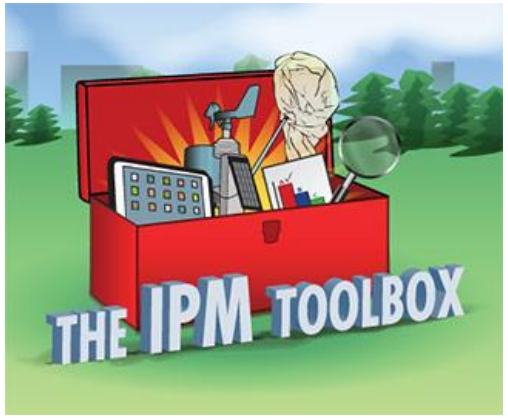
Northeastern IPM Center

Tick IPM Series

Part 6: Host-Targeted Tick Control: What Works, What Does Not, and What's New

September 30, 2020



USDA United States Department of Agriculture National Institute of Food and Agriculture

Welcome

A recording of this webinar will be available within a week at

http://www.neipmc.org/go/ipmtoolbox

We Welcome Your Questions

- Please submit a question **at any time** using the Q&A feature to your right at any time

- If you'd like to ask a question anonymously, please indicate that at the beginning of your query.

Presenter

Dr. Andrew Li
Research Entomologist,
USDA-ARS Invasive Insects
Biocontrol and Behavior
Laboratory, Beltsville, MD

Northeastern IPM Center

Some Questions for You

Host-targeted Tick Control: *What Works, What does not, and What's New*

Andrew Y. Li

USDA, ARS, BARC, Invasive Insect Biocontrol and Behavior Laboratory
Beltsville, Maryland


Northeastern IPM Center

The IPM Toolbox Webinar

9/30/2020

USDA ARS


Lone Star tick


Deer tick

Presentation outline

1. Background
2. WFM and WTD as key hosts for the blacklegged tick
3. Integrated Tick Management
4. Host-targeted control
5. Damminix Tick Tubes
6. Thermacell Tick Tubes
7. Select TCS Bait Boxes
8. Reservoir Targeted Vaccine (RTV)
9. “4-Poster”
10. “TickLick” – a new generation of bait treatment system
11. Summary

Major tick species and diseases they transmit in the Northeastern area

Blacklegged tick (*Ixodes scapularis*)

- ✓ *Borrelia burgdorferi* and *B. mayonii* (Lyme disease)
- ✓ *Anaplasma phagocytophilum* (anaplasmosis)
- ✓ *B. miyamotoi* disease (a form of relapsing fever)
- ✓ *Ehrlichia muris eauclairensis* (ehrlichiosis)
- ✓ Babesia microti (babesiosis)
- ✓ Powassan virus (Powassan virus disease)

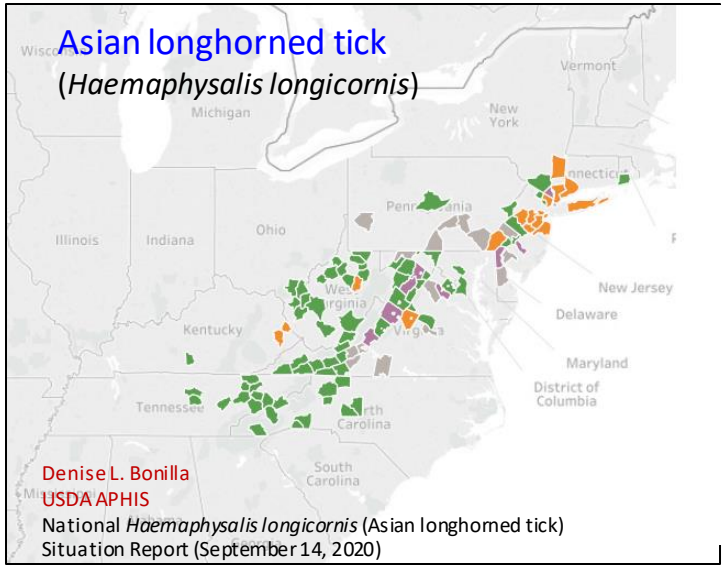
Lone star tick (*Amblyomma americanum*)

- ✓ *Ehrlichia chaffeensis* & *Ehrlichia ewingii*
- ✓ (which cause human ehrlichiosis)
- ✓ Heartland virus
- ✓ Tularemia
- ✓ STARI

American dog tick (*Dermacentor variabilis*)

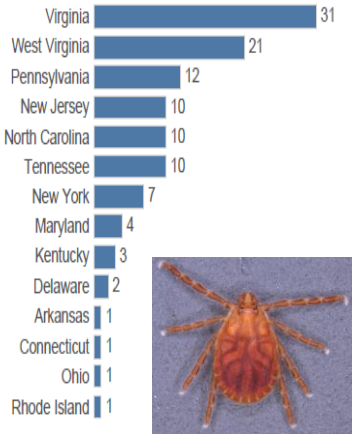
- ✓ Tularemia
- ✓ Rocky Mountain spotted fever

Asian longhorned tick (*Haemaphysalis longicornis*)



Denise L. Bonilla
USDA APHIS
National *Haemaphysalis longicornis* (Asian longhorned tick) Situation Report (September 14, 2020)

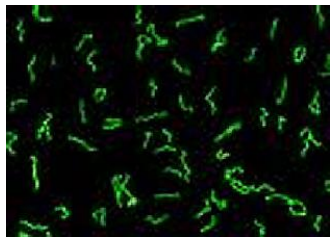
States with confirmed local Asian longhorned tick populations with number of counties in each state



Blacklegged ticks

the vector of

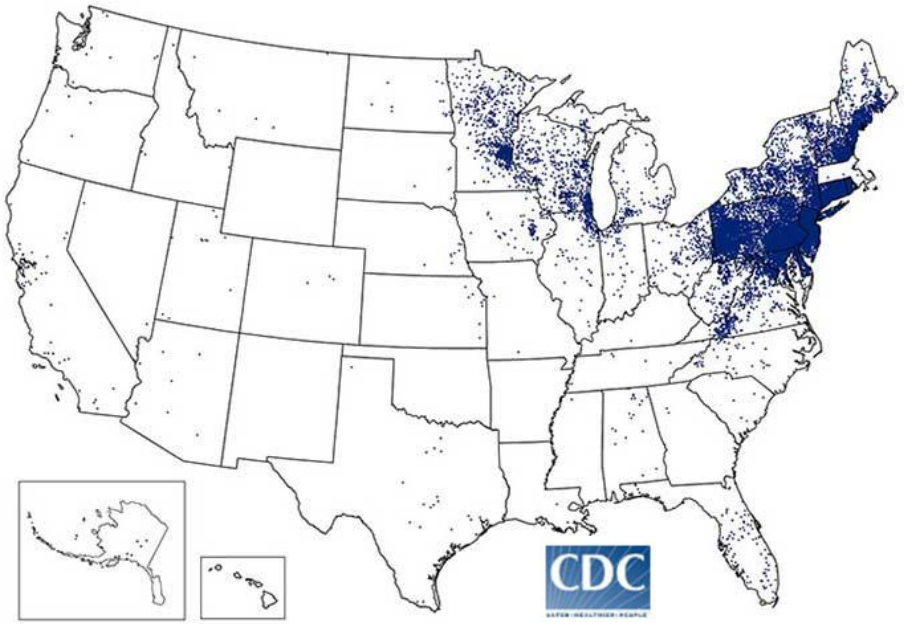
Lyme disease



Borrelia burgdorferi

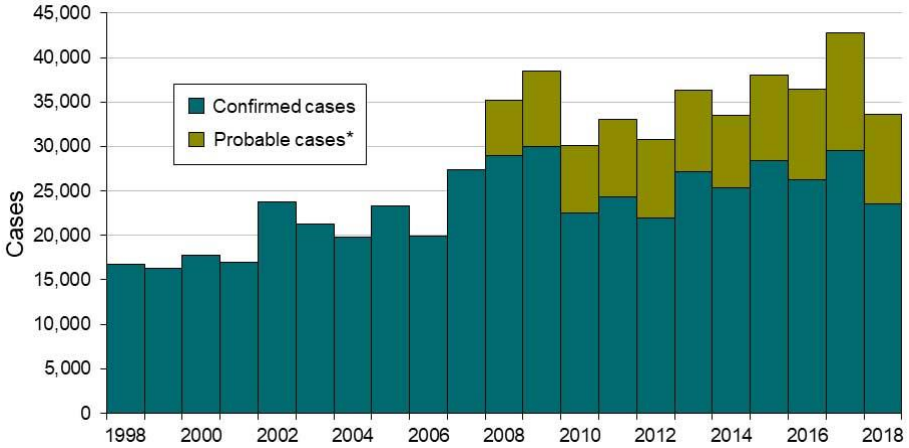
- ✓ *Erythema migrans (EM) or "bull's-eye" rash*
- ✓ *Facial or Bell's*
- ✓ *Severe headaches and neck stiffness*
- ✓ *Arthritis <pain and swelling in the large joints>*
- ✓ *Lyme carditis*

