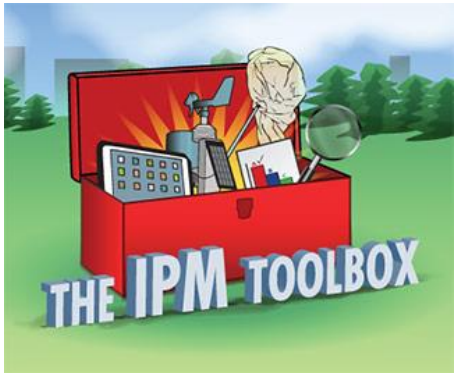
How IPM Can Help Keep Children Safe from Lyme Disease at Schools and in Suburban Communities



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Webinar Details

- 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.

Webinar Presenters

Kathy Murray, Ph.D.
Maine Department of Agriculture, Conservation and Forestry, Augusta, ME
www.maine.gov/IPM |
www.maine.gov/schoolipm

Andrew Li, Ph.D.
USDA

Outline

- Scope of the tick/Lyme disease problem
- IPM Resources for Schools

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Some Questions For You

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The Scope of the Tick/Lyme Problem

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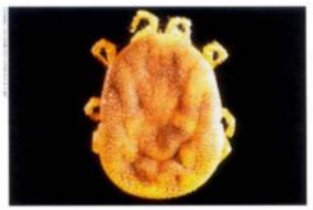


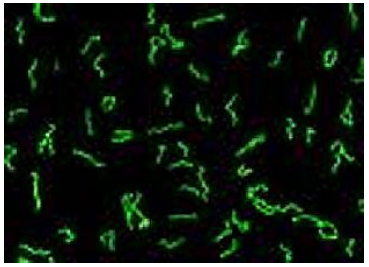
Tick species common name	Distribution	Diseases transmitted
Ixodes scapularis Blacklegged tick	Wide distribution in Eastern half of the U.S.	Lyme disease, anaplasmosis, babesiosis, and Powassan disease
Ixodes pacificus Western blacklegged tick	Along the Pacific coast of the U.S., particularly northern California	Anaplasmosis and Lyme disease
Amblyomma americanum Lone star tick	Widely distributed in the southeastern and eastern United States.	Causative agents of human ehrlichiosis, tularemia, and southern tick-associated rash illness.
Amblyomma maculatum Gulf coast tick	Coastal areas of the U.S. along the Atlantic coast and the Gulf of Mexico	Rickettsia parkeri rickettsiosis, a form of spotted fever.
Dermacentor variabilis American dog tick	Widely distributed east of the Rocky Mountains. Also occurs in limited areas on the Pacific Coast	Tularemia and Rocky Mountain spotted fever.
Dermacentor andersoni Rocky Mountain wood tick	Rocky Mountain states and southwestern Canada from elevations of 4,000 to 10,500 feet.	Rocky Mountain spotted fever, Colorado tick fever, and tularemia.
Rhipicephalus sanguineus Brown dog tick	Throughout the U.S.	Rocky Mountain spotted fever (in the southwestern U.S. and along the U.S.-Mexico border)
Ixodes cookei Woodchuck tick	Throughout the eastern half of the U.S. and Canada	Powassan disease
Ornithodoros spp. soft ticks	Throughout the western half of the U.S. and southwestern Canada	Tick-borne relapsing fever (Borrelia hermsii, B. parkerii, or B. turicatae)

The Blacklegged Tick

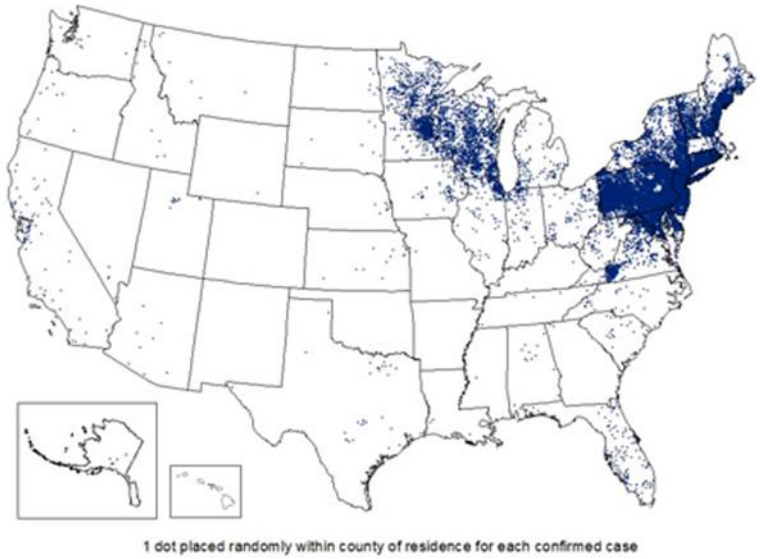
the vector of

Lyme disease

- ✓ *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*

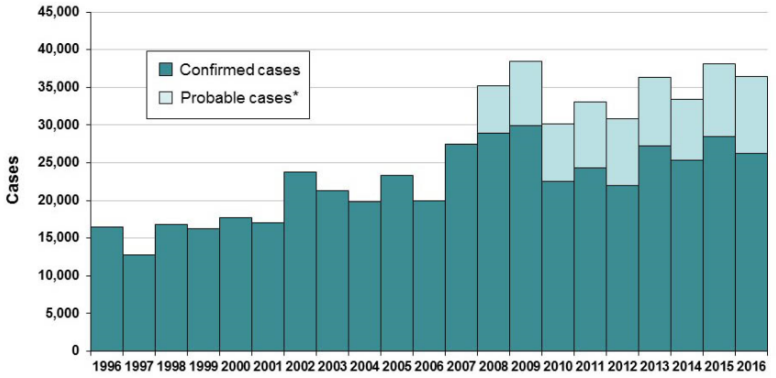


Borrelia burgdorferi



~ 300,000 cases / year

Reported Cases of Lyme Disease by Year, United States, 1996-2016



*National Surveillance case definition revised in 2008 to include probable cases; details at http://www.cdc.gov/ncphi/disss/nndss/casedef/lyme_disease_2008.htm

CDC

The **burden** of tick-borne illness, in terms of cost to both individuals and society, is astronomical and **only getting worse**.

Annual Cost of Lyme disease in the United States

Annual Cases of Lyme Disease The CDC raised case estimates based on national survey data by a factor of 10X in 2013

300,000

* **Lyme Disease Cost Per Case**
Direct Medical Costs, Indirect Medical Costs, Lost Income, Lost Taxes, and Related Lyme Disease Costs Per Case and adjusted for 2014 dollars

X $10,769

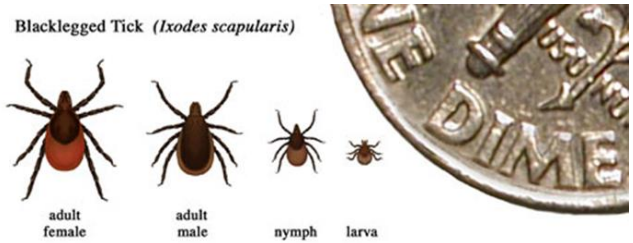
Total Annual Cost Burden

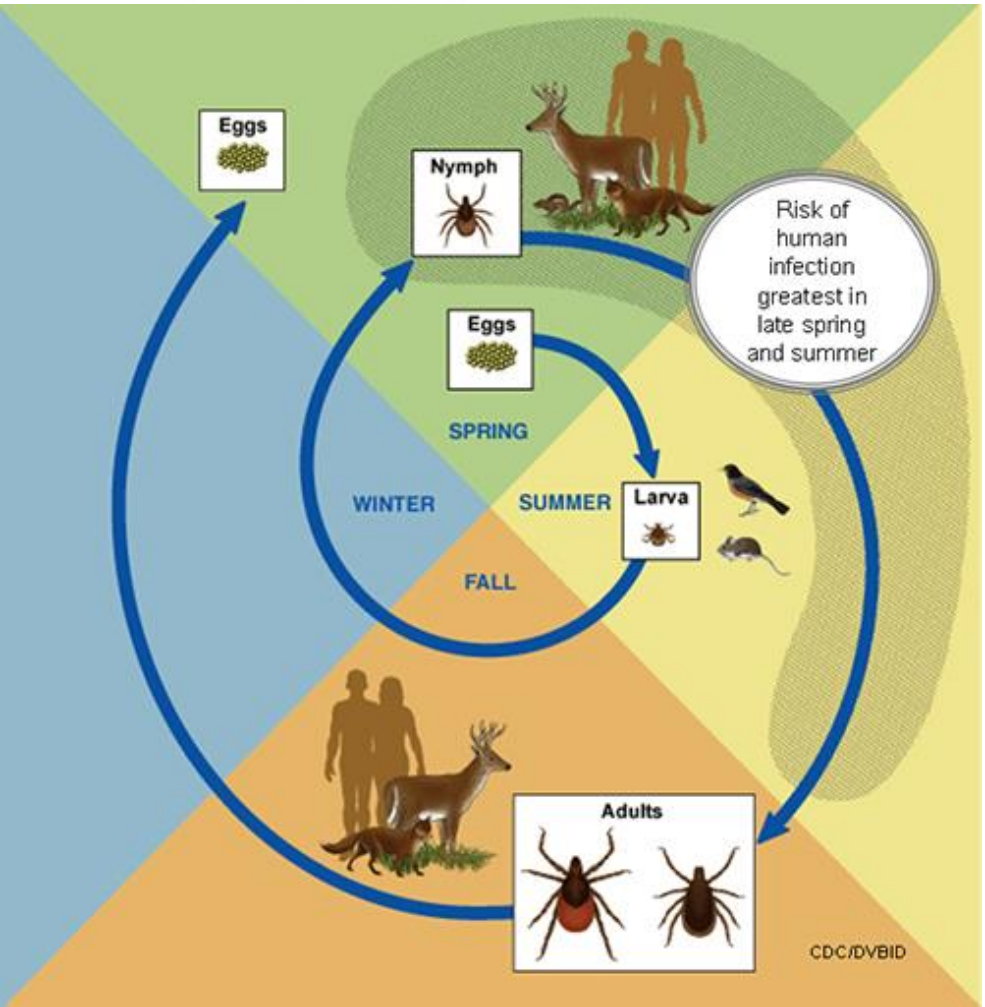
$3,230,700,000

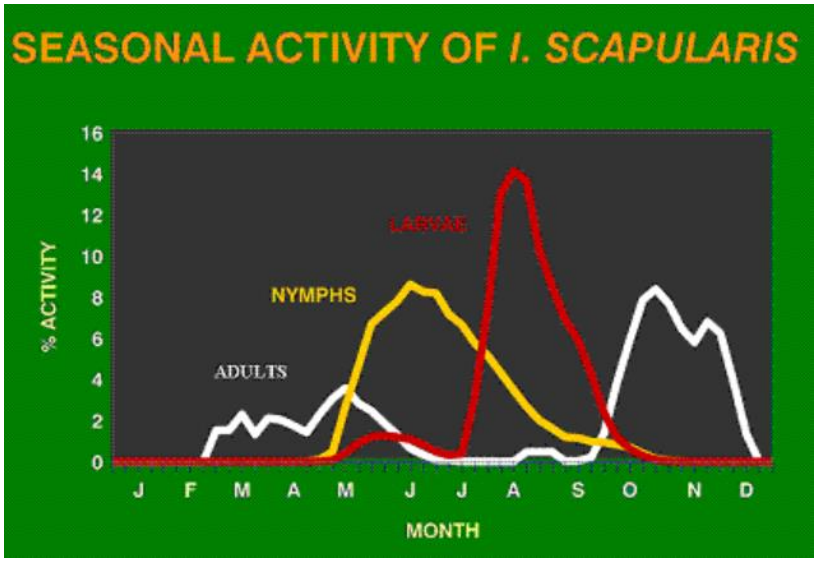
*Source: Zhang, X., Meltzer, M.I., Pena, C.A., Hopkins, A.B., Wroth, L., and Fix, A.D. (2006) Economic Impact of Lyme Disease, Emerging Infectious Diseases, 12(4), 653 – 660. Adj. for inflation 2006 - 13)

