

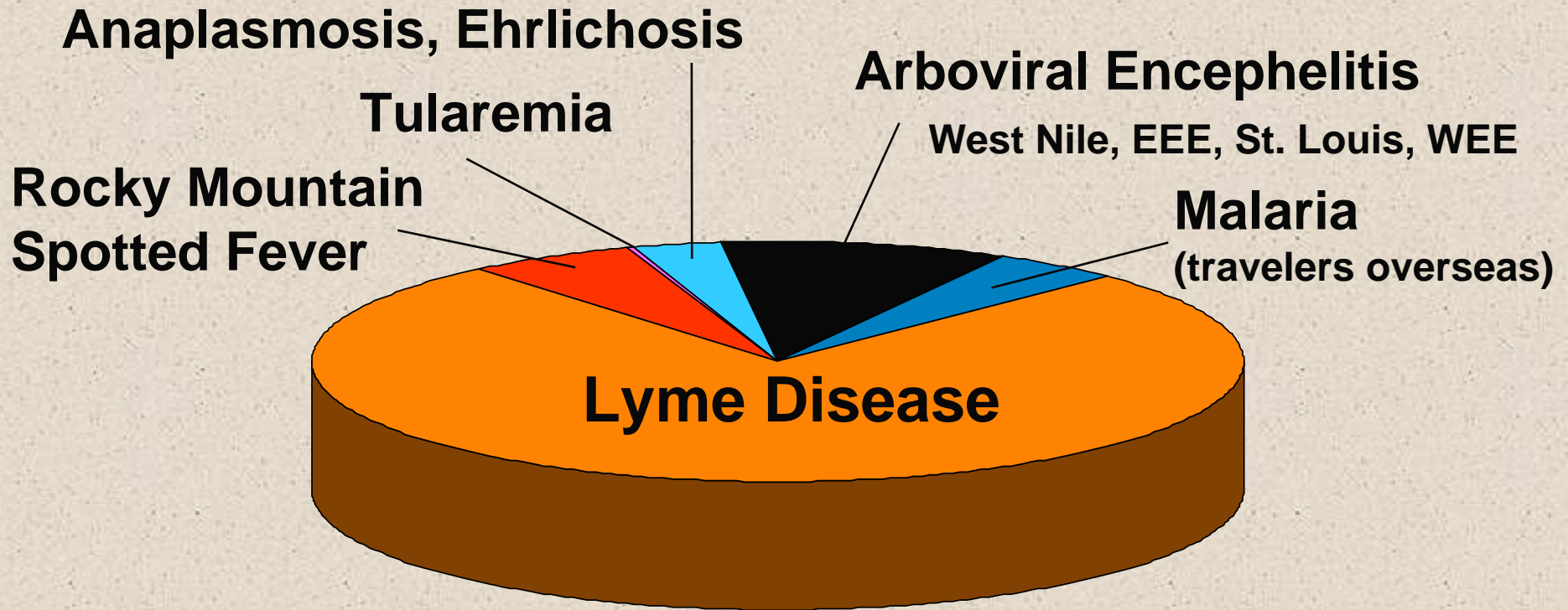


# Ticks & Lyme Disease: An Update



**Kirby C. Stafford III, Ph.D.**  
**Vice Director, State