Reported Cases of Lyme Disease – United States, 2018



1 dot placed randomly within county of residence for each confirmed case

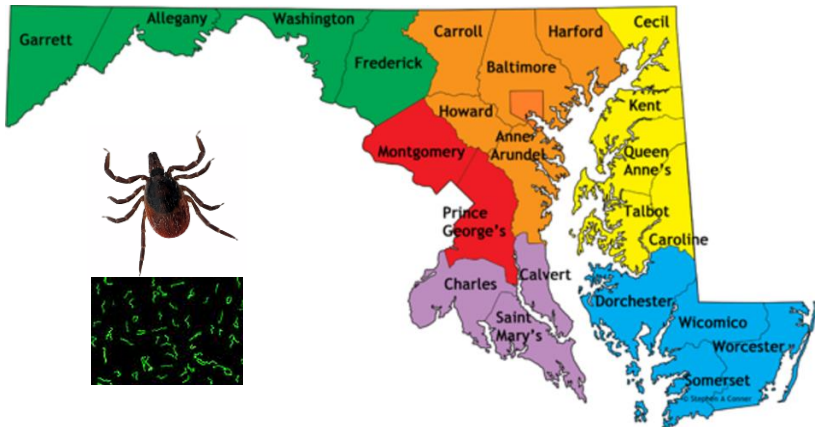
~ 300,000 cases / year



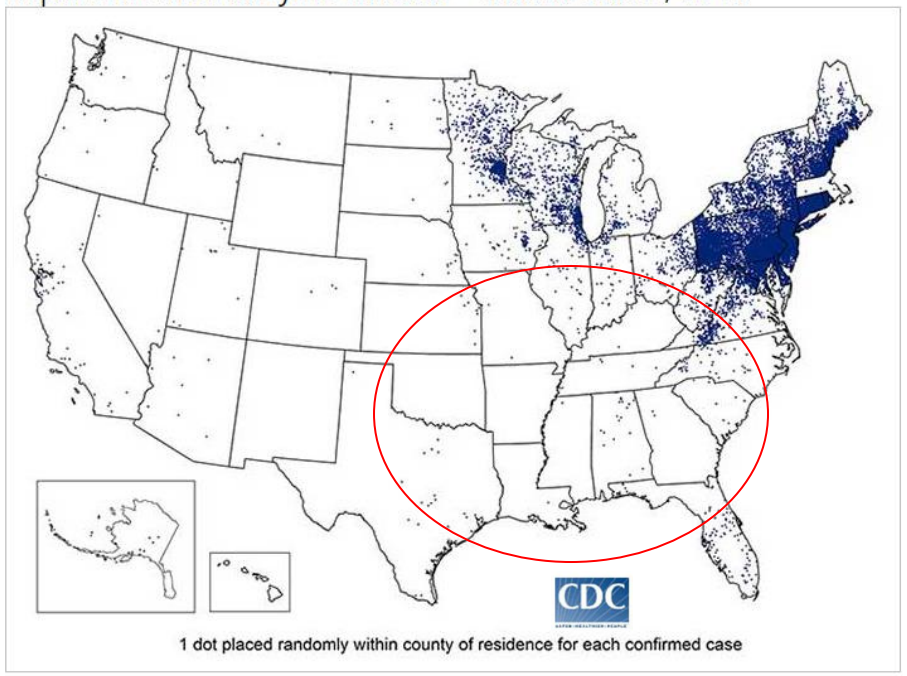
Blacklegged ticks

the vector of

Lyme disease



Reported Cases of Lyme Disease – United States, 2018

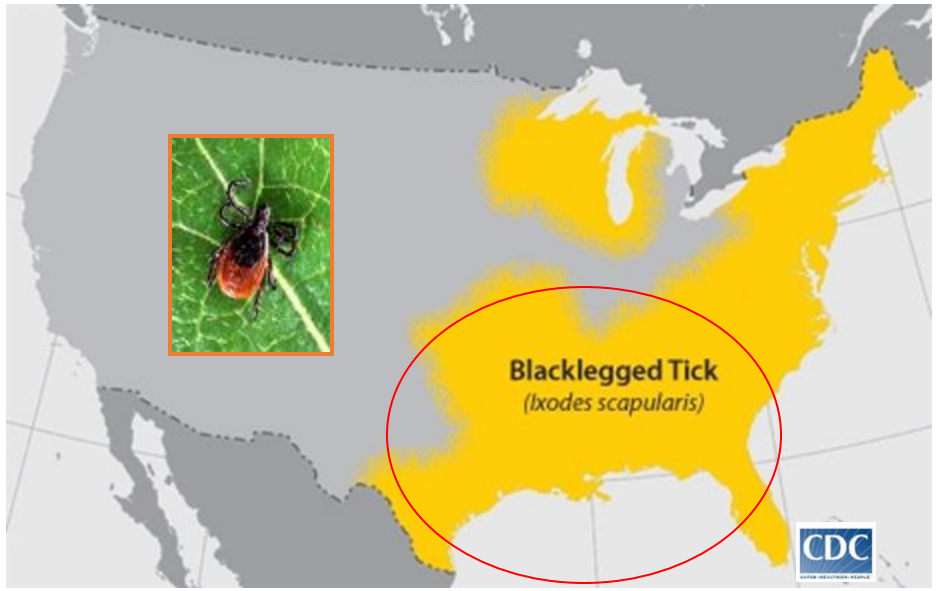


Historical data (2000-2018):

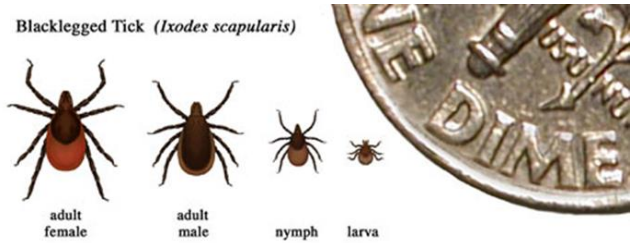
25,725 confirmed cases of Lyme disease in Maryland.

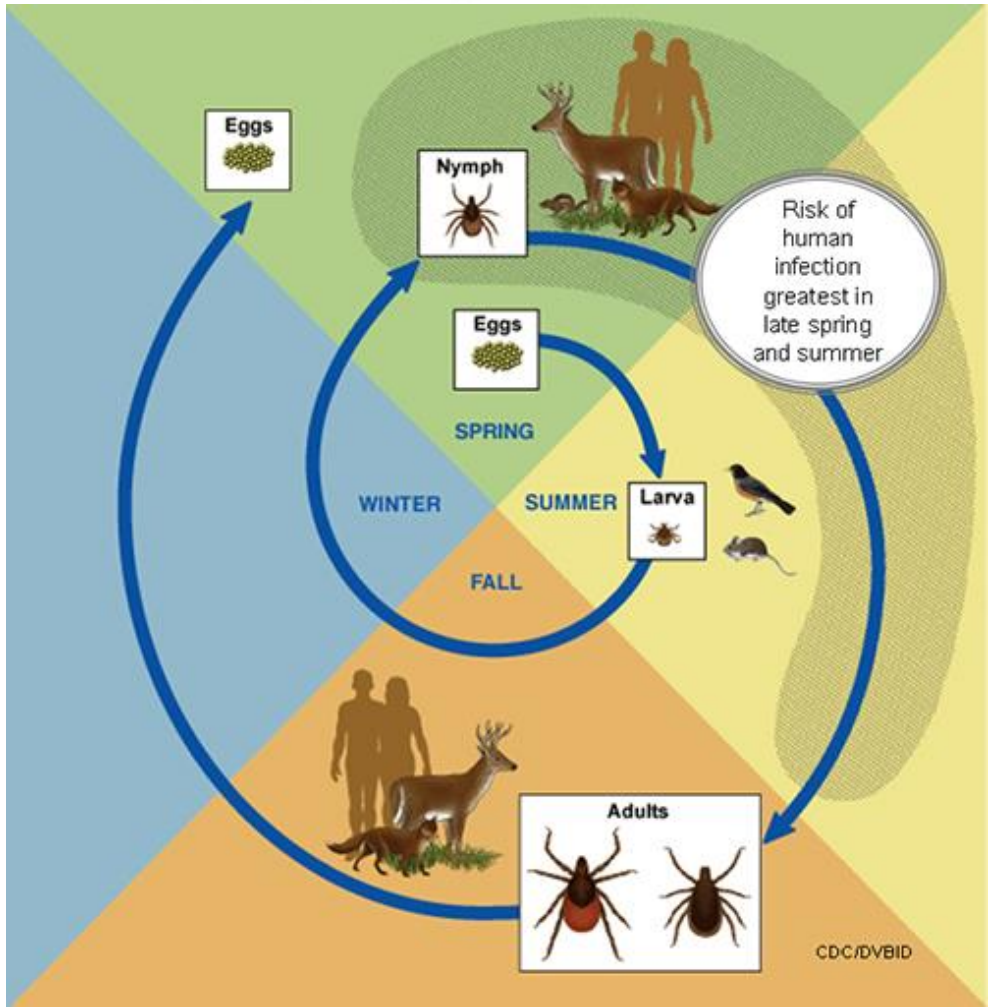
- Montgomery County: **3,412**
- Howard County: **2,835**
- Anna Arundel County: **2,088**
- Harford County: **1,968**
- Frederick County: **1,796**
- Carroll County: **1,770**
- Cecil County: **1,299**

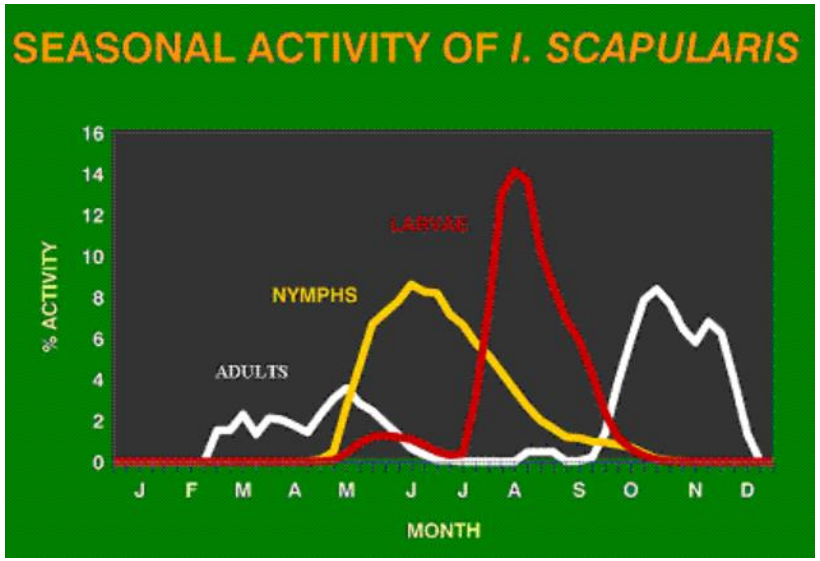
https://www.tickcheck.com/stats/state/maryland/lyme