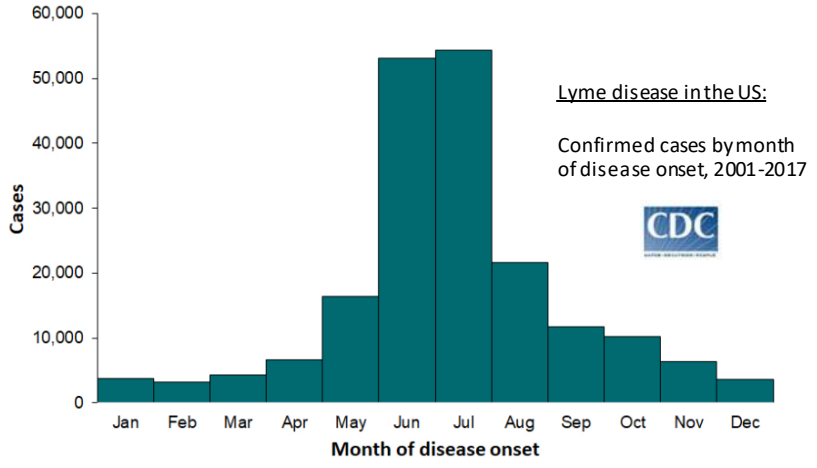
Jill Auerbach
Chairperson, Hudson Valley Lyme Disease Association
Coordinator, Tick Research to Eliminate Diseases: Scientist Coalition

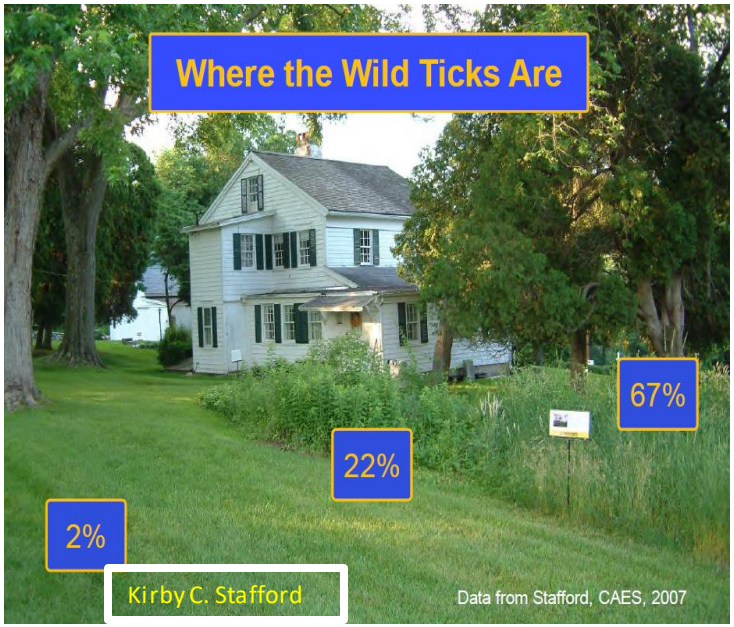
Life cycle of the blacklegged tick

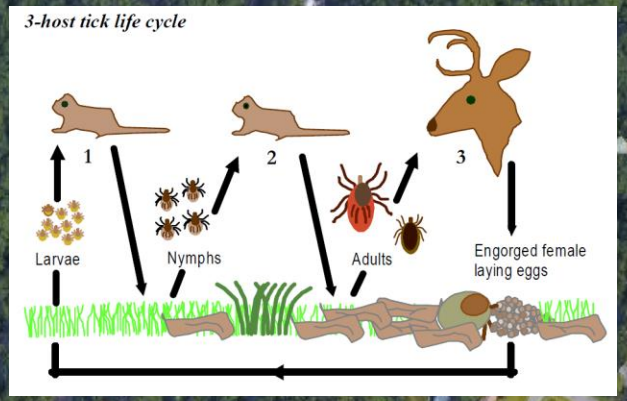










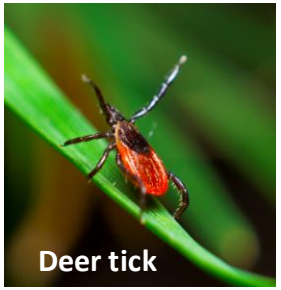


Distribution of *I. scapularis* ticks:

- 67.3% woods, 21.6% ecotone, 2% on the lawn
- 82% nymphs are within 3-m of the lawn edge with woods, stone walls, ecotone, etc.

Estimated 75% ticks are picked up outdoors at home.

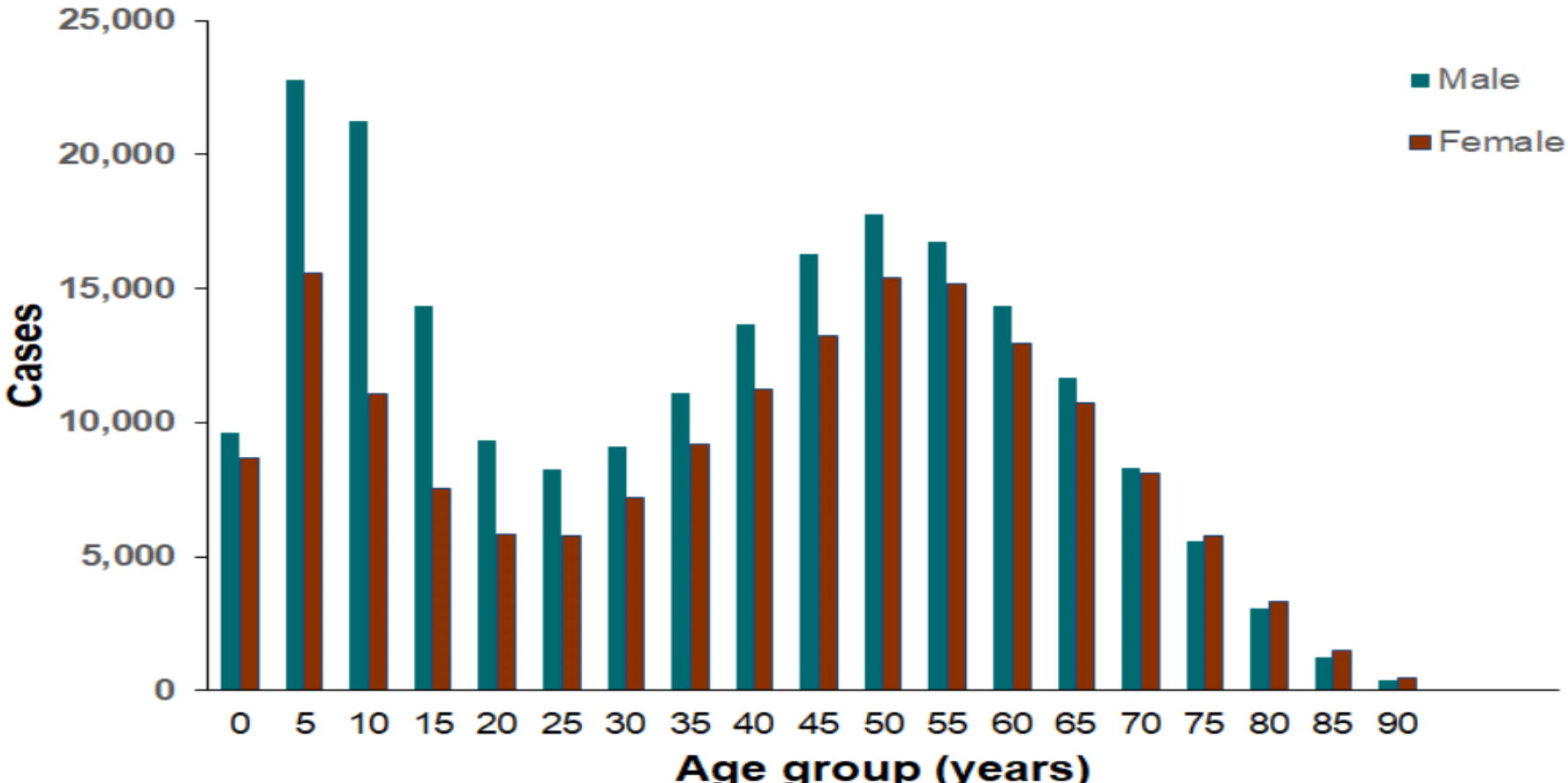
Maupin et al. 1991; Stafford & Magnarelli 1993; Carroll et al. 1992.


Deer tick


School children are at high risk
to tick bite and Lyme disease
Elementary School




Confirmed Lyme disease cases by age and sex--United States, 2001-2017



QUESTIONS

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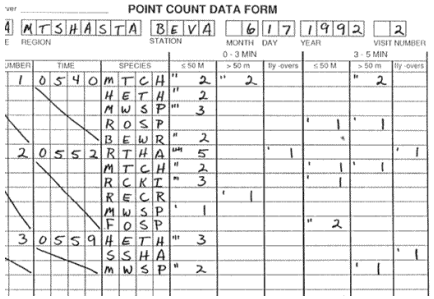
Tick Management at Schools


POINT COUNT DATA FORM

4 MTSHASTA BEVA 6 17 1992 2

REGION STATION MONTH DAY YEAR VISIT NUMBER

NUMBER	TIME	SPECIES	0-3 MIN ≤50 M	0-3 MIN >50 m	0-3 MIN fly-overs	3-5 MIN ≤50 M	3-5 MIN >50 m	3-5 MIN fly-overs
1	0540	MTCH	2	2			2	
		HETH	2					
		MWSP	3					
		ROSP				1	1	
		BEWR	2					
2	0552	RTHA	5		1			1
		MTCH	2			1	1	
		RCKI	3			1		
		RECR		1				
		MWSP	1					
		FOSP				2		
3	0559	HETH	3					1
		SSHA						
		MWSP	2				1	

4. Record-keeping and evaluation

1.Identify and Monitor Ticks

2. Develop Prevention & Action Plan

3. Employ multi-pronged tick management strategies

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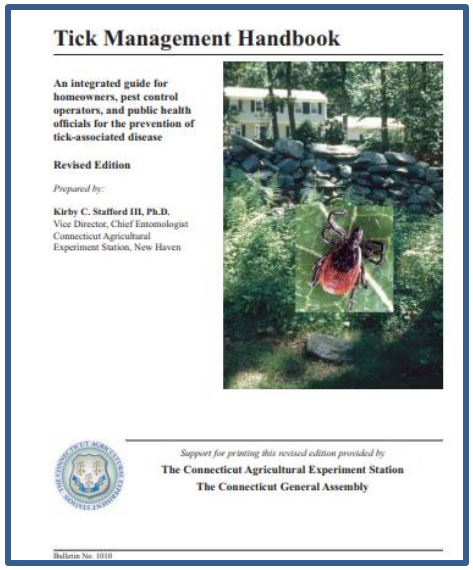
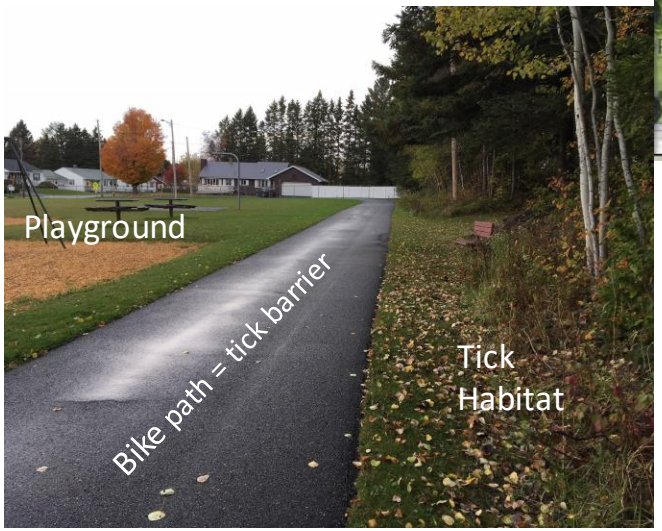
Landscape Management

- Vegetation management
  - Keep grass mown
  - prune shrubs/ trees to decrease shade and humidity
  - Widen trails
- Move playground structures away from wooded edges
- Install dry barrier (gravel or paved path) at playground/woods interface



Graphic courtesy of Dr. Kirby Stafford, CT Agricultural Experiment Station



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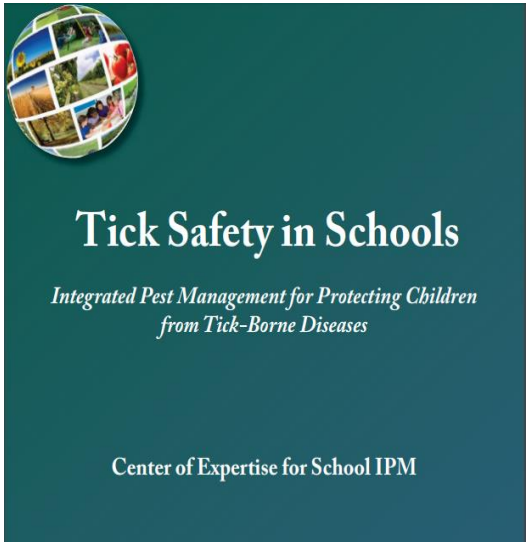
Tick IPM Strategies (con't)

- Discourage rodent activity on playgrounds
  - Seal stone walls
  - Close up spaces under sheds
  - Eliminate bird-feeders
- Redirect human activity away from infested areas (signage, education, barriers)

www.maine.gov/schoolipm



www.epa.gov/managing-pests-schools

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Personal Protection

- Apply repellent to exposed skin
- Wear protective clothing
- Body checks
- Education and communication