Entomologist**

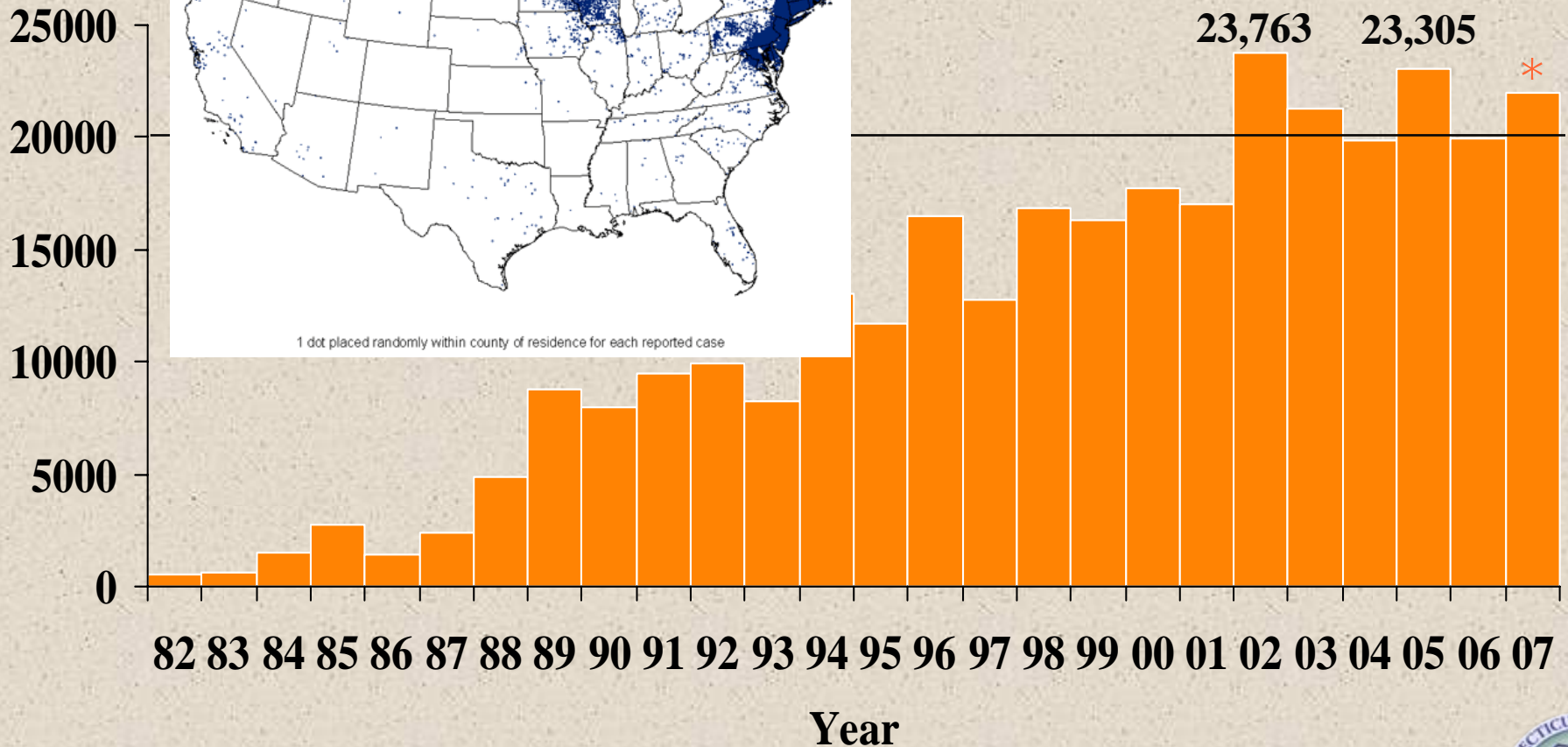
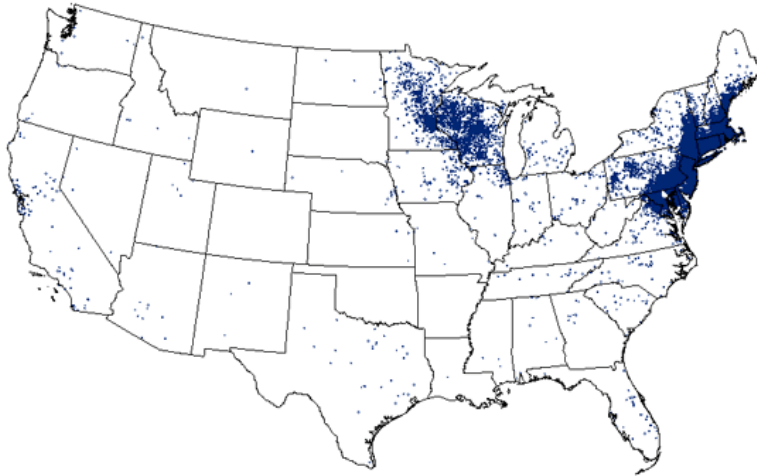
# Arthropod-Associated Diseases in the U.S. (2005)