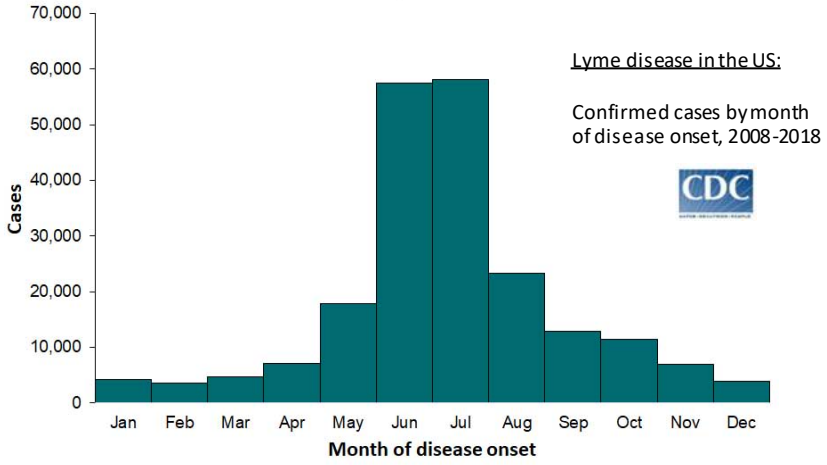


Life cycle of the blacklegged tick



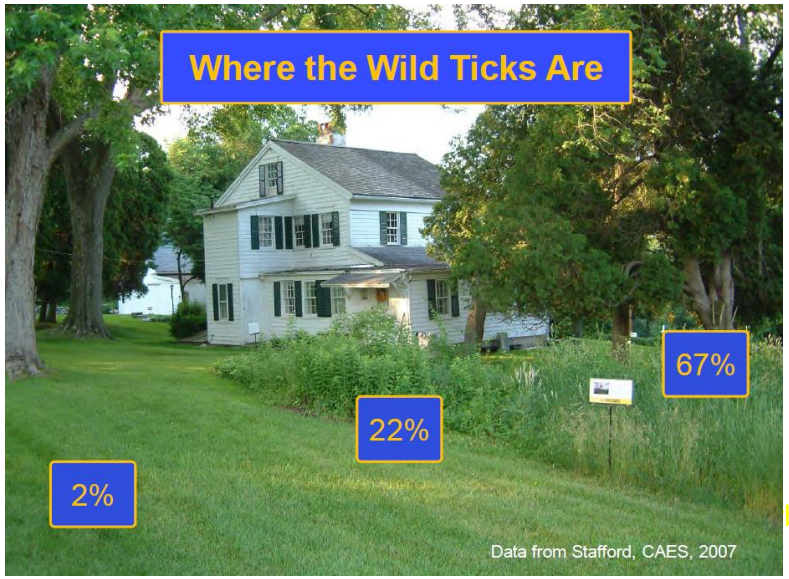


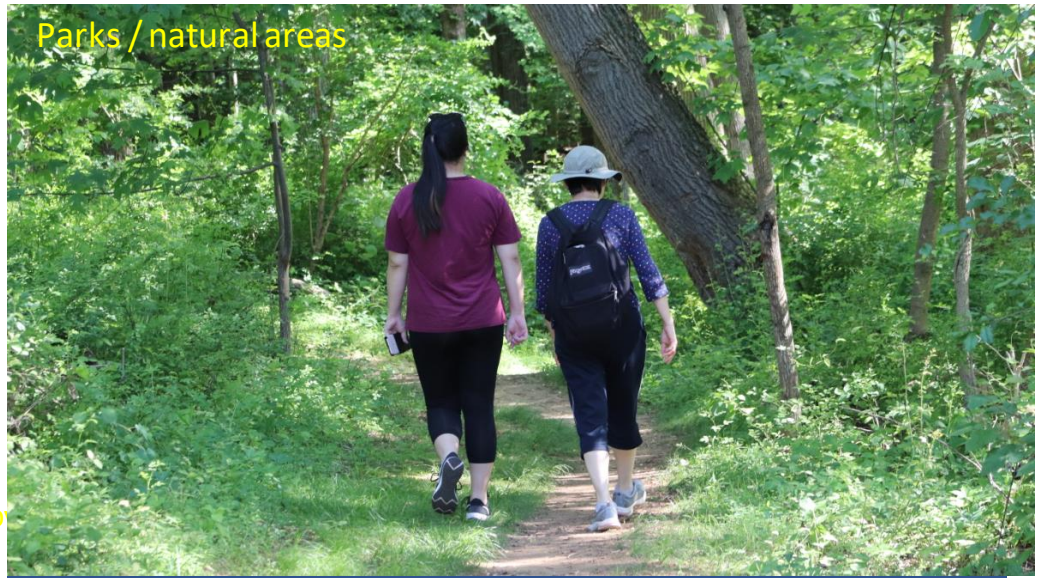


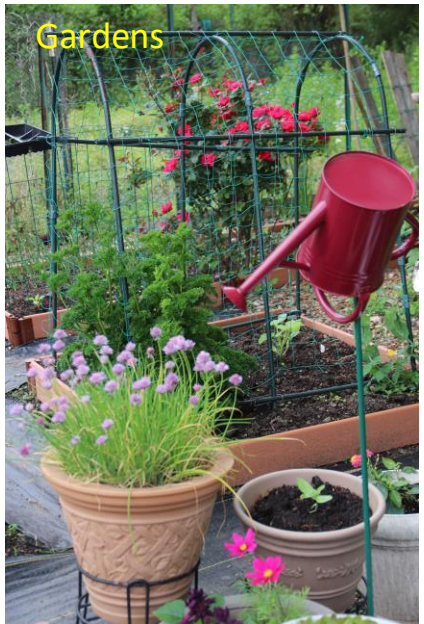


Tick bite risk & Integrated Tick Management (ITM)

Residential areas







Integrated Tick Management (ITM)

Pesticide spray
- * synthetic acaricides
- * organic acaricides
- * biopesticides (fungi)

Host-targeted tick control
- * tick tubes, bait boxes (mice)
- * 4-Poster (deer)

Deer reduction / exclusion

Tick barriers - physical, chemical

Major vertebrate animals that can serve as hosts for the blacklegged tick:

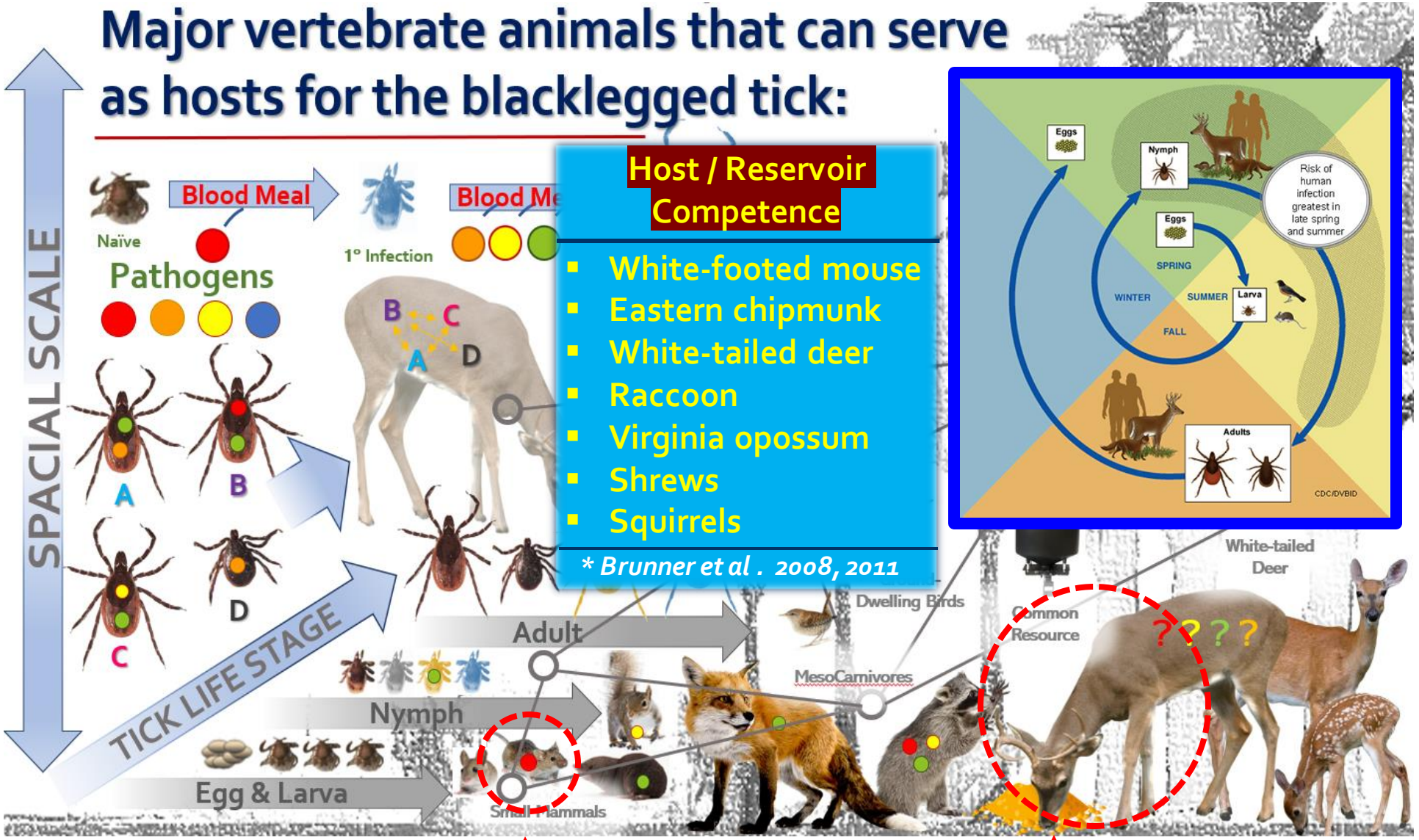


Diagram credit - Matt Milholland

White-footed mice (WFM)

White-tailed deer (WTD)

Host-targeted control to break the life cycle of the blacklegged tick

Questions?

Host-targeted Tick Control - WFM

Whit-footed mice as hosts for nymphs and larvae of the Blacklegged ticks and reservoir for pathogens

VECTOR/PATHOGEN/HOST INTERACTION, TRANSMISSION

Estimating Reservoir Competence of *Borrelia burgdorferi* Hosts: Prevalence and Infectivity, Sensitivity, and Specificity

JESSE L. BRUNNER,[1,2] KATHLEEN LoGIUDICE,[3] AND RICHARD S. OSTFELD[1]

J. Med. Entomol. 45(1): 139–147 (2008)

USDA-ARS Areawide Tick Control Project in Maryland (Li - unpublished date)

Pathogen infection (%) in *Peromyscus* captured using Sherman traps

Park	2017					2018				
	# of mice	B. burgdorferi	A. phagocytophilum	B. microti	B. miyamotoi	# of mice	B. burgdorferi	A. phagocytophilum	B. microti	B. miyamotoi
BL	163	56.4	1.8	0	1.8	215	62.3	0	0	0
CL	94	33.3	1.1	0	4.3	110	36.4	0	0	0
CT	79	49.4	0	0	1.3	91	35.2	0	0	1.1
DF	151	70.7	33.8	0	1.3	163	75.5	15.3	0	1.8
MPEA	55	38.2	5.5	5.5	0	32	28.1	0	3.1	0
RB	70	52.2	0	0	0	90	43.3	0	0	0
WT	8	37.5	0	0	0	12	25	0	0	0
Mean		**48.2**	**6.0**	**0.8**	**1.2**		**43.7**	**2**	**0**	**0**
Total	**620**					**713**				

Lyme Infection Status

Comparison of *Borrelia burgdorferi* infection in *Ixodes scapularis* individuals removed from mice and individuals questing in 2017

Host-targeted Tick Control - WFM

White-footed mice as hosts for nymphs and larvae of the Blacklegged ticks and reservoir for pathogens

USDA-ARS Areawide Tick Control Project in Maryland (Li - unpublished date)

***B. burgdorferi* infection (%) in questing *I. scapularis* in 2017**

Park	n=	infected adults	n=	infected nymphs	n=	total infection
BL	2	0.0	8	0.00	10	0.0
CL	8	50.00	11	18.18	19	31.58
CT	4	25.00	15	20.00	19	21.05
DF	2	0.0	12	25.00	12	25.00
MPEA	8	12.50	18	5.56	26	7.69
RB	9	11.11	49	12.24	58	12.07
WT	9	0.00	54	0.00	63	0.0
TOTAL	42	3.38	167	7.25	207	9.18
MEAN		14.09		11.57		13.91

***B. burgdorferi* infection (%) in *I. scapularis* removed from *Peromyscus* in 2017**

Park	n=	infected nymphs	n=	infected larva	n=	total infection
BL	17	94.12	77	28.57	94	40.43
CL	15	26.67	59	30.51	74	29.73
CT	6	50.00	41	39.02	47	40.43
DF	31	48.39	190	53.68	221	52.94
MPEA	4	25.00	59	40.68	63	39.68
RB	3	66.67	99	37.37	102	38.24
WT	3	33.33	2	50.00	5	40.00
TOTAL	79	53.16	527	41.75	606	43.23
MEAN		49.17		39.98		40.21

http://www.ticktubes.com

cotton balls treated with 7.4% permethrin

Damminix Tick Tubes
(EcoHealth, Inc., Boston, MA)

Damminix Ticks Tubes® rely on the natural nesting instincts of mice to take the battle to source and deliver tick controlling permethrin directly to this host animal and the ticks it infects.