Art by Hailey Mealey
haileyjaneco.com

Pesticides

Perimeter Treatment: Spray or granular application at wooded margins of play areas

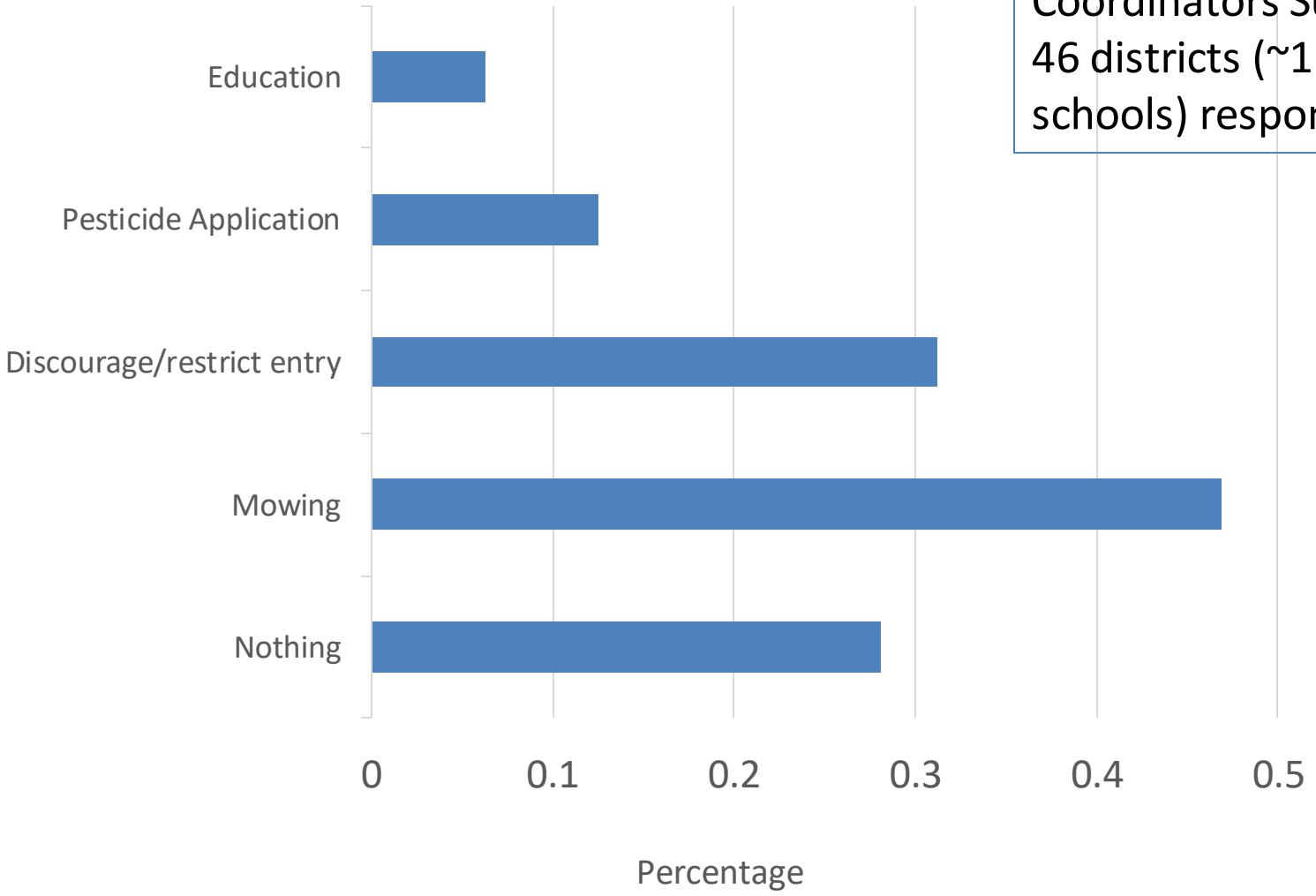
- Commercially licensed applicator required
- 2-3 applications (in New England: ~ mid-May, mid-June, plus September if needed)
- Select pesticides with proven efficacy.
- Follow all applicable state and federal regulations.

Photo: TickEncounter.org

Good resource:
www.TickEncounter.org (URI)

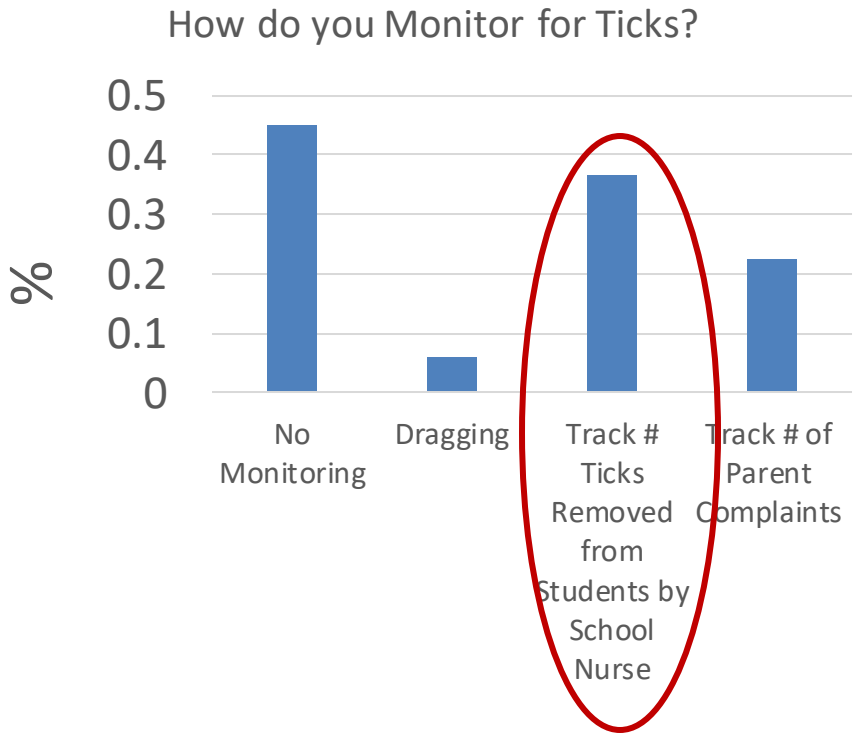
How are Maine Schools Managing Ticks?

Maine School IPM Coordinators Survey, 2017. 46 districts (~175 schools) responding



Are Schools Monitoring for Ticks?

Maine School IPM Coordinators Survey, 2017. 46 districts responding



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Effective School IPM is a Team Effort

Nurse: Diagnosis, tick removal, communication, education

Contracted pest Service: monitoring, control communication

IPM Coordinator is the Team Captain

Students. Teachers, Coaches: education, tick avoidance, personal protection

Business Manager: Service contracts, budgeting

Office Staff: communication, records, scheduling

Maintenance Staff and Grounds Keepers:

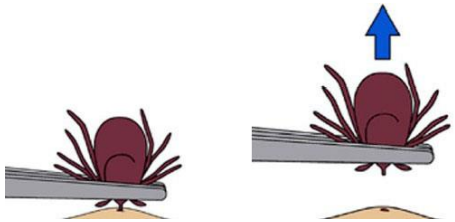
Turf and Grounds Maintenance

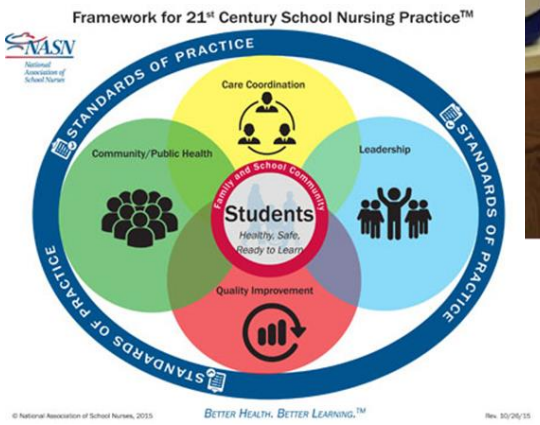
Engage School Nurses in Tick IPM

NE School IPM Working Group
www.neipmc.org/schools

Why School Nurses?

- **First-responders** for health-threat pests
- **Trained** to use **evidence-based practices**
- **Leaders and educators**
- **Strong Networks**





Needs Assessment: What do School Nurses Want?

On-line Survey

827 participants

10 states

Video Conference

- Pre-conference survey: 46 participants 8 states
- Conference: 27 participants in 5 states

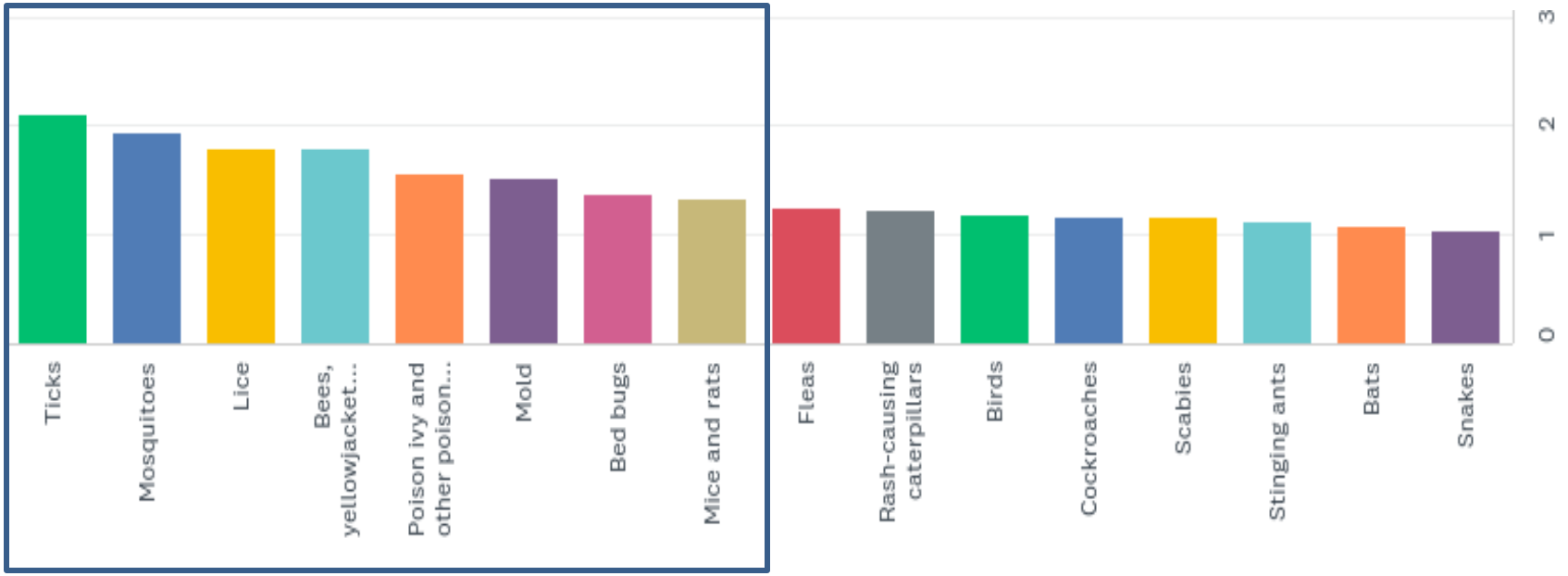
Findings and Recorded Conference

www.maine.gov/schoolipm

Q3: How do you view pest risk concerns in your school(s)?