**Others: Human Babesiosis, Powassan Encephalitis, Tick-borne Relapsing Fever, Colorado Tick Fever, Plague**

# Lyme Disease – United States, 1982-2007

Reported Cases of Lyme Disease -- United States, 2006

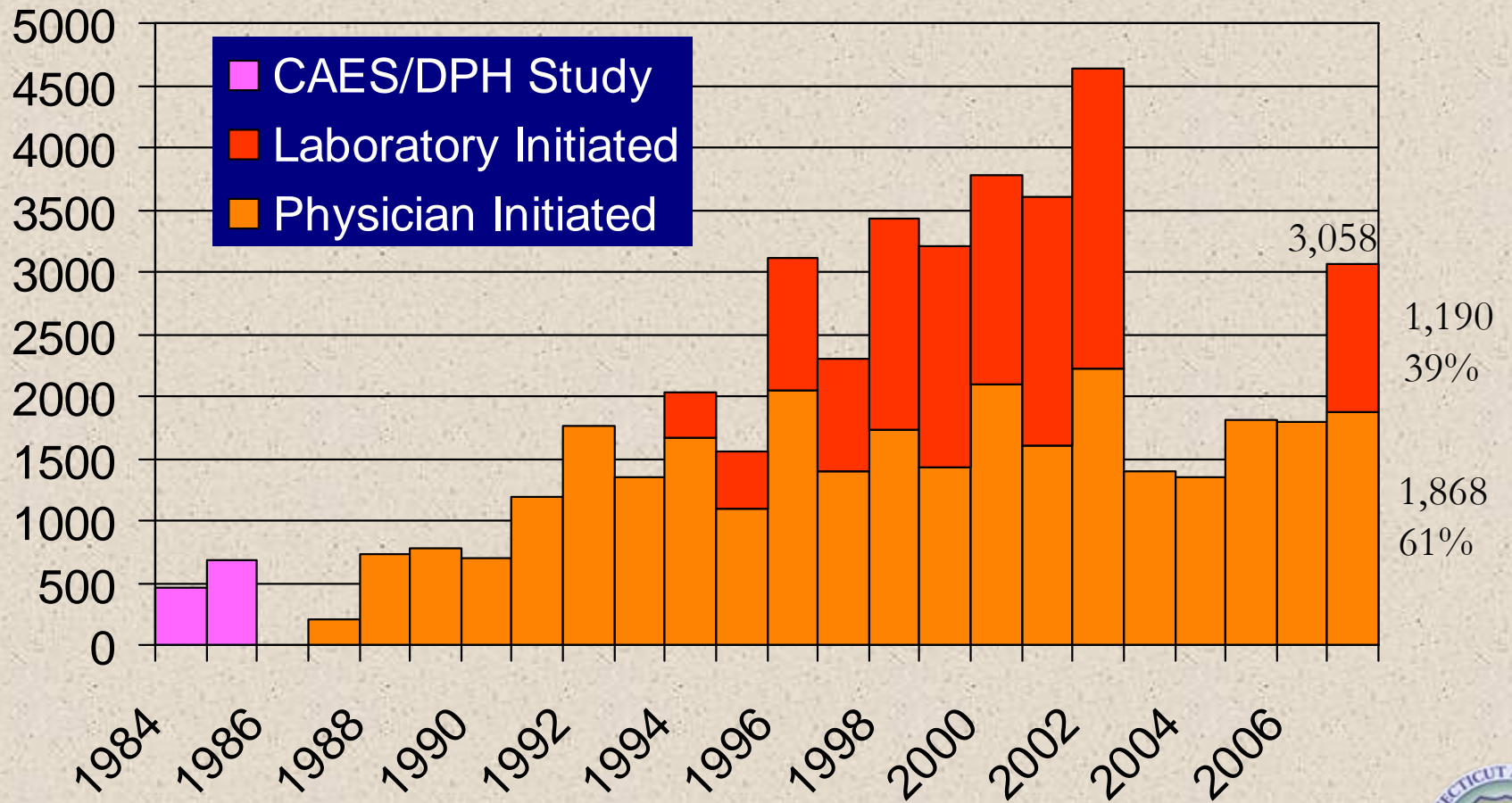


\*preliminary numbers 2007