Damminix Tick Tubes® are biodegradable, cardboard tubes filled with permethrin treated cotton balls. Mice collect the cotton to build their nests. Deer ticks that feed on mice in the Spring and the Fall are exposed to permethrin and killed. All the while, the mice, other mammals and your lands are unharmed and undisturbed.

Previous field trials demonstrated various efficacies:

Mather, Ribeiro, Spielman. 1987. Lyme disease and babesiosis: acaricide focused on potentially infected ticks. Am J Trop Med Hyg.
90% reduction in ticks/animal; 72% reduction infestation rate.

Daniels, Fish, Falco. 1991. Evaluation of host-targeted acaricide for reducing risk of Lyme disease in southern NY state. J Med Entomol.
No observed differences in host-seeking ticks or proportion of infected ticks.

Stafford, KC III. 1991, 1992, 1993. Effectiveness of host-targeted permethrin in the control of *I. dammini* in southeastern CT. J Med Entomol.
3 years of treatment demonstrated no reduction in risk of exposure to spirochete infected, host-seeking nymphs & adults of I. dammini.

Deblinger & Rimmer. 1991. Efficacy of permethrin-based acaricide to reduce the abundance of *I. dammini*. J Med Entomol.
Confirmed efficacy of Damminix for reducing abundance of vector ticks.

Journal of Medical Entomology, 56(4), 2019, 1095–1101
doi: 10.1093/jme/tjz046
Advance Access Publication Date: 15 April 2019
Research

Vector Control, Pest Management, Resistance, Repellents

Ability of Two Commercially Available Host-Targeted Technologies to Reduce Abundance of *Ixodes scapularis* (Acari: Ixodidae) in a Residential Landscape

Robert A. Jordan[1,3] and Terry L. Schulze[2]

[1]Monmouth County Mosquito Control Division, 1901 Wayside Road, Tinton Falls, NJ 07724, [2]Terry L. Schulze, Ph.D., Inc., 9 Evergreen Court, Perrineville, NJ 08535, and [3]Corresponding author, e-mail: robert.jordan@co.monmouth.nj.us

Table 1. Summary of small mammal use of recovered Damminix Tick Tubes and Select TCS Bait Boxes deployed against subadult *I. scapularis* at Millstone Township, N.J. sites, May 2014–Sept. 2015

		Damminix		
Year	Deployment season	*n*	Tubes used (%)	Tubes empty (%)
2014	May–June	138	22 (20.3)	19 (13.8)
	Aug.–Sep.	141	34 (24.1)	22 (15.6)
2015	May–June	129	33 (25.6)	8 (6.2)
	Aug.–Sep.	131	63 (48.1)	24 (18.3)

Deployment of Damminix tubes - (1) had conclusive evidence regarding effect on nymphal tick infestation prevalence and intensity during May-June; (2) had measurable effect on larval tick burden in July –August; and (3) resulted in 27.6% and 20.3% control of questing nymphs in treated areas at year 1 and 2 postintervention.

Thermacell Repellents, Inc
Bedford, MA 01730

https://www.thermacell.com/products/tick-control-tubes

AVAILABILITY

AMOUNT NEEDED PER PROPERTY

Property Size	Each Application	For the Year*
1/4 Acre	6 tubes	12 Tubes
1/2 Acre	12 tubes	24 tubes
1 Acre	24 tubes	48 tubes

Received: 2 January 2020 | Revised: 24 March 2020 | Accepted: 25 March 2020
DOI: 10.1111/jen.12758

Check for updates

JOURNAL OF APPLIED ENTOMOLOGY WILEY

SHORT COMMUNICATION

Tick tubes reduce blacklegged tick burdens on white-footed mice in Pennsylvania, USA

Jessica E. Brown | Taylor M. Miller | Erika T. Machtinger

TABLE 1 Comparison of *Ixodes scapularis* ticks removed from trapped *Peromyscus leucopus* pre-deployment and post-deployment of tick tubes with cotton treated with either water (control), permethrin or permethrin+ a bittering agent (permethrin+) in Centre County, Pennsylvania

Treatment	Date	Number of captured *P. leucopus*	Mean (Ticks per mouse)	Standard Deviation (Ticks per mouse)	95% Confidence Interval	*p**
Control	Pre-deployment	14	4.78	1.56	1.60 to 7.97	.2020
	Post-deployment	18	7.49	1.35	4.58 to 10.20	
Permethrin	Pre-deployment	11	1.55	0.41	−0.94 to 0.94	.0134**
	Post-deployment	9	0.00	0.00	0.69 to 2.40	
Permethrin+	Pre-deployment	8	3.73	0.95	1.72 to 5.74	.0201**
	Post-deployment	11	0.00	0.00	−2.36 to 2.36	

*Mean comparisons were made with a *t* test.
**Indicates significance at $\alpha = 0.05$.

How to Make Tick Tubes:

Do-It-Yourself (DIY)

Erin.

https://www.myfrugalhome.com/how-to-make-tick-tubes/

TICK TUBE INSTRUCTIONS:

What You'll Need:

Empty toilet paper rolls
Dryer lint (or cotton balls)
Gloves
A mask
A cardboard box
Permethrin insect repellent. You can buy it in diluted form or as a concentrate. Look for it on the camping/hunting aisle.
A spray bottle (if the permethrin didn't come with one)

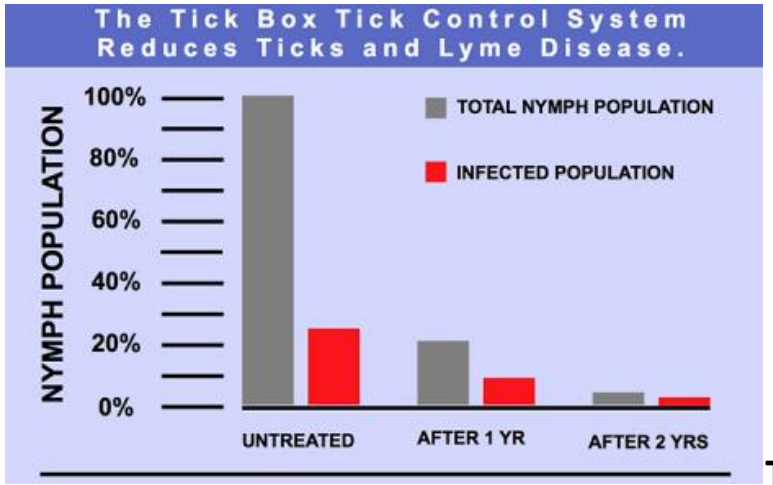
My Frugal Home™

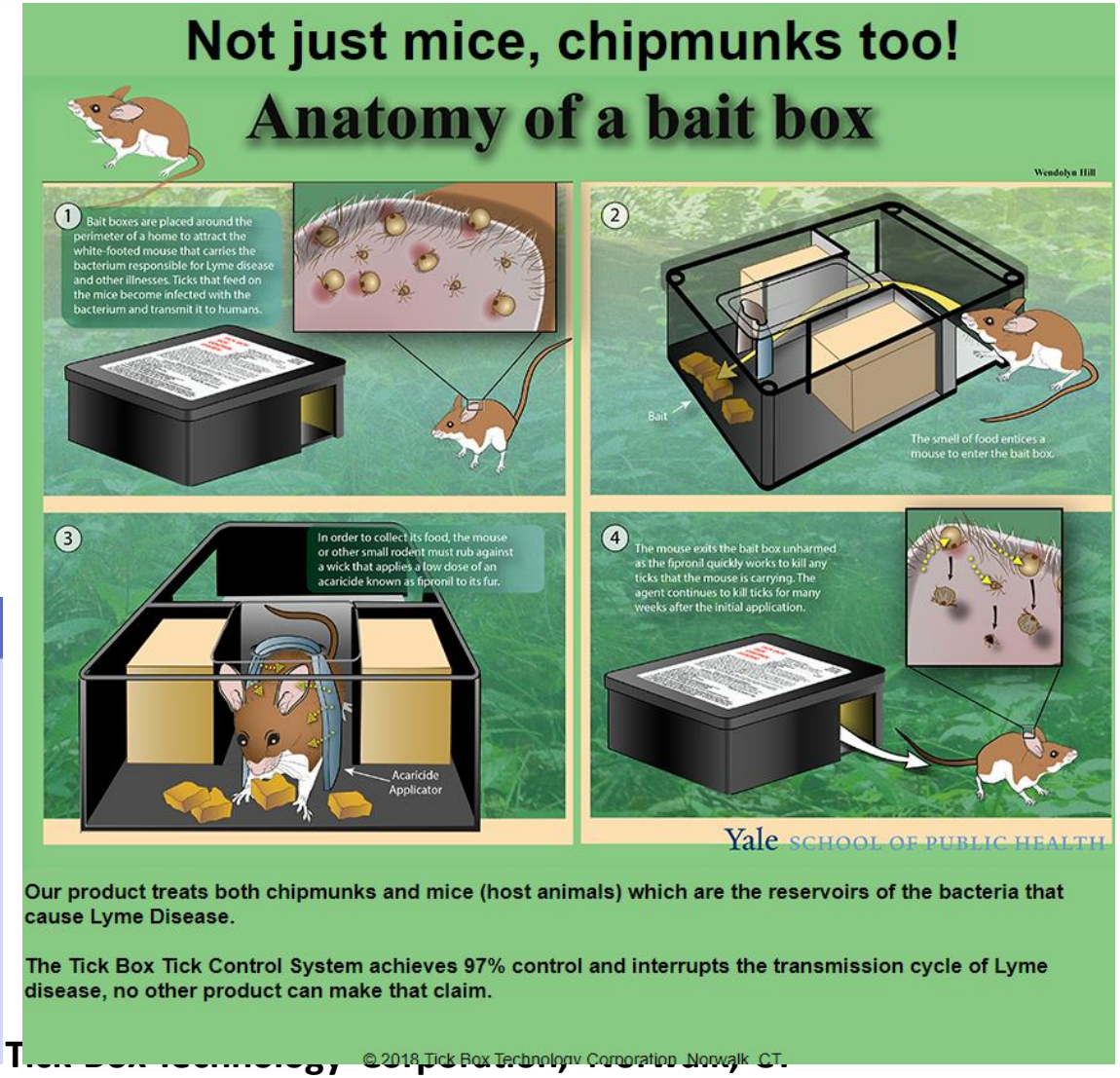
SELECT TCS™
TICK CONTROL SYSTEM

Developed by researchers at CDC/DVBD
(formerly MaxForce TMS)