- Answered: 827 Skipped: 0

On a scale of 1(low) to 3 (high) ticks and mosquitoes are of highest concern

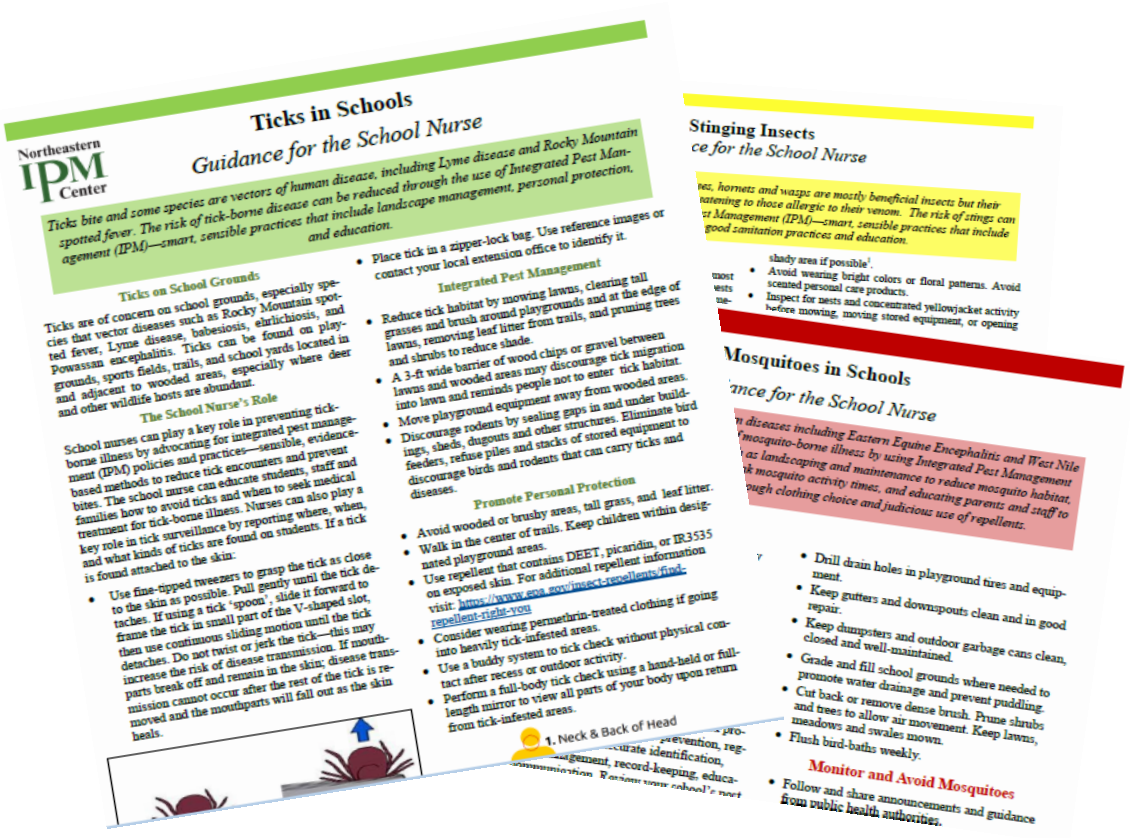


What Do School Nurses Need?

- Concise pest-specific information packets
  - Clearly written protocols
  - Action/decision guides (eg flowcharts)
  - Communication tools (eg sample parent letters and staff memos)
  - Web-based materials
- Training
  - Webinars
  - On-line self-paced modules

Pest-Specific Guide Sheets

- Ticks
- Mosquitoes
- Head Lice
- Stinging Insects
- Rodents



Ticks in Schools

Guidance for the School Nurse

Northeastern IPM Center

Ticks bite and some species are vectors of human disease, including Lyme disease and Rocky Mountain spotted fever. The risk of tick-borne disease can be reduced through the use of Integrated Pest Management (IPM)—smart, sensible practices that include landscape management, personal protection, and education.

Ticks on School Grounds

Ticks are of concern on school grounds, especially species that vector diseases such as Rocky Mountain spotted fever, Lyme disease, babesiosis, ehrlichiosis, and Powassan encephalitis. Ticks can be found on playgrounds, sports fields, trails, and school yards located in and adjacent to wooded areas, especially where deer and other wildlife hosts are abundant.

The School Nurse's Role

School nurses can play a key role in preventing tick-borne illness by advocating for integrated pest management (IPM) policies and practices—sensible, evidence-based methods to reduce tick encounters and prevent bites. The school nurse can educate students, staff and families how to avoid ticks and when to seek medical treatment for tick-borne illness. Nurses can also play a key role in tick surveillance by reporting where, when, and what kinds of ticks are found on students. If a tick is found attached to the skin:

- Use fine-tipped tweezers to grasp the tick as close to the skin as possible. Pull gently until the tick detaches. If using a tick 'spoon', slide it forward to frame the tick in small part of the V-shaped slot, then use continuous sliding motion until the tick detaches. Do not twist or jerk the tick—this may increase the risk of disease transmission. If mouthparts break off and remain in the skin; disease transmission cannot occur after the rest of the tick is removed and the mouthparts will fall out as the skin heals.
- Place tick in a zipper-lock bag. Use reference images or contact your local extension office to identify it.

Integrated Pest Management

- Reduce tick habitat by mowing lawns, clearing tall grasses and brush around playgrounds and at the edge of lawns, removing leaf litter from trails, and pruning trees and shrubs to reduce shade.
- A 3-ft wide barrier of wood chips or gravel between lawns and wooded areas may discourage tick migration into lawn and reminds people not to enter tick habitat.
- Move playground equipment away from wooded areas.
- Discourage rodents by sealing gaps in and under buildings, sheds, dugouts and other structures. Eliminate bird feeders, refuse piles and stacks of stored equipment to discourage birds and rodents that can carry ticks and diseases.

Promote Personal Protection

- Avoid wooded or brushy areas, tall grass, and leaf litter.
- Walk in the center of trails. Keep children within designated playground areas.
- Use repellent that contains DEET, picaridin, or IR3535 on exposed skin. For additional repellent information visit: https://www.epa.gov/insect-repellents/find-repellent-right-you
- Consider wearing permethrin-treated clothing if going into heavily tick-infested areas.
- Use a buddy system to tick check without physical contact after recess or outdoor activity.
- Perform a full-body tick check using a hand-held or full-length mirror to view all parts of your body upon return from tick-infested areas.

1. Neck & Back of Head

Stinging Insects

ce for the School Nurse

…es, hornets and wasps are mostly beneficial insects but their …atening to those allergic to their venom. The risk of stings can …t Management (IPM)—smart, sensible practices that include …good sanitation practices and education.

- … shady area if possible[1].
- Avoid wearing bright colors or floral patterns. Avoid scented personal care products.
- Inspect for nests and concentrated yellowjacket activity before mowing, moving stored equipment, or opening

Mosquitoes in Schools

…ance for the School Nurse

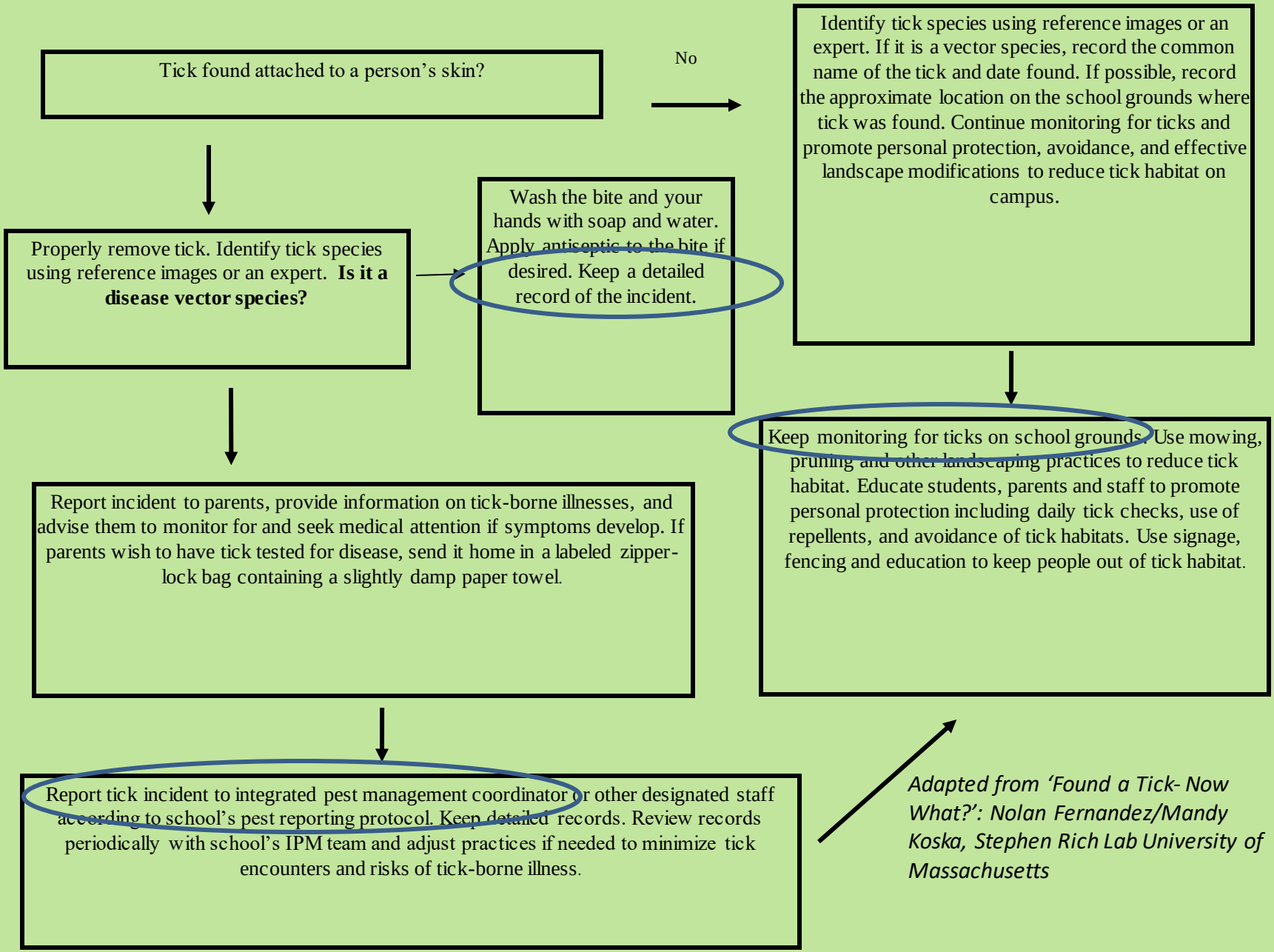
…n diseases including Eastern Equine Encephalitis and West Nile … mosquito-borne illness by using Integrated Pest Management … as landscaping and maintenance to reduce mosquito habitat, …k mosquito activity times, and educating parents and staff to …ough clothing choice and judicious use of repellents.

- Drill drain holes in playground tires and equipment.
- Keep gutters and downspouts clean and in good repair.
- Keep dumpsters and outdoor garbage cans clean, closed and well-maintained.
- Grade and fill school grounds where needed to promote water drainage and prevent puddling.
- Cut back or remove dense brush. Prune shrubs and trees to allow air movement. Keep lawns, meadows and swales mown.
- Flush bird-baths weekly.

Monitor and Avoid Mosquitoes

- Follow and share announcements and guidance from public health authorities.

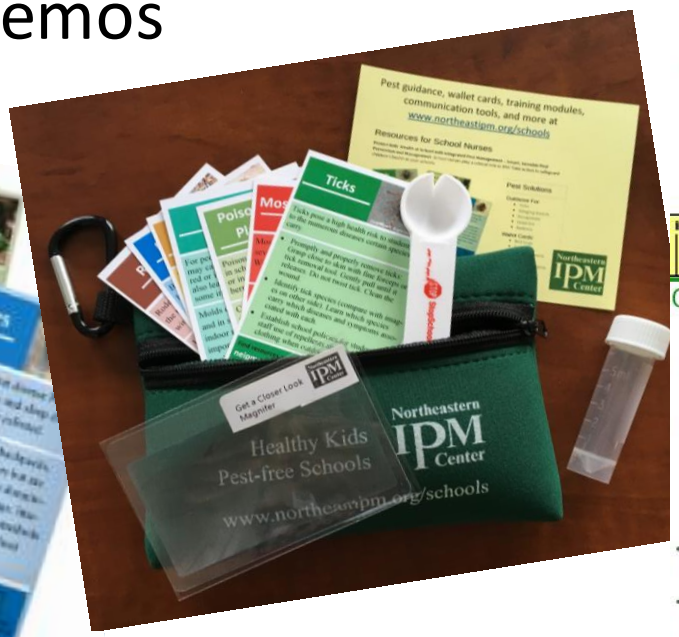
Tick Monitoring and Response Action Chart for Schools