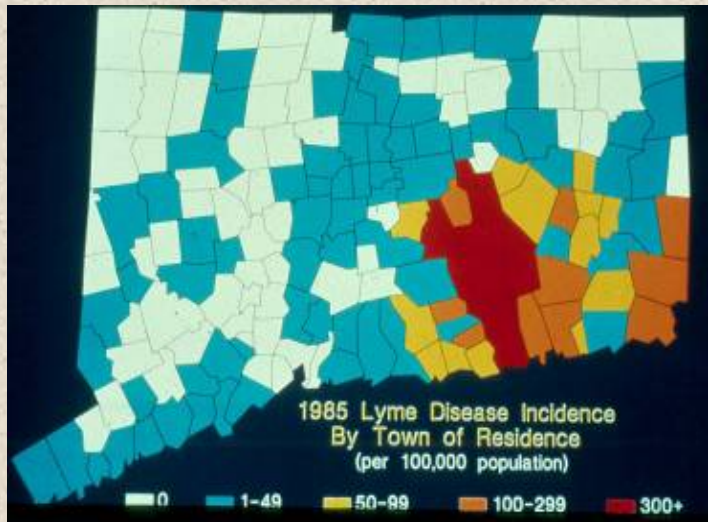
CAES--Spring 2008 Open House



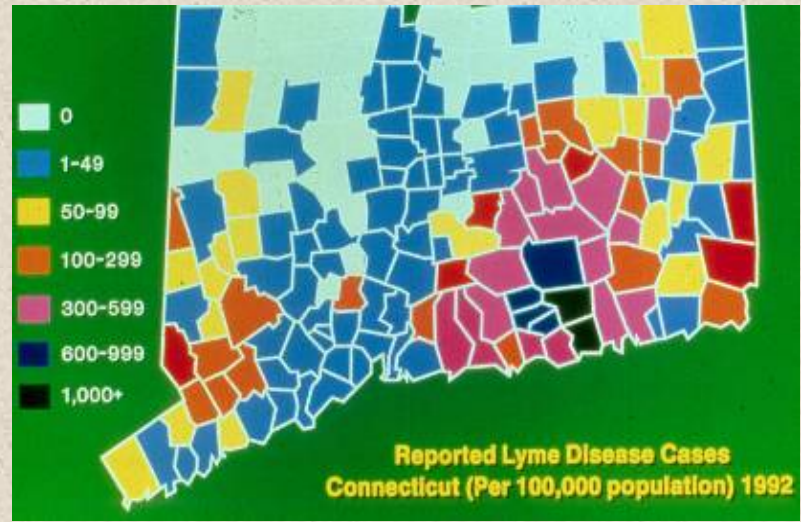
# Lyme disease cases by surveillance method and year, Connecticut, 1984-2007





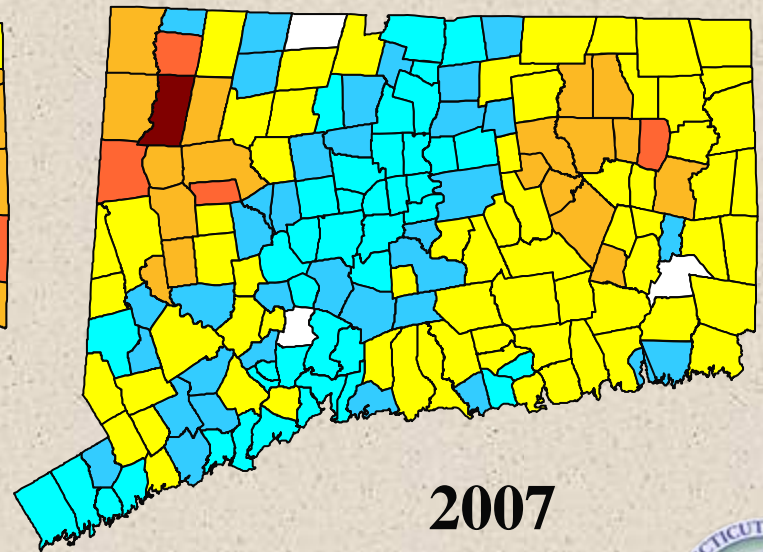
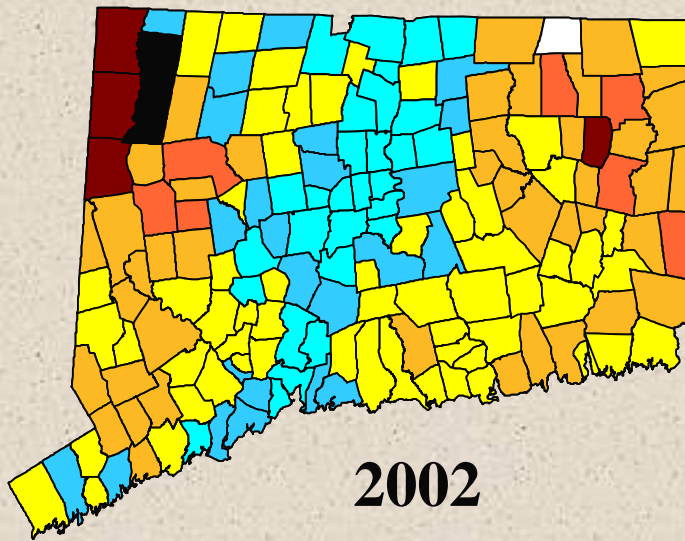