Tick Box Technology Corporation
Norwalk, CT

http://www.tickboxtcs.com/





SELECT TCS™
TICK
CONTROL
SYSTEM

Results of field trials have been consistently positive

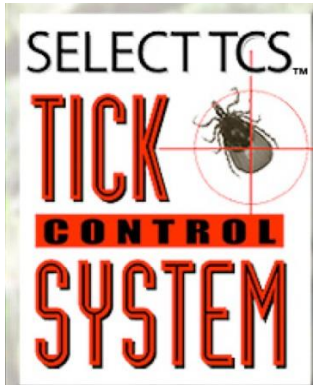
Dolan et al. 2004. Control of immature I. scapularis on rodent reservoirs of B. burgdorferi in a residential community of southeastern CT. J Med Entomol.
50% reduction in host-seeking nymphs; 57% reduction in infected nymphs

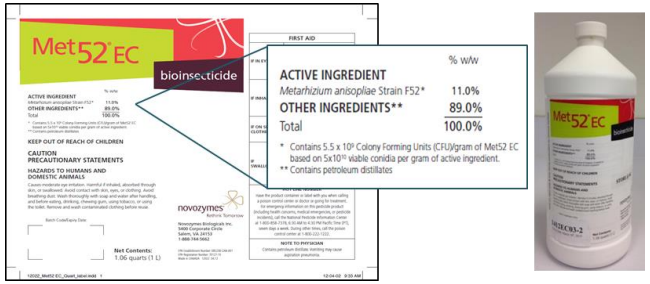
Schulze et al. 2007. Integrated use of 4-Poster passive topical treatment devices for deer, targeted acaricide applications, and MaxForceTMS bait boxes to rapidly suppress populations of I. scapularis in a residential landscape. J Med Entomol.
94% reduction small mammal tick burdens; 90% reduction in host seeking ticks

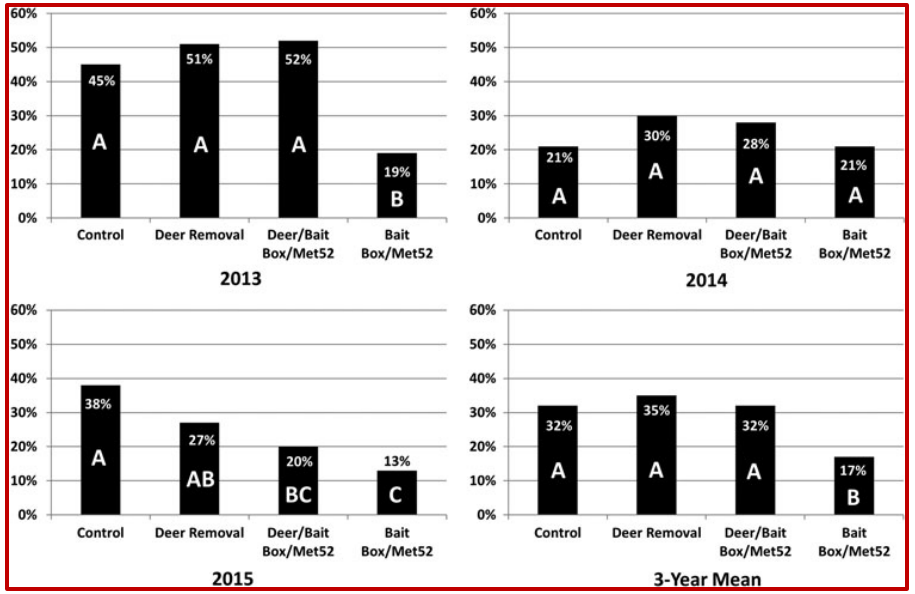
Schulze et al. 2017. Evaluation of Select TCS, a host-targeted bait box to reduce exposure to I. scapularis in a Lyme disease endemic area of NJ. J Med Entomol. In Preparation.
97.3% control of host-seeking nymphs in treatment sites

Dolan et al. 2018. Evaluation of doxy bait and topical fipronil in a single bait box to control I. scapularis and reduce B. burgdorferi and A. phagocytophilum infection in small mammals reservoirs and host-seeking ticks. J Med Entomol.
81% reduction in host-seeking nymphal I. scapularis; 96% reduction in Borrelia infection in infected small mammals and 93% reduction in infected ticks

Integrated Tick Management (ITM)







Integrated Control of Nymphal *Ixodes scapularis*: Effectiveness of White-Tailed Deer Reduction, the Entomopathogenic Fungus *Metarhizium anisopliae*, and Fipronil-Based Rodent Bait Boxes

Scott C. Williams,[1] Kirby C. Stafford, III,[1] Goudarz Molaei,[1,2] and Megan A. Linske[1]

INTEGRATED CONTROL OF NYMPHAL *IXODES SCAPULARIS*

TABLE 4. MEAN DENSITY OF QUESTING *I. SCAPULARIS* NYMPHS (/100 m^2) FOR PRE-MET52 TREATMENT (BASELINE) AND POSTTREATMENT (SUMMER) FOR CONTROL AND BAIT BOX/MET52 TREATMENTS AND PERCENT EFFECTIVENESS

Year	*Treatment*	*Baseline*	*Summer*	*% Effectiveness*
2013	Control	0.27	1.69	
2013	Bait box/Met52	0.60	0.20	95
2014	Control	0.31	0.46	
2014	Bait box/Met52	0.55	0.02	97
2015	Control	1.34	1.06	
2015	Bait box/Met52	0.36	0.06	78
2016	Control	1.14	0.59	
2016	Bait box only	0.56	0.51	–77

FIG. 1. Positive encounters for ≥1 questing *Ixodes scapularis* nymph for May to July 2013, 2014, 2015 and the average for all 3 years combined for all treatment assignments. Columns with the same letter are not significantly different within each year.

VECTOR-BORNE AND ZOONOTIC DISEASES
Volume 18, Number 1, 2018

Comparison of bait boxes and tick tubes

Journal of Medical Entomology, 56(4), 2019, 1095–1101
doi: 10.1093/jme/tjz046
Advance Access Publication Date: 15 April 2019
Vector Control, Pest Management, Resistance, Repellents Research

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Robert A. Jordan[1,3,] and Terry L. Schulze[2]

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Table 3. Infestation prevalence (number infested and total number trapped) and intensity (mean number of ticks ± SE/captured animal) of *I. scapularis* subadults on live-trapped small mammals before and after intervention, May–August 2015

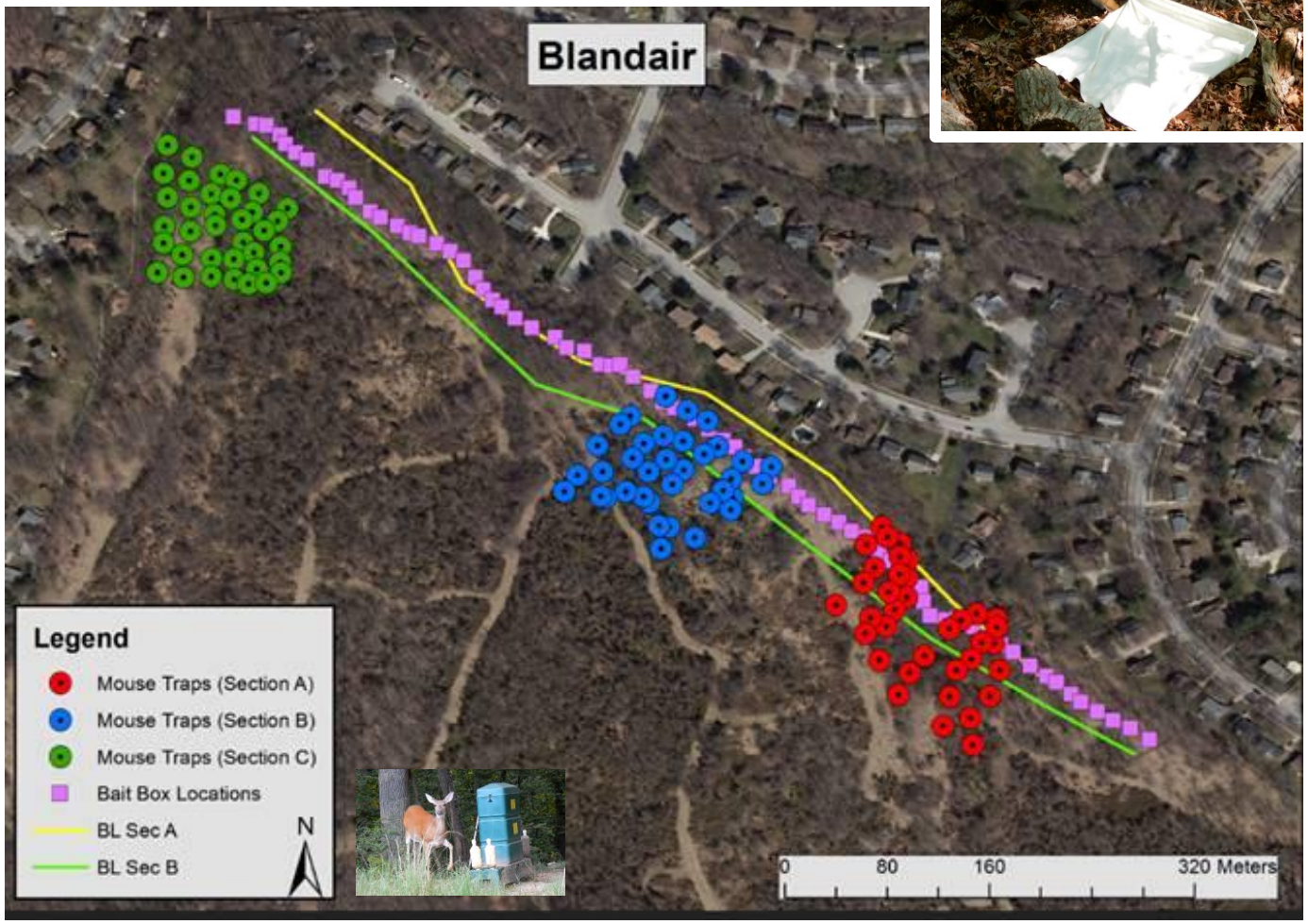
		Deployment vs nymphs					
		May[1]			June		
Treatment	Species	*n*	Prevalence (%)	Intensity	*n*	Prevalence (%)	Intensity
Untreated	*P. leucopus*	12	10 (83.3)	9.7 ± 2.7	18	15 (83.3)	2.3 ± 0.5
	T. striatus	4	1 (25.0)	1.8 ± 1.8	0	0	-
	All	16	11 (68.7)	7.7 ± 2.2	18	15 (83.3)	2.3 ± 0.5
Damminix	*P. leucopus*	8	5 (62.5)	4.8 ± 2.5	21	11 (52.4)	1.1 ± 0.3
	T. striatus	1	1 (100.0)	1.0	14	14 (100)	6.1 ± 1.5
	All	9	6 (66.7)	4.4 ± 2.3	35	25 (71.4)	3.1 ± 0.7
Select TCS	*P. leucopus*	5	4 (80.0)	4.4 ± 2.7	4	1 (25.0)	1.0
	T. striatus	12	9 (75.0)	3.0 ± 1.3	9	3 (33.3)	0.8 ± 0.5
	All	17	13 (76.5)	3.4 ± 1.2	13	4 (30.8)	0.9 ± 0.4

TCS bait boxes provided 84.0% and 79.1% control, while **Tick tubes** resulted in 27.6% and 20.3% control of questing nymphs in treated areas at 1 year and 2 year postintervention

Questions?