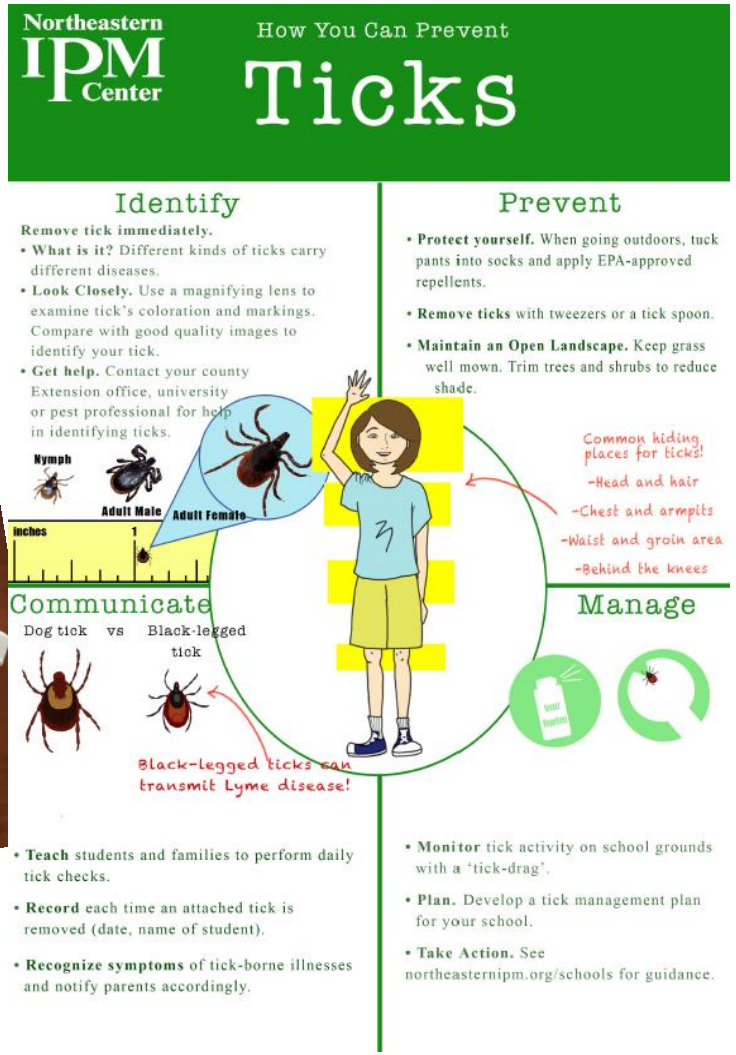


Adapted from 'Found a Tick- Now What?': Nolan Fernandez/Mandy Koska, Stephen Rich Lab University of Massachusetts

Communication and Outreach Tools

- Wallet cards
- Tick “spoons” and kits
- Posters
- Sample memos





Outreach to School Nurses

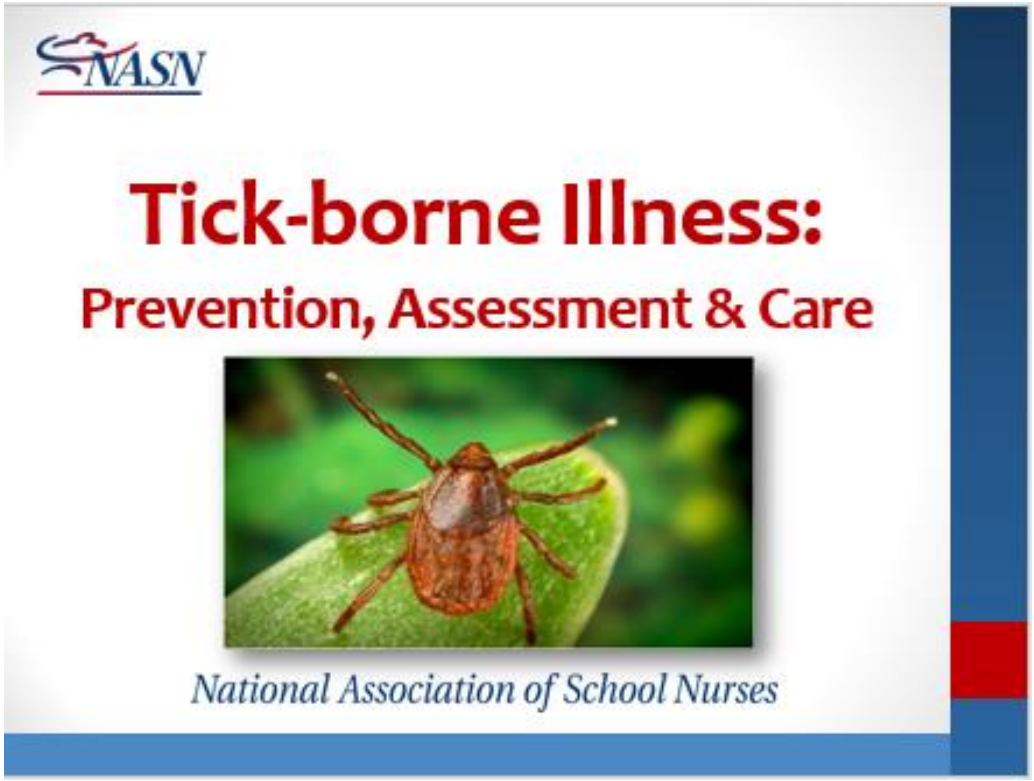
- **National School Nurse Association**
  - Annual Conference
  - Social media and e-news bulletins
- **State and local school nurse conferences**

NASN
1968 - 2018
National Association of School Nurses

maine Department of Agriculture Conservation & Forestry

Updated free Training Module for School Nurses

- **Tick-borne Illness: Prevention, Assessment and Care [2019]** https://www.pathlms.com/nasn/courses/10995
- 1.25 CNE credits for nurses



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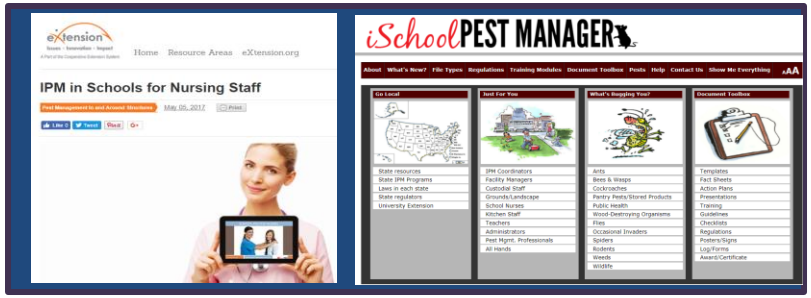
IPM Resources for Schools

- **NE IPM Center: *neipmc.org/schools.* Guidelines, posters, wallet cards, fact sheets and more**

- **IPM Institute: *PestDefenseforHealthySchools.com*** certificate training modules

- **eXtension: *iSchoolPestManager.org.*** Free training modules and searchable repository of resources



- **US EPA: *www.epa.gov/managing-pests-schools.*** Webinars and resources

QUESTIONS

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USDA Areawide Tick Control Project (2016–2021):

Preliminary research results

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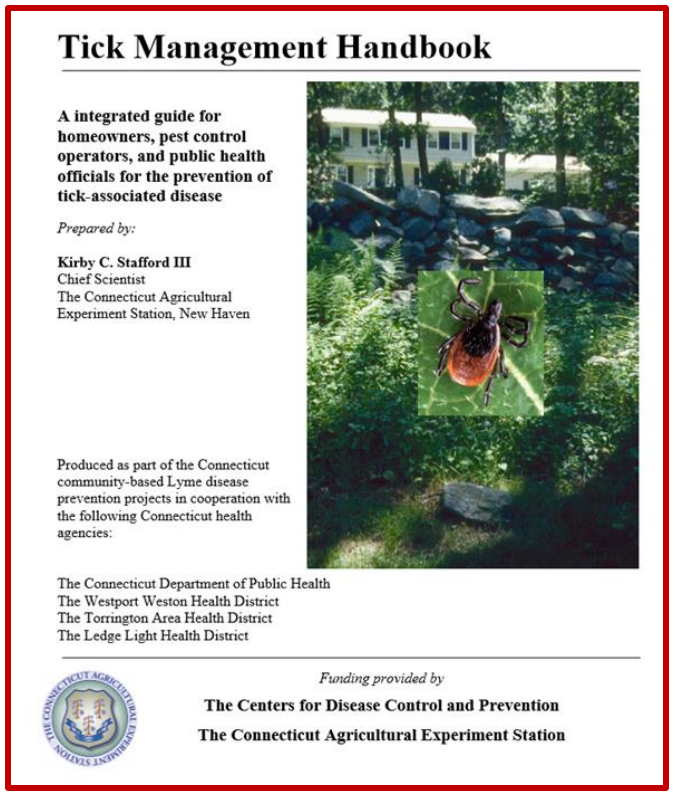

Tick Management Handbook

A integrated guide for homeowners, pest control operators, and public health officials for the prevention of tick-associated disease

Prepared by:

Kirby C. Stafford III
Chief Scientist
The Connecticut Agricultural Experiment Station, New Haven

Produced as part of the Connecticut community-based Lyme disease prevention projects in cooperation with the following Connecticut health agencies:

The Connecticut Department of Public Health
The Westport Weston Health District
The Torrington Area Health District
The Ledge Light Health District

Funding provided by
The Centers for Disease Control and Prevention
The Connecticut Agricultural Experiment Station

Limited number of tick control tools available

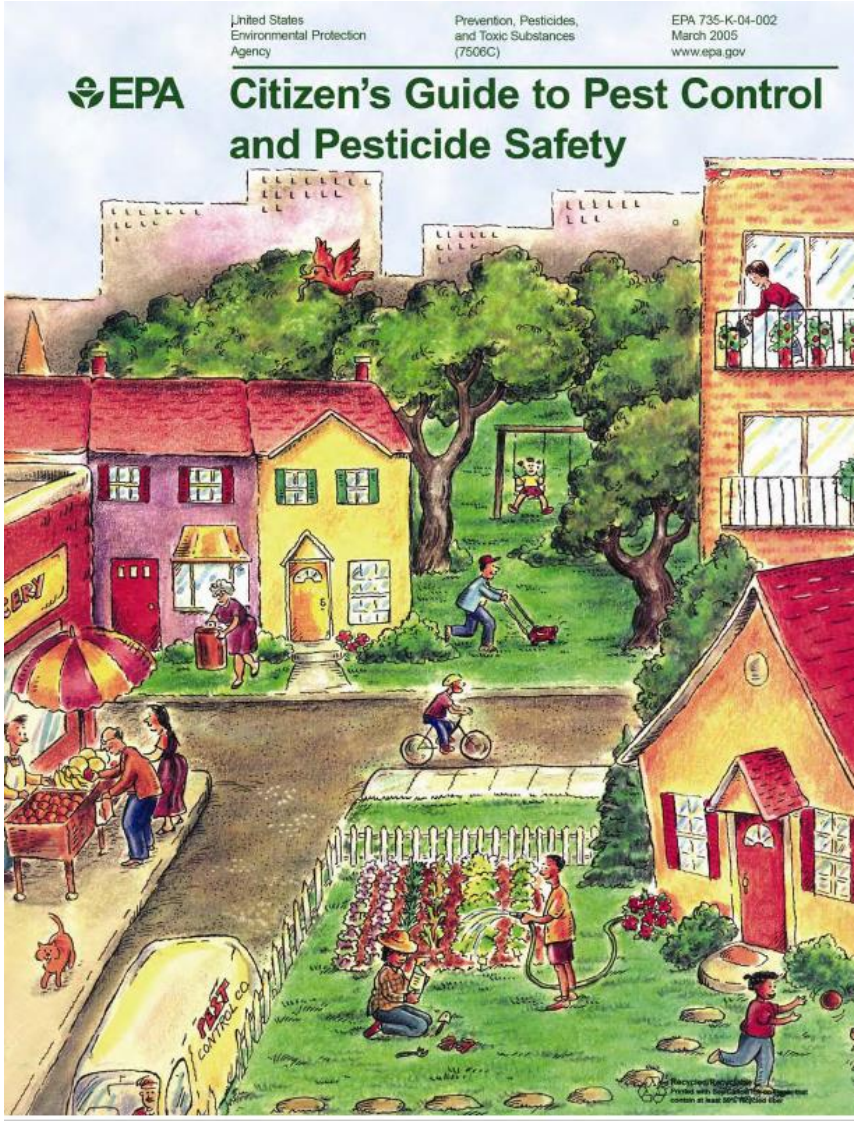
- Area spray of pesticides: *synthetic-* & *bio-pesticides*
- Host-targeted control (immature ticks): *Tick tube*, *Bait box*
- Host-targeted control (adult ticks): *4-Poster*

University of Rhode Island TickEncounter Resource Center

Area application of acaricides & biopesticides

Table 4. Acaricides with products labeled for the control of ticks in the residential landscape.

Chemical	Some brand or common names*	Chemical type and usage
Bifenthrin	Talstar® Ortho® product	Pyrethroid insecticide. Available as liquid and granular formulations. Products available for homeowner use and commercial applicators.
Carbaryl	Sevin®	Carbamate insecticide. A common garden insecticide for homeowner use, some products are for commercial use only.
Cyfluthrin	Tempo® Powerforce™	Pyrethroid insecticide. Available for commercial and homeowner use with concentrates and ready to spray (RTS) products.
Deltramethrin	Suspend® DeltaGard® G	A pyrethroid insecticide for commercial applicators.
lambda-cyhalothrin	Scimitar® Demand®	A pyrethroid insecticide for commercial applicators.
Permethrin	Astro® Ortho® products Bonide® products Tengard® SFR Others	Pyrethroid insecticide. There are concentrates and ready to spray (RTS) products. Most are for homeowner use, a few are for commercial use only.
Pyrethrin	Pyrenone® Kicker® Organic Solutions All Crop Commercial & Agricultural Multipurpose Insecticide®	Natural pyrethrins with the synergist piperonyl butoxide (PBO) or insecticidal soap provide limited tick control. A combination of pyrethrin and PBO with either insecticidal soap or silicon dioxide (from diatomaceous earth) was found effective against ticks in one trial.