1985



1992

Legend For 2002 & 2007



# Lyme Disease Incidence, CT

CAES--Spring 2008 Open House



Photo courtesy American Lyme Disease Foundation



*Ixodes scapularis* nymph & female

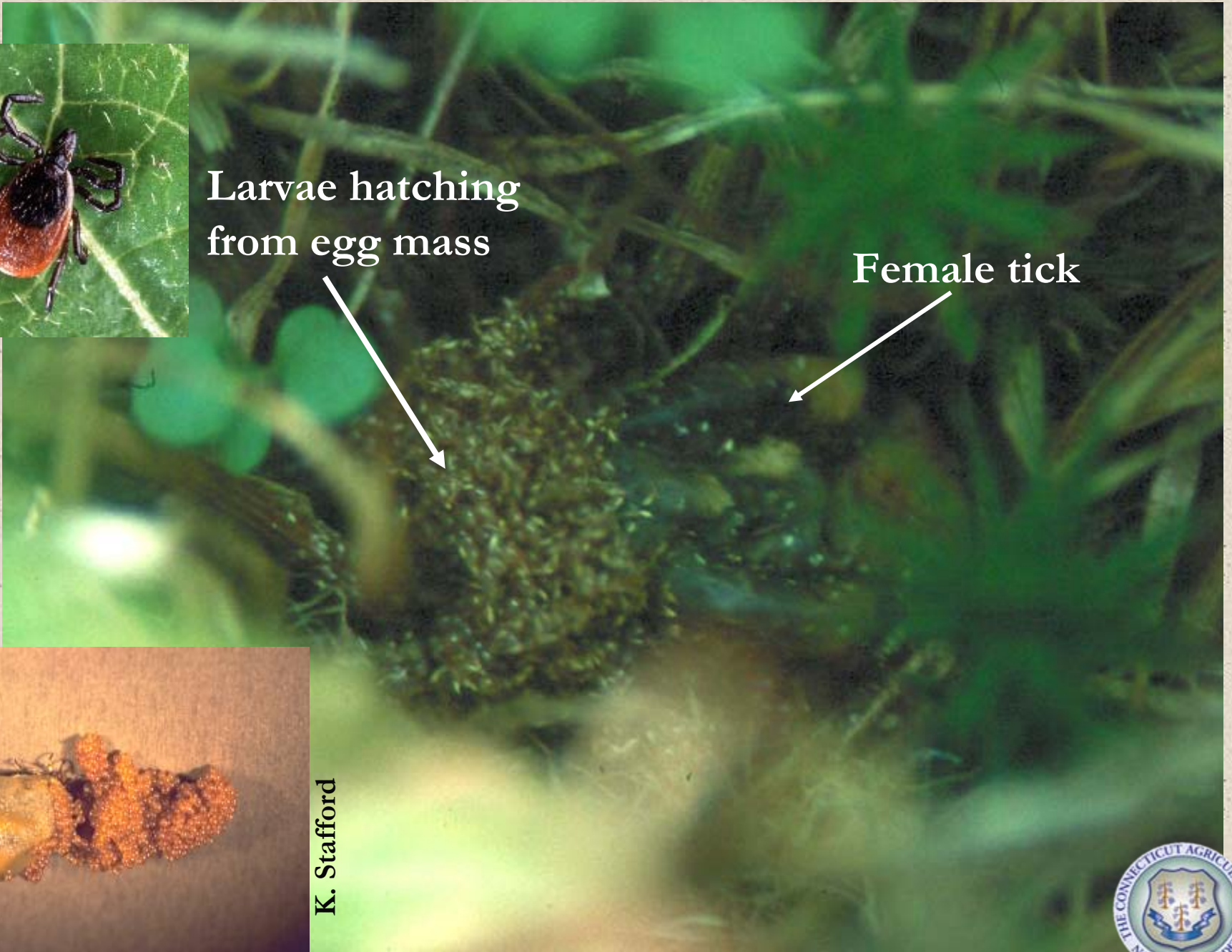






Larvae hatching  
from egg mass

Female tick



K. Stafford



K. Stafford

White-footed mouse, birds  
Eastern chipmunk & shrews