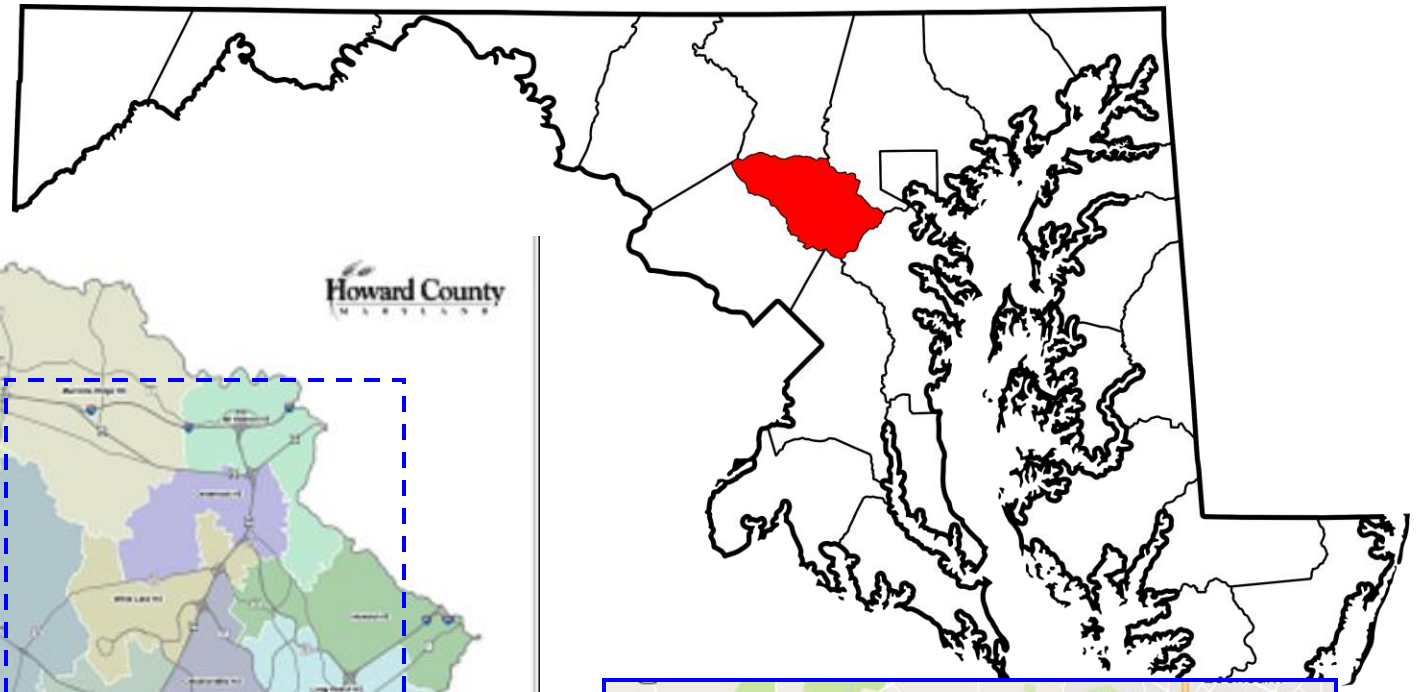
Ongoing USDA-ARS Project in Maryland

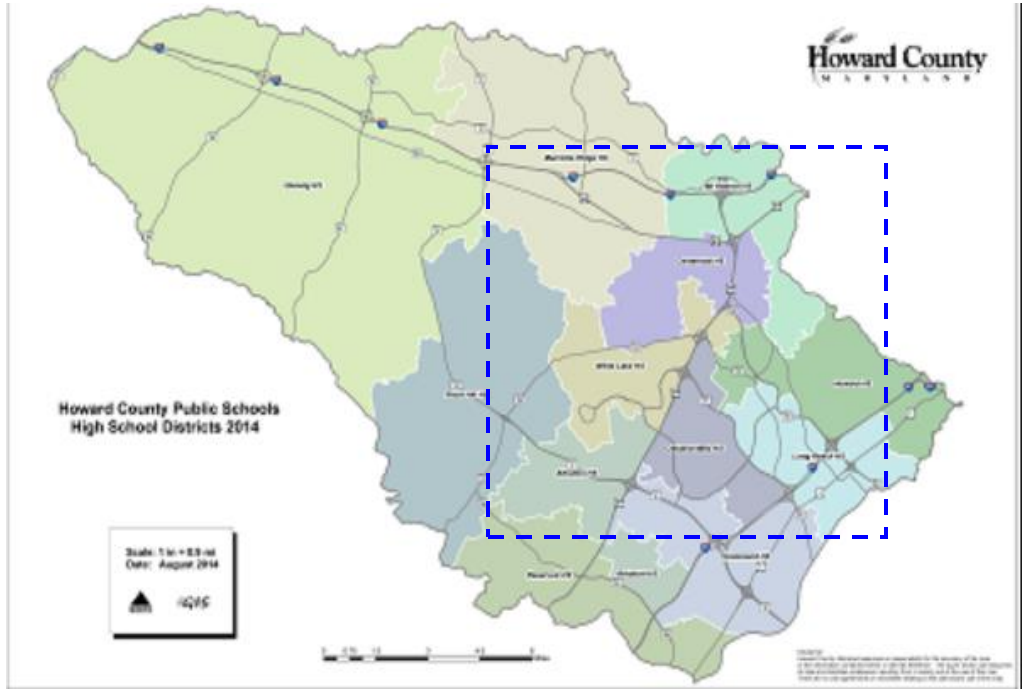
TCS Bait Boxes are being used as a component of Integrated Pest Management (IPM)

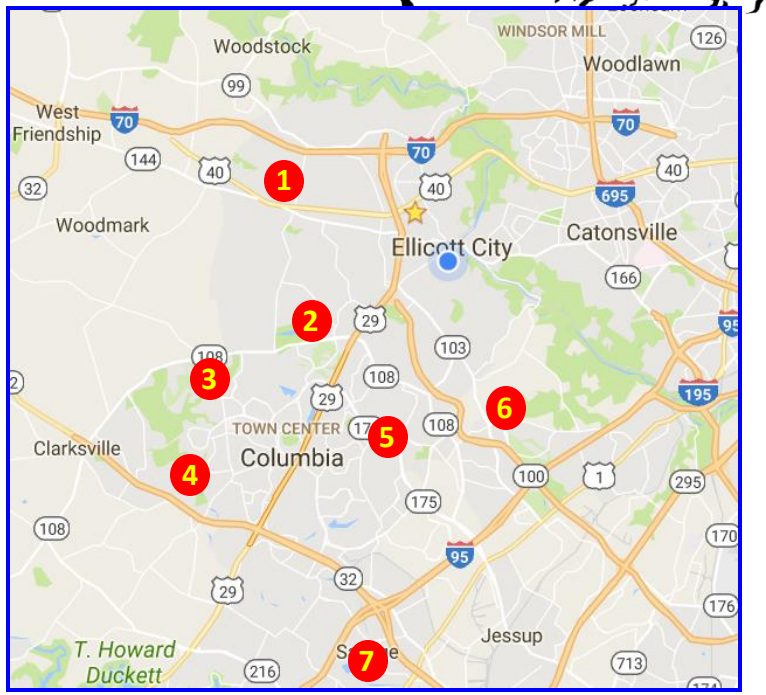


Howard County, MD

Field study sites

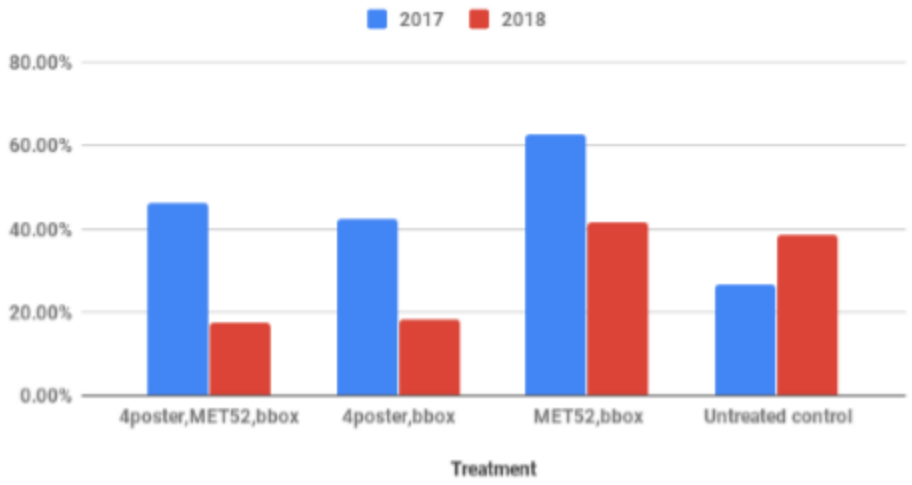




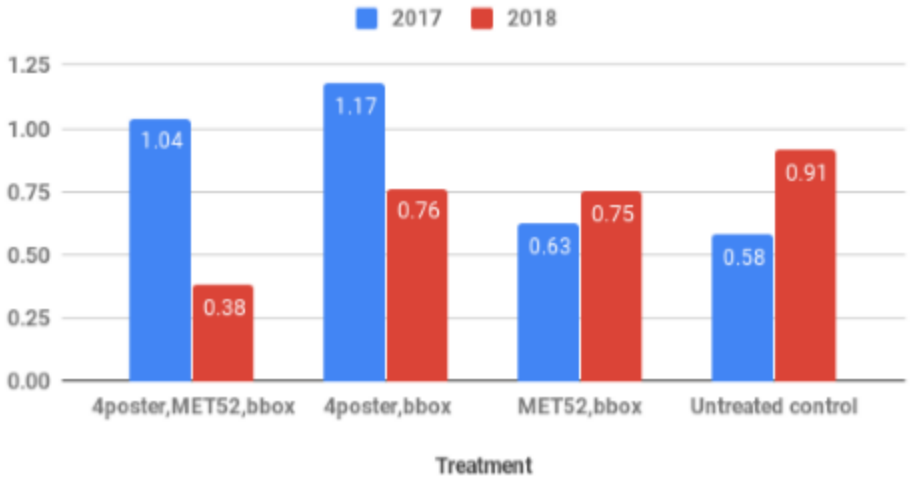


1. David Force Park (Bait box, Met52)
2. Centennial Park (Untreated Control)
3. Cedar Lane Park (4-Poster, Bait box)
4. MPEA (4-Poster, Bait box)
5. Blandair Park (Bait box, Met52, 4-Poster)
6. Rockburn Park (Bait box, Met52, 4-Poster)
7. Wincopin Trail (Bait box+Met52)

% of Peromyscus infested with I.scapularis nymphs & larvae



I. scapularis tick load (# of ticks/# of mice) on Peromyscus



Mouse Trapping in 2017

- Monthly from May to September 2017
- At each of the 7 areawide parks
- Each trapping effort consisted of two consecutive days of captures, with 72 traps at each park.
- After each mouse was ear tagged, tissue, blood and ticks were collected.