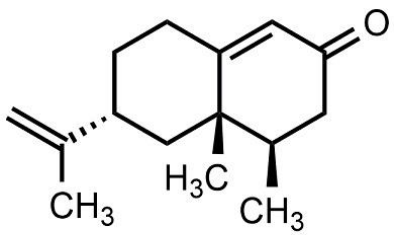
MEDICAL ENTOMOLOGY

Ability of Two Natural Products, Nootkatone and Carvacrol, to Suppress *Ixodes scapularis* and *Amblyomma americanum* (Acari: Ixodidae) in a Lyme Disease Endemic Area of New Jersey

MARC C. DOLAN,[1,2] ROBERT A. JORDAN,[3] TERRY L. SCHULZE,[3,4] CHRISTOPHER J. SCHULZE,[4] MARK CORNELL MANNING,[5] DANIEL RUFFOLO,[5] JASON P. SCHMIDT,[1] JOSEPH PIESMAN,[1] AND JOSEPH J. KARCHESY[6]

J. Econ. Entomol. 102(6): 2316–2324 (2009)

Spray application of natural pesticides can quickly suppress and maintain control of both the blacklegged tick and the lone star tick populations at relatively low concentrations.



(+)-nootkatone

Grapefruit, Alaska Yellow Cedar

Table 1. Probit analysis of four species of ticks (unfed nymphs, n = 250 for each species) 24 h after exposure to nootkatone concentrations

Species	Nootkatone $\mu g/cm^2$ (95% CI)		Slope ± SE	χ^2
	LC_{50}	LC_{90}		
Amblyomma americanum (Lone star tick)	0.352 (0.259–0.481)	1.001 (0.684–2.048)	2.827 ± 0.295	3.761
Dermacentor variabilis (American dog tick)	0.233 (0.172–0.307)	0.644 (0.460–0.170)	2.905 ± 0.307	3.288
Ixodes scapularis (Black-legged ticks)	0.169 (0.138-0.202)	0.549 (0.429–0.771)	2.522 ± 0.295	2.087
Rhipicephalus sanguineus (Brown dog tick)	0.197 (0.169–0.228)	0.485 (0.397–0.641)	3.274 ± 0.357	0.649

χ^2 values <7.81 (0.95, 3 df) indicate that the data do not significantly depart from probit model expectations.

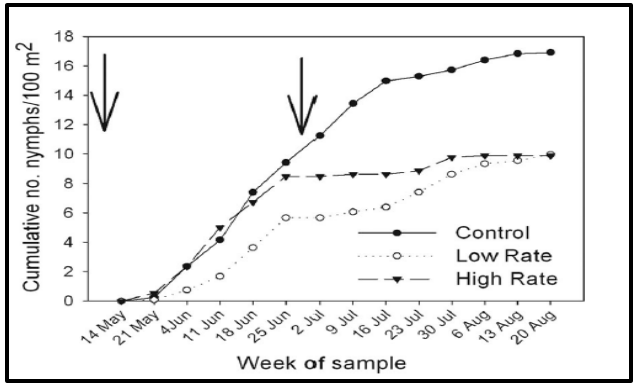
VECTOR CONTROL, PEST MANAGEMENT, RESISTANCE, REPELLENTS

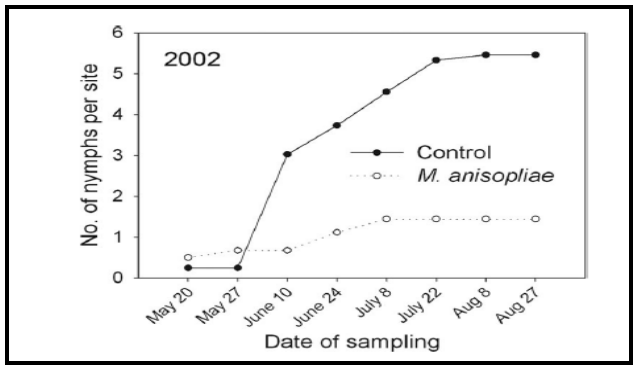
Evaluation of *Metarhizium anisopliae* Strain F52 (Hypocreales: Clavicipitaceae) for Control of *Ixodes scapularis* (Acari: Ixodidae)

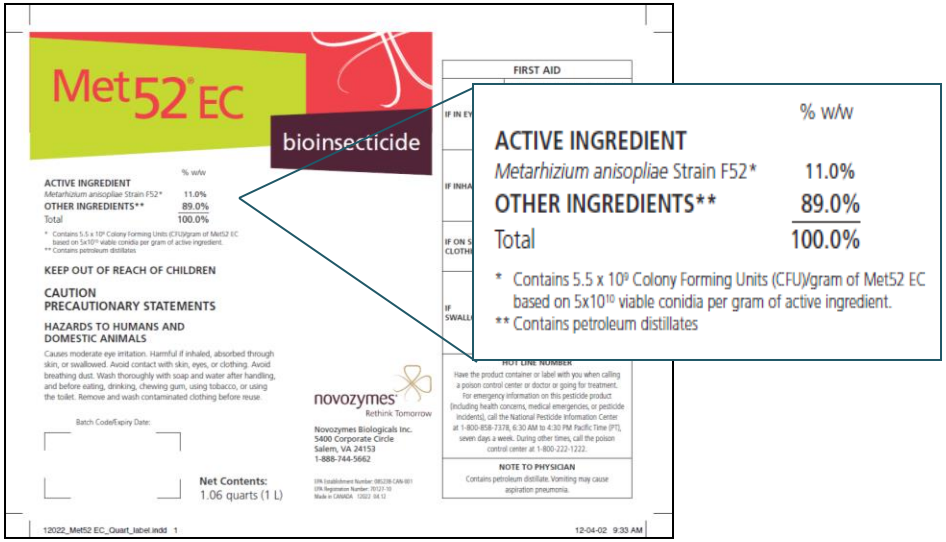
ANUJA BHARADWAJ[1] AND KIRBY C. STAFFORD III

The Connecticut Agricultural Experiment Station, 123 Huntington Street – Box 1106, New Haven, CT 06504

J. Med. Entomol. 47(5): 862–867 (2010); DOI: 10.1603/ME10020







Previous studies indicate that entomopathogenic fungi can suppress host-seeking deer tick populations

Stafford and Allan, 2010

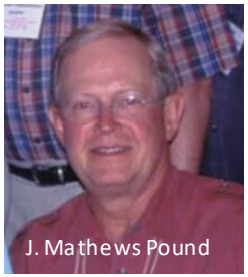
Bharadwai and Stafford, 2010

- Reduced tick abundance 55-84% on lawn and woodland plots.

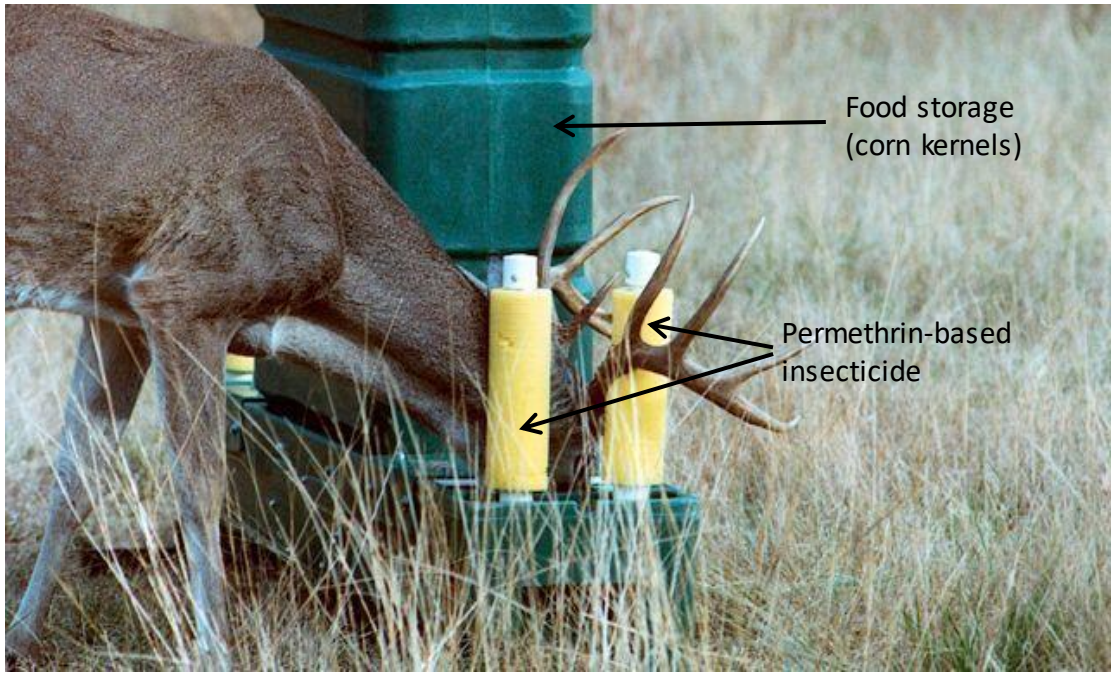
- Reduced tick abundance
  87-96% 3 weeks posttreatment
  53-74% % 5 weeks posttreatment .

Natural fungus kills ticks

ARS “4-Poster”
Deer Treatment Bait Station



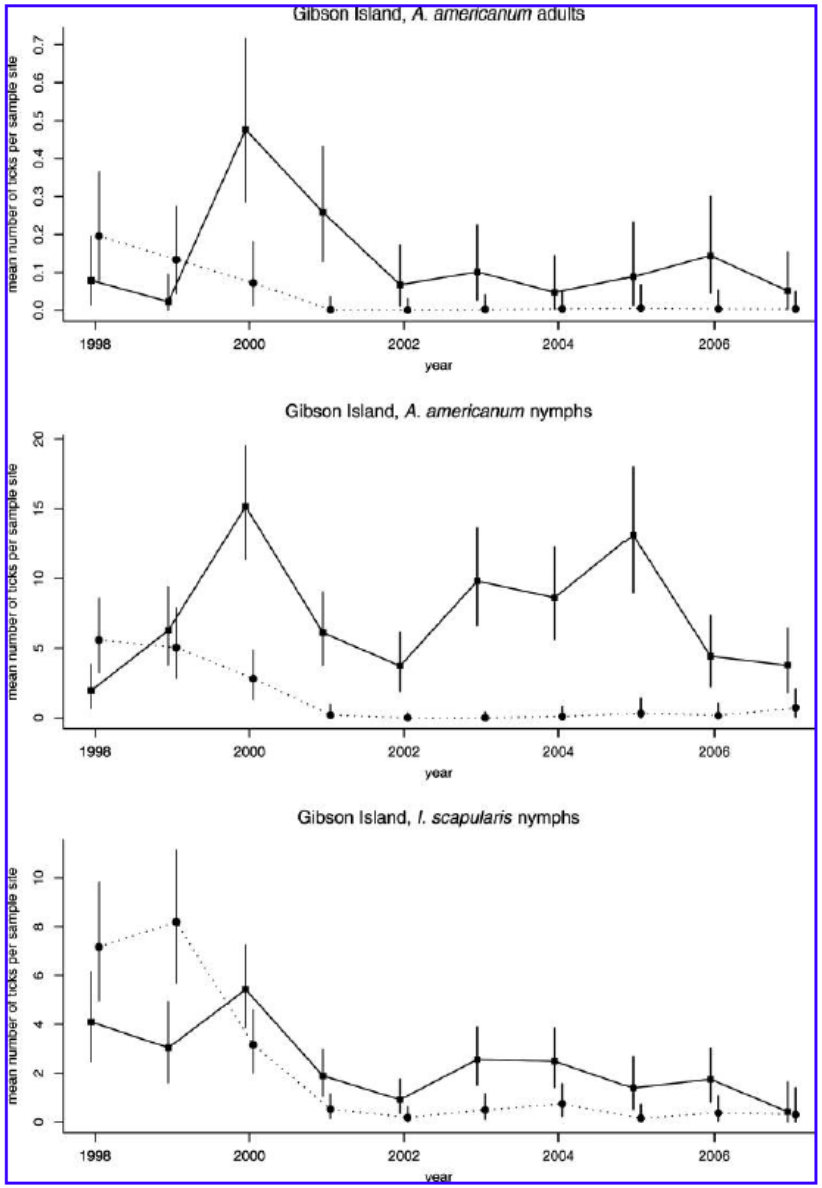
To control ticks feeding on white-tailed deer



An ARS-patented “4-poster” device that lures (with food!) deer so that they get tick-killing pesticide transferred to their heads, necks and ears while feeding at the device.

Use of “4-Poster” leads to 60–80% reduction in tick population

John Carroll / USDA-ARS; Gibson Island, MD



VECTOR-BORNE AND ZOONOTIC DISEASES
Volume 9, Number 4, 2009
© Mary Ann Liebert, Inc.
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]

untreated

treated

VECTOR CONTROL, PEST MANAGEMENT, RESISTANCE, REPELLENTS

Control of Immature *Ixodes scapularis* (Acari: Ixodidae) on Rodent Reservoirs of *Borrelia burgdorferi* in a Residential Community of Southeastern Connecticut

MARC C. DOLAN,[1] GARY O. MAUPIN,[2] BRADLEY S. SCHNEIDER,[1] CHRISTOPHER DENATALE,[3] NICK HAMON,[4] CHUCK COLE,[4] NORDIN S. ZEIDNER,[1] AND KIRBY C. STAFFORD III[5]

J. Med. Entomol. 41(6): 1043–1054 (2004)

❖ Dolan *et al*. 2004

- 3-year study in Connecticut.
- Reduced *Borrelia* infection in white-footed mice by 53%.
- Reduced questing adults by 77%.
- Also reduced *Borrelia* infection rate in ticks (31% vs 47%).

Journal of Medical Entomology, 54(4), 2017, 1019–1024
doi: 10.1093/jme/tjx044
Advance Access Publication Date: 15 March 2017
Vector Control, Pest Management, Resistance, Repellents Research article

Evaluation of the SELECT Tick Control System (TCS), a Host-Targeted Bait Box, to Reduce Exposure to *Ixodes scapularis* (Acari: Ixodidae) in a Lyme Disease Endemic Area of New Jersey

Terry L. Schulze,[1] Robert A. Jordan,[2,3] Martin Williams,[4] and Marc C. Dolan[4]

❖ Schulze *et al*. 2017

- 2-year study in New Jersey.
- Reduced host-seeking nymphs *by 87.8%* at 1 year post intervention. *by 97.3%* at 2 year post intervention.

Journal of Medical Entomology, 54(2), 2017, 403–410
doi: 10.1093/jme/tjw194
Advance Access Publication Date: 8 December 2016
Vector Control, Pest Management, Resistance, Repellents Research article
OXFORD

Evaluation of Doxycycline-Laden Oral Bait and Topical Fipronil Delivered in a Single Bait Box to Control *Ixodes scapularis* (Acari: Ixodidae) and Reduce *Borrelia burgdorferi* and *Anaplasma phagocytophilum* Infection in Small Mammal Reservoirs and Host-Seeking Ticks

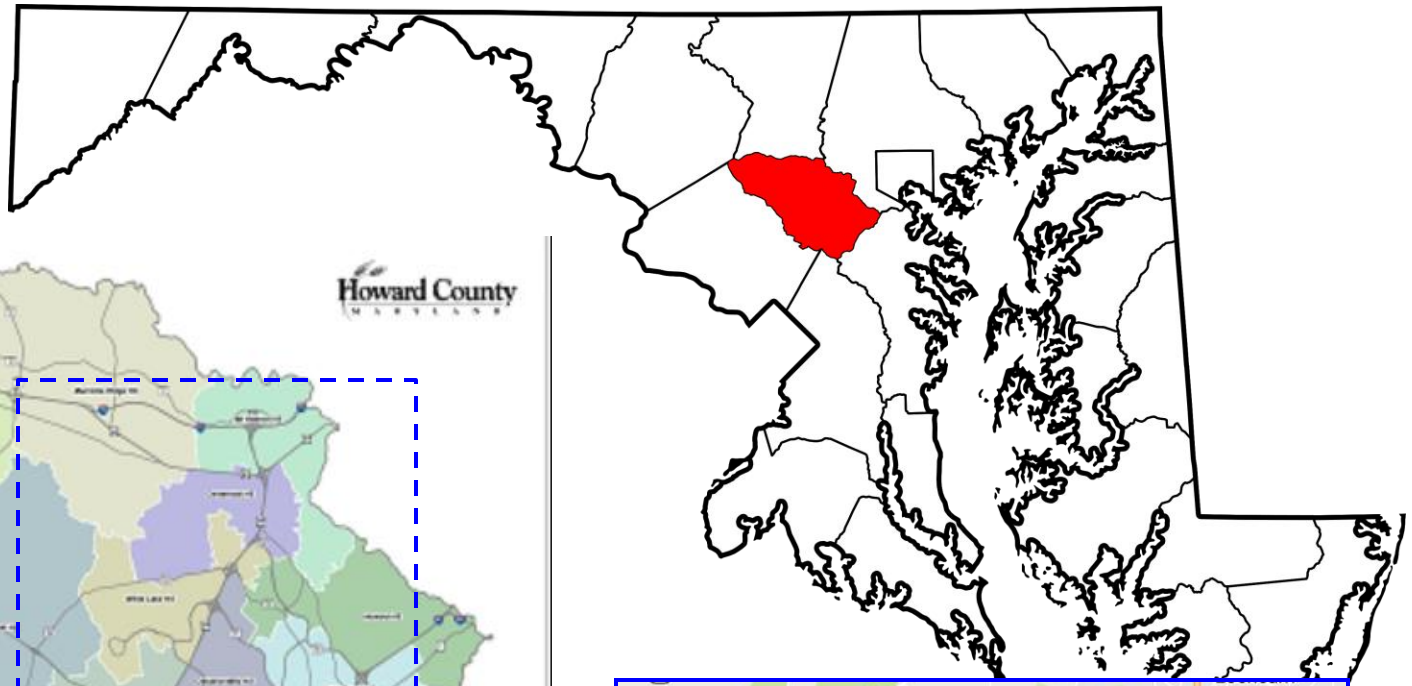
Marc C. Dolan,[1,2] Terry L. Schulze,[3] Robert A. Jordan,[4,5] Christopher J. Schulze,[3] Amy J. Ullmann,[1] Andrias Hojgaard,[1] Martin A. Williams,[1] and Joseph Piesman[1,6]

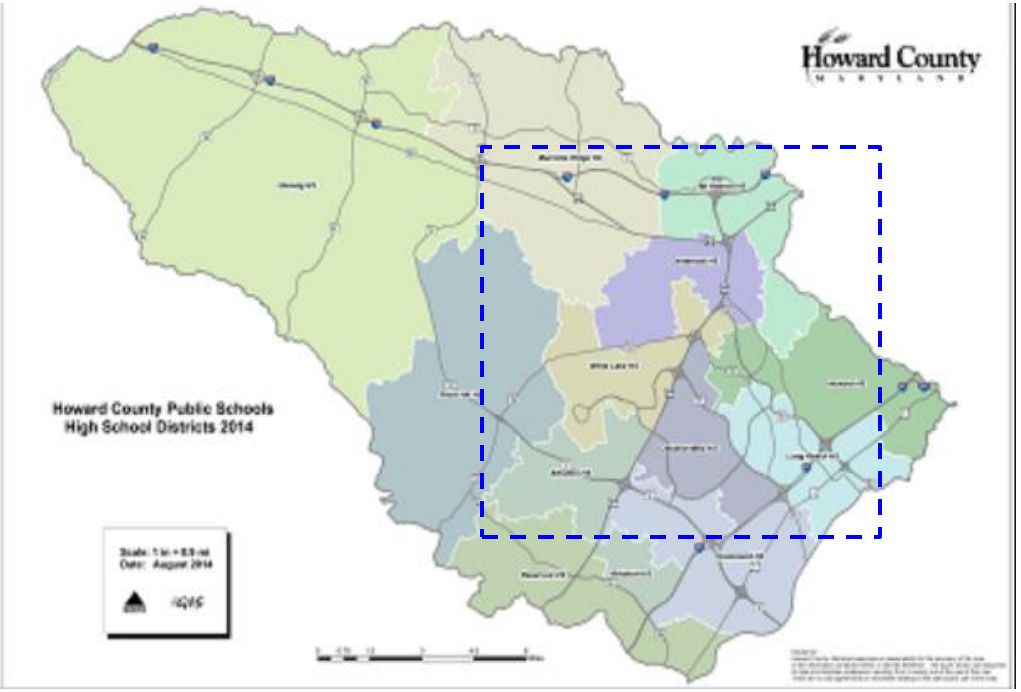
❖ Dolan *et al*. 2017

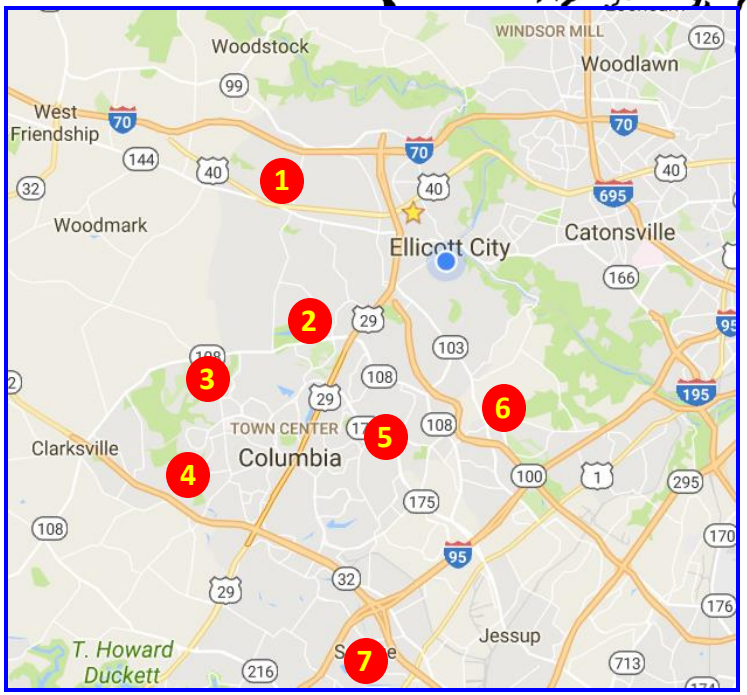
- A study in New Jersey.
- Reduced nymphal and larval tick burdens on small mammals by 76% and 77%.

Tick Box Technology Corporation

Field study sites

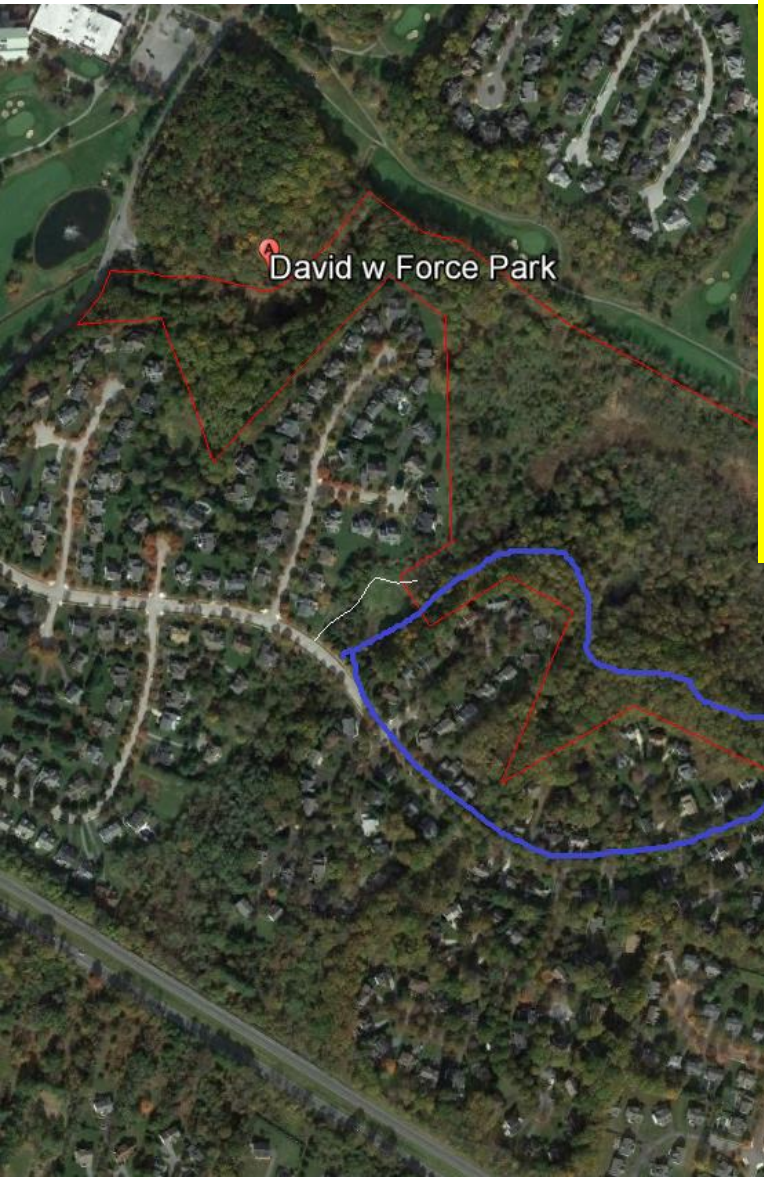






1. Davis Force Park (Bait box + Met52)
2. Centennial Park (Untreated Control)
3. Cedar Lane Park (4-Poster + Bait box)
4. MPEA (4-Poster + Bait box)
5. Blandair Park (4-Poster + Bait box + Met52)
6. Rockburn Park (4-Poster + Bait box + Met52)
7. Wincopin Trail (Bait box + Met52)