Results:

- Captured a total of **341 individual mice, 620 recaptures.**
- Collected a total of **1,463** mouse ear tissue and blood samples.
- Collected **625** ticks from mice.

USDA-ARS Areawide Tick Control Project in Maryland (Li - unpublished date)

New

CAES
The Connecticut Agricultural Experiment Station
Putting Science to Work for Society since 1875

Williams et al. 2020.
Vector-Borne Zoonotic Dis. 22(8): 603-612.

Administration of an Orally Delivered Substrate Targeting a Mammalian Zoonotic Pathogen Reservoir Population: Novel Application and Biomarker Analysis

- U.S. Biologic, Inc. - inactivated, recombinant OspA vaccine coated on small bait pellets.
- Initial bait consumption study in 2014 at 22 residences and bait was amended with the dye Rhodamine-B in late summer.
- 2018 study to compare two distribution methods:
  experimental time-release bait station
  vs
  hand-distribution.

Objective: to determine the percentage of the population of primary rodent reservoirs that consumed bait.

Results: In bait box locations, 91% of captured mice were RhB-positive, 89% in hand broadcast locations, and 80% in time-release station locations.

New

CAES
The Connecticut Agricultural Experiment Station
Putting Science to Work for Society since 1875

US BIOLOGIC

For Additional Information
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Mason Kauffman, (901) 230-5771
mason.kauffman@usbiologic.com

Stafford III, Kirby C., Scott C. Williams, Jolieke G. van Oosterwijk, Megan A. Linske, Steve Zatechka, Luciana M. Richer, Goudarz Molaei, Chris Przybyszewski, and Stephen K. Wikel. 2020.

Field Evaluation of a Novel Oral Reservoir-Targeted Vaccine Against *Borrelia burgdorferi* Utilizing an Inactivated Whole-Cell Bacterial Antigen Expression Vehicle. Exp. Appl. Acarol. 80(2):257-268.

Borrelia burgdorferi infection in fully, partially, and slightly engorged larval *Ixodes scapularis* parasitizing *Peromyscus leucopus* in 2015 and 2016.

	2015		2016	
	Control	RTV	Control	RTV
# larvae	54	31	66	87
# Infected	22	11	26	8
% infected	41%	35%	39%	9%
Pearson *P* value	No Significance		< 0.001	

During the two-year vaccination period, a significant decrease ($P < 0.001$) in the percentage of *B. burgdorferi*-infected *I. scapularis* larvae parasitizing *P. leucopus* was observed, as was a significant reduction ($P < 0.0001$) in the percentage of infected *P. leucopus*, based on enzyme-linked immunosorbent assay, on RTV-treated properties when compared to control properties.

White-tailed deer

- ✓ Dramatic increase in population density in many areas.
- ✓ Increased deer-human conflicts:.
  - * deer-vehicle collision
  - * agricultural damage
  - * forest damage
  - * damages to households
- ✓ Primary host for adult ticks

The Relationship Between Deer Density, Tick Abundance, and Human Cases of Lyme Disease in a Residential Community

HOWARD J. KILPATRICK,[1,2] ANDREW M. LABONTE,[1] AND KIRBY C. STAFFORD, III[3]

J. Med. Entomol. 51(4): 777–784 (2014); DOI: http://dx.doi.org/10.1603/ME13232

Fig. 1. MC and adjacent Groton Long Point community in Groton, CT, with tracts of open space. Red lines delineated three tracts of land open to hunting.

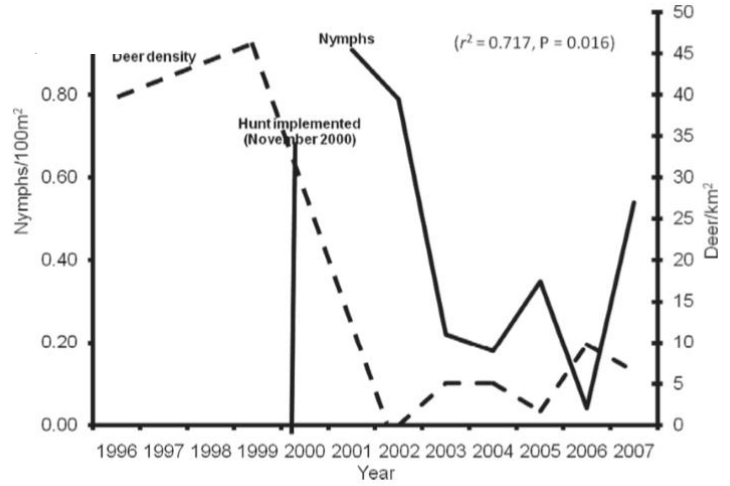


Fig. 4. Nymphal tick density and deer densities in the MC community in Groton, CT, 1996–2007.

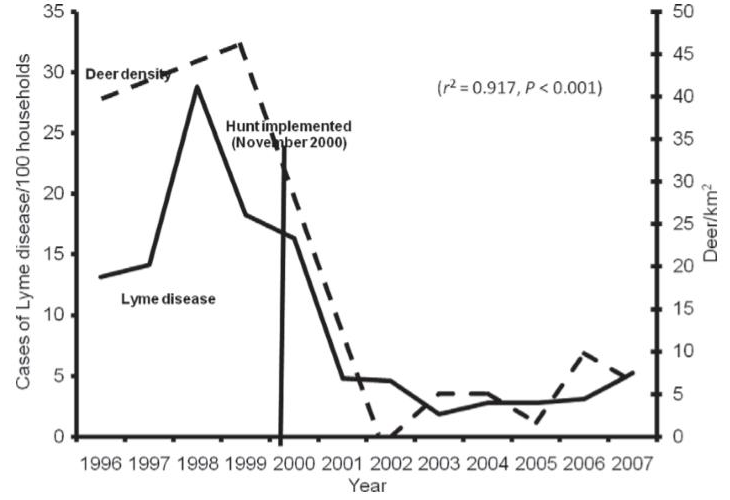


Fig. 5. Reported cases of Lyme disease and deer densities in the MC community in Groton, CT, 1996–2007.

Important things to know about Lyme disease:

- It's a serious public health issue.
- The black-legged tick spreads the disease by ingesting and spreading a bacterium that is transmitted through blood.
- The black-legged tick itself becomes infected with Lyme disease-causing bacteria by feeding on an infected "reservoir host", an organism that carries high levels of the bacteria in its bloodstream. In most areas, this first host is the white-footed mouse.
- Deer are one of many vertebrate hosts that carry this tick. Other hosts include mice, chipmunks, raccoons, squirrels, lizards in addition to many popular songbirds, totaling well over 60 species.
- The black-legged tick has three active life stages (larva, nymph, and adult) which each take a single blood meal from a host. The tick seems to prefer a progressively larger host to feed upon at each life stage.
- Killing deer will not reduce the risk of Lyme disease for people.

https://www.humanesociety.org/resources/lyme-disease

Lyme Disease

Killing deer can make matters worse

THE HUMANE SOCIETY OF THE UNITED STATES

Practical solutions

4-Poster Bait Box System

One proven way to reduce tick numbers is the

4-Poster bait box system

. It attracts deer to corn bait stations where a tick-killing product is applied to the deer's neck and shoulders. In essence, this device uses deer to kill ticks and has shown dramatic reductions in tick numbers in areas where it has been used. The 4-Poster bait box is commercially available in the United States, but using and maintaining it requires a special license. For more information, see: http://www.liebertonline.com/toc/vbz/9/4.

Tick Tubes

Homeowners can use Damminix Tick Tubes—tubes filled with permethrin-treated cotton balls which mice use for nesting material. This kills the ticks in their early larval stage when they attach to mice as their first host. Damminix tubes are an effective approach to reducing ticks and are commercially available at garden or hardware stores or the internet.

Avoiding Lyme disease

- Check your body thoroughly for ticks immediately after removing clothing and placing everything in the washer. Do the same for your child until he is old enough to do so for himself. This is the single most important way to find ticks before they engorge themselves and are able to transmit the disease. It generally takes about 36 hours before the tick has consumed enough blood to transmit Lyme disease—thus if a tick is found within 24 hours of attaching to a person, it is unlikely it could have transmitted enough of the bacterium to cause Lyme disease.

ARS ‘4-Poster’ Deer Treatment Bait Station & ‘2-Poster’ Treatment Adaptor:

The Northeast Area-wide Tick Control Project (NEATCP)

- ✓ **2.1 million, 5-year (1997-2002) project**
- ✓ **7 individual 2-square-mile study sites**
- ✓ **in five states: Connecticut, Maryland, New Jersey, New York, and Rhode Island**
- ✓ **60-82 % reduction in tick population.**

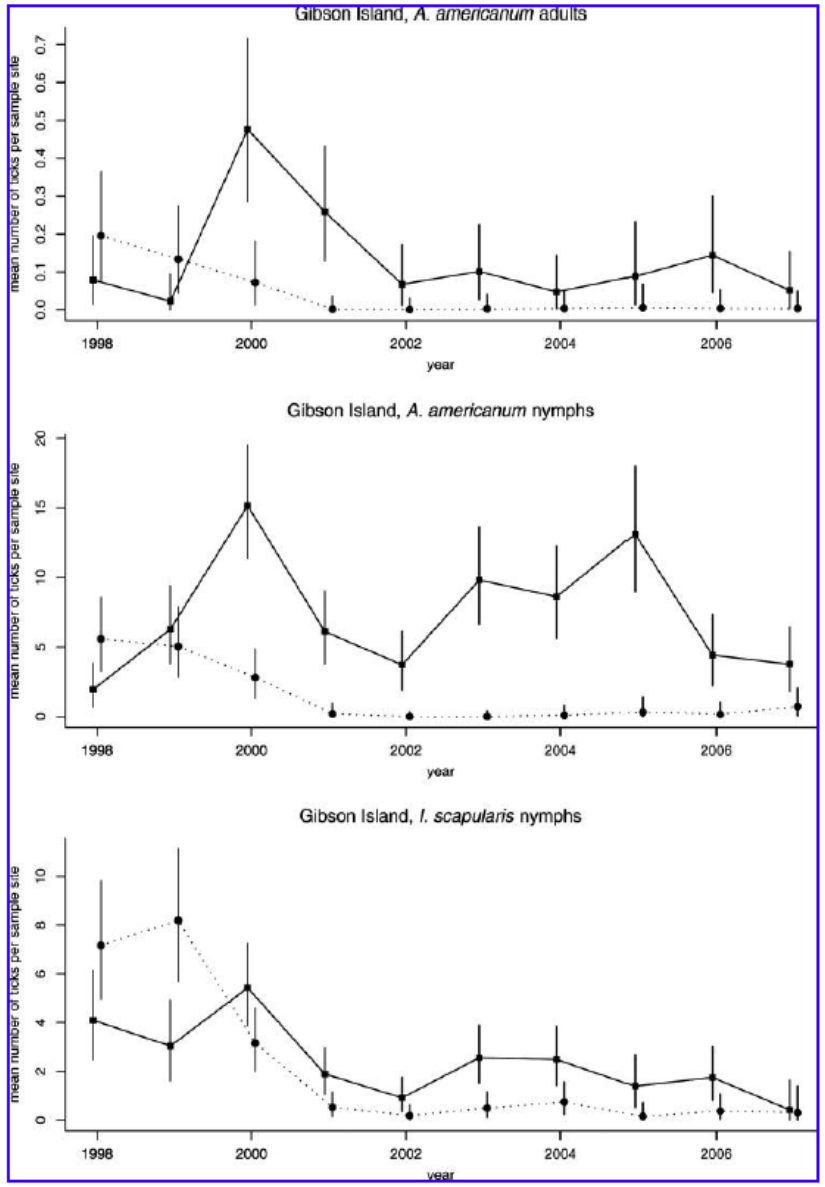
VECTOR-BORNE AND ZOONOTIC DISEASES
Volume 9, Number 4, 2009

DOI: 10.1089/vbz.2008.0166

ORIGINAL ARTICLE

Sustained Control of Gibson Island, Maryland, Populations of *Ixodes scapularis* and *Amblyomma americanum* (Acari: Ixodidae) by Community-Administered 4-Poster Deer Self-Treatment Bait Stations

John F. Carroll,[1] J. Mathews Pound,[2] J. Allen Miller,[2] and Matthew Kramer[3]



Previous studies

USDA-ARS Northeast Tick Project (1997–2002)

Evaluation of "4-Poster" for control of the blacklegged tick and lone star tick in 5 northeastern states.

Results published in Vector-Borne and Zoonotic Diseases 9(4) 2009

New Jersey (Schulze et al. 2009)

- 83%, 77%, and 94% reduction in host-seeking larvae, nymphs, ad adults (*I. scapularis*)
- 83%, 77%, and 94% reduction in host-seeking larvae, nymphs, ad adults (*A. americanum*)

Maryland (Carroll et al. 2009)

- 69-80% reduction in host-seeking nymphs of the blacklegged tick (*I. scapularis)*
- 95-99% reduction in host-seeking nymphs of the lone star tick (*A. americanum*)

Rhode Island (Miller et al. 2009)

* After 2 years of "4-Poster" use, 50% control of nymphal blacklegged ticks was achieved.
- The tendency of white-tailed deer to use the 4-Poster appeared to be dependent on the availability of alternative food sources.

Connecticut (Stafford et al. 2009)

- 46-70% reduction in host-seeking nymphs and 19% in host-seeking adults (*I. scapularis*)
- The passive topical application to deer of the acaricide amitraz resulted in a significant decrease in the population of free-living *I. scapularis* nymphs in the treated core in Connecticut

New York (Daniels et al. 2009)

- 54-80% reduction in host-seeking nymphs (*I. scapularis*)
- The 4-Poster effectively reduced the density of *Ixodes scapularis*, though the level of control is dependent on environmental factors that affect feeding behavior of white-tailed deer.

Overall, the density of nymphs infected with *B. burgdorferi* and consequently the acarological risk for Lyme disease was reduced by 68% among five study sites. (Hoen et al. 2009)

More recent studies

"4-Poster" study on Cape Cod, Martha's Vineyard, and Nantucket (2012-2015)

Grear et al. 2014. Parasites and vectors

* Achieved only a 8.4% reduction in blacklegged tick abundance.

"4-Poster" study against the lone star tick in Tennessee (4-year study)

Harmon et al. 2011. Journal of Vector Ecology

* 91%, 68%, and 49% reduction in larval, nymphal and adult abundance close (>300 m) to '4-Poster".
* The use of "4-Poster" has little large scale effect on the health risk posed by ticks in the community.

"4-Poster" Study in Fairfax County, Virginia (2012-2015)

Fairfax County Study Report. 2016

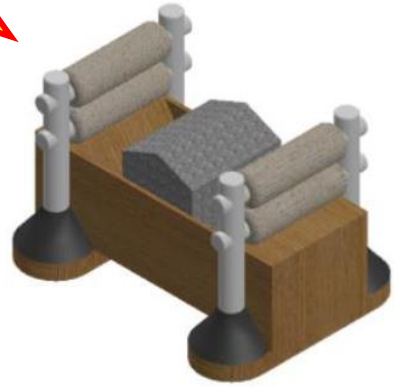
* Although some tick control was seen, widespread reduction in tick abundance was not observed.
* Negative environmental effects; Increased deer density

Issues observed with the “4-Poster” device

Damages

TickLick - USDA's new generation of the deer "Bait Treatment System"

New

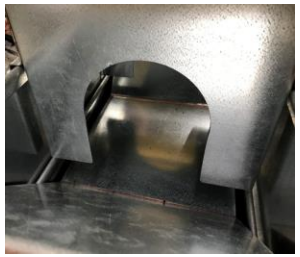


Preliminary test of animal access / usage in 9 days (June 1-9, 2017)

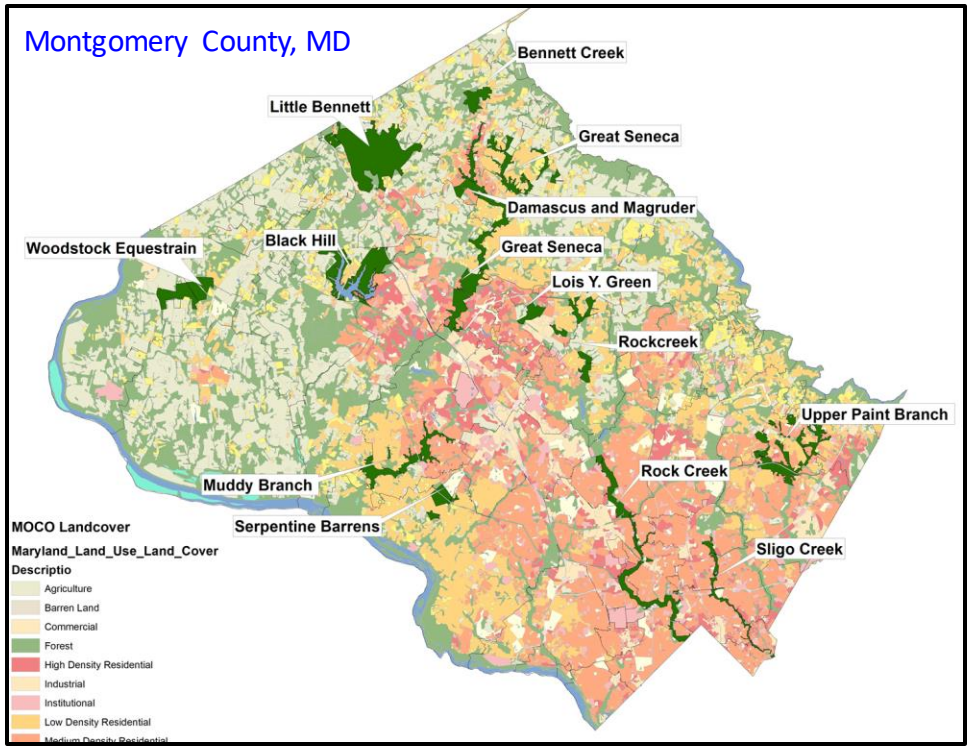
Animal species	Bait type	Total times visited
White-tailed deer	Salt	63
Squirrel	Salt	16
Raccoon	Salt	3

- Mineral /salt block as bait.
- Use the same acaricide formulation (10% permethrin) to treat rollers.
- A patent application has been filed in August 2020.
- New study is planed for Montgomery County, MD (2020 - 2022)

Field trials of "TickLick" by USDA-ARS with cooperation of the University of Maryland (2020 – 2022)



- Deer visits in comparison to "4-poster"
- Non-target animals
- Preferred bait (mineral/salt) blocks for different seasons
- Preferred locations
- Number of units for a given area



Summary

- We have a limited number of host-targeted tick control tools/commercial products for tick control. None has achieved widespread use.
- Pros and Cons:
  - **Tick tubes**
    + easy to use, relatively inexpensive
    - uncertain about efficacy; need more studies
  - **TCS Bait Boxes**
    + proven efficacy, scientific studies
    - expensive, deployed by pest control professional
  - **"4-Poster" device**
    + demonstrated efficacy in early studies
    - not very effective in recent studies
    - deployed only by pest control professional
    - costs, maintenance issues, large amount of corns fed to wildlife
- Few new devices are in development, but no silver bullet.
- Studies to test and validate IPM strategies are in progress
- Lack of the organizational structure and funds required for community-based tick IPM.

USDA-ARS
Areawide Tick Management Project Team
& Cooperators / Collaborators

Acknowledgments




USDA Agricultural Research Service
Howard County Recreation & Parks
University of Maryland
CDC
APHC
The Pennsylvania State University
University of Massachusetts Amherst

Questions?

Northeastern IPM Center

Some Questions for You

Request for Proposals

Northeastern IPM Center

- Due date: November 12, 2020
- https://www.northeastipm.org/grant-programs/ipm-center-grants/ipm-partnership-grants/

Find a Colleague

Northeastern IPM Center

- To post a profile about yourself and your work:
  - http://neipmc.org/go/APra
- “Find a Colleague” site
- http://neipmc.org/go/colleagues

Upcoming Webinars

Northeastern IPM Center

- **Tick IPM #7: Leaf Litter/Snow Removal for Tick Reduction**

  Dr. Kirby C. Stafford III, Connecticut Agricultural Experiment Station,

  October 7, 2020 – 11:00 a.m.

For Updates: https://www.northeastipm.org/ipm-in-action/the-ipm-toolbox/

Northeastern IPM Center

Recording of Tick IPM Webinar Series

- Past recordings and today's Webinar will be available to view **on demand** in a few business days.
- http://www.neipmc.org/go/ipmtoolbox
- You can watch as often as you like.

Acknowledgments

This presentation was funded in part by the Northeastern IPM Center through Grant #2018-70006-28882 from the National Institute of Food and Agriculture, Crop Protection and Pest Management, Regional Coordination Program.

United States Department of Agriculture
National Institute of Food and Agriculture