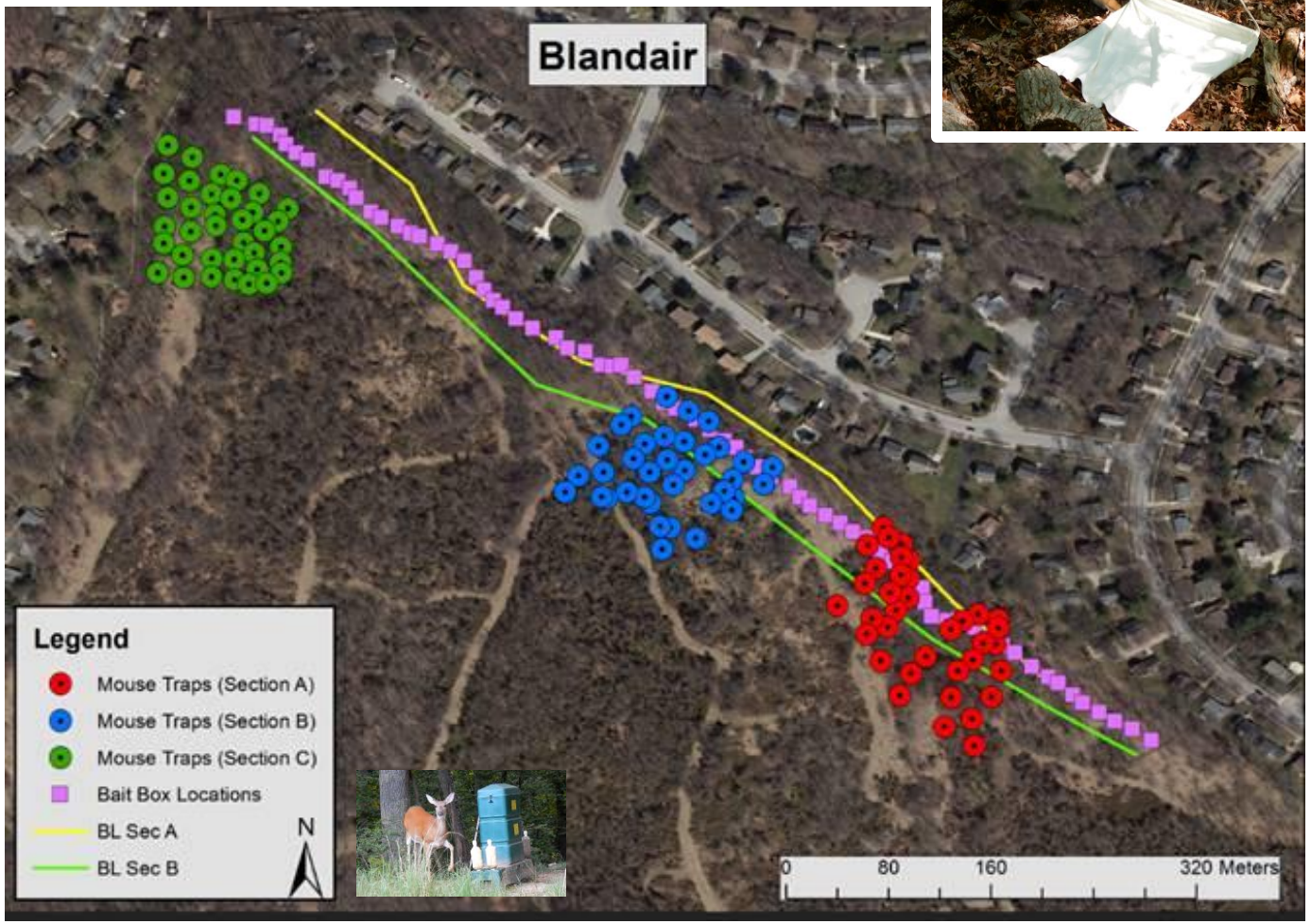
Residential neighborhood



Recruitment of Homeowner Participation

Treatment & mouse/tick sampling

- **Bait box placement**
- **Tick sampling**
- **Mouse trapping**



Tick and mouse sampling

Lyme Infection Status

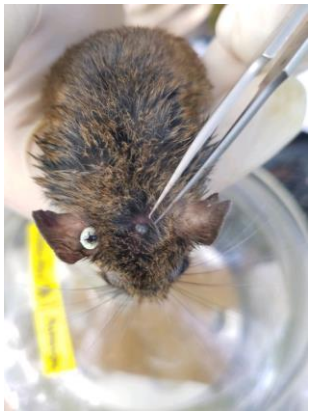
Comparison of *Borrelia burgdorferi* infection in *Ixodes scapularis* individuals removed from mice and individuals questing in 2017

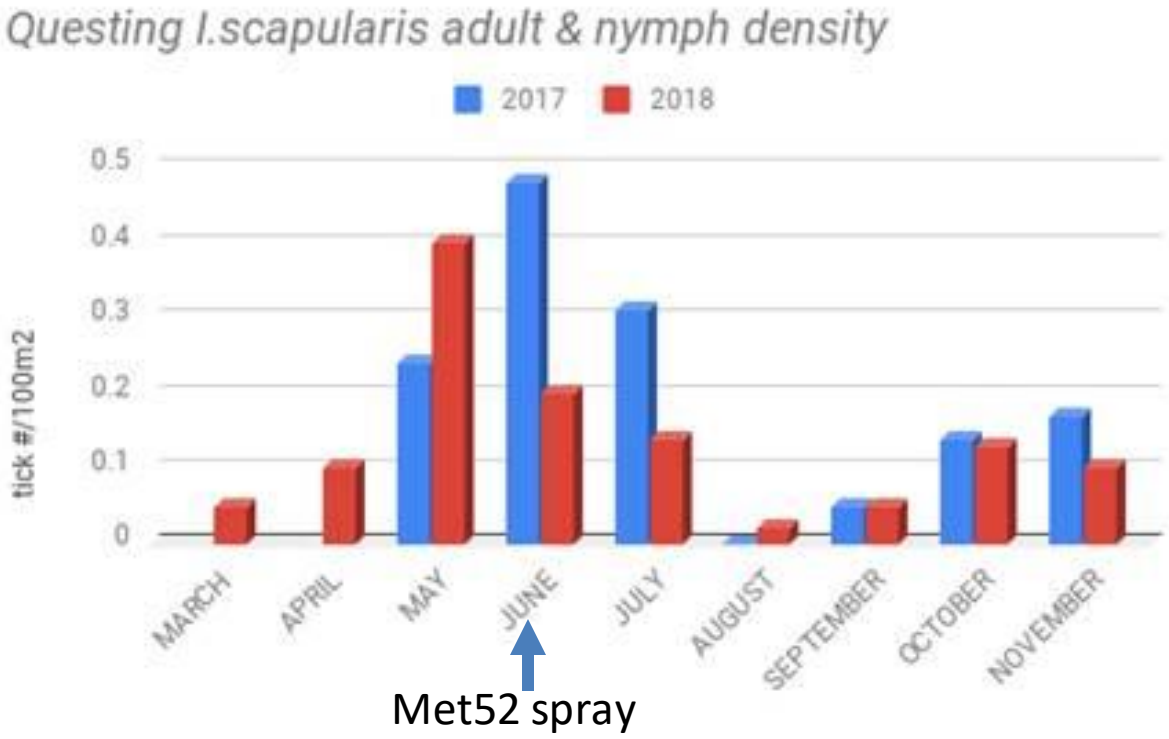
B. burgdorferi infection (%) in questing _I. scapularis_ in 2017

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

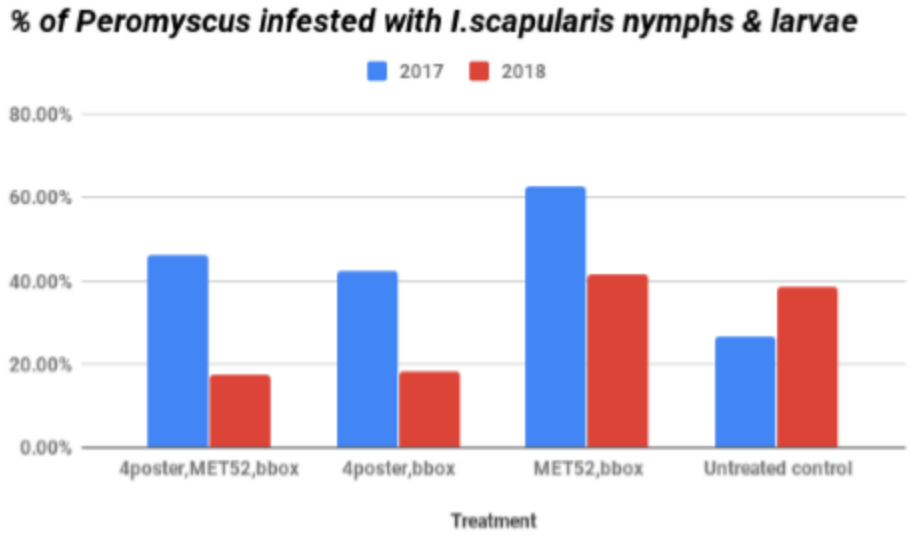


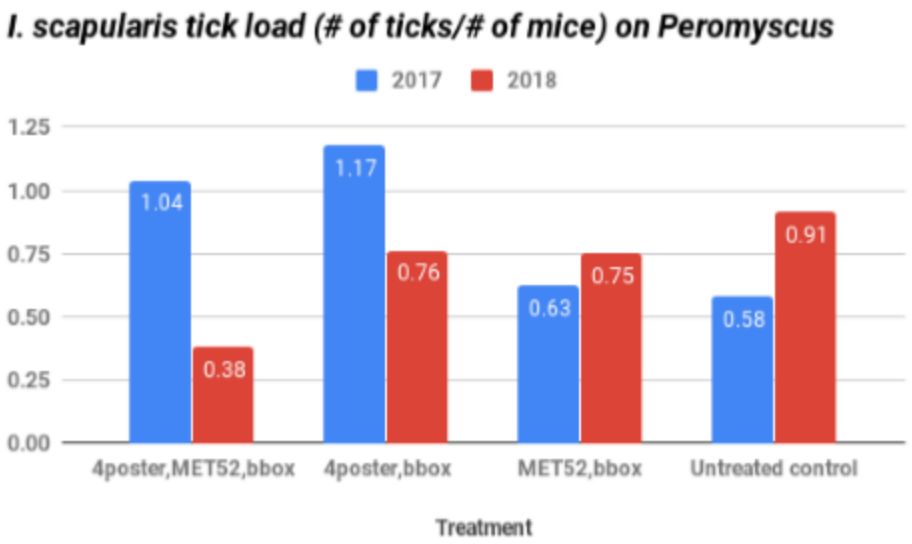


Pathogen infection (%) in *Peromyscus* captured using Sherman traps

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**				

How about ticks feeding on mice?





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.

Related Topics

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Projects

Prevention of Arthropod Bites
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Interagency Reimbursable Agreement (I)

ARS News Articles

- ARS Leads New Lyme Disease Control Efforts in Howard County, Md.
- Collaring the Mice that Carry Lyme Disease-Causing Ticks
- Tick Control Program Reveals High Level of Infection in White-Footed Mice
- Work With Us Home

QUESTIONS

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Acknowledgements

This presentation was funded in part by the Northeastern IPM Center through Grant #2014-70006-22484 from the National Institute of Food and Agriculture, Crop Protection and Pest Management, Regional Coordination Program.

United States Department of Agriculture

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Acknowledgements

- National Association of School Nurses
- US Environmental Protection Agency
- IPM Institute of North America
- NE School IPM Working Group and National School IPM Steering Committee
- State and Regional School Nurses Associations
- NY State IPM Program
- Northeastern IPM Center
- Maine Department of Education
- Maine Department of Agriculture, Conservation and Forestry

Acknowledgments

USDA-ARS
Area-wide Pest Management Program


Phil Norman


Erika Machtinger


Jennifer Murrow

USDA ARS Project Team

- Dr. Erika Machtinger
- Laura Beimfohr
- Yasmine Hentati
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Cooperators / Collaborators

- Dr. Erika Machtinger
- Dr. Jennifer Murrow
- Phil Norman / Brenda Belensky
- Drs. Kirby Stafford & Scott Williams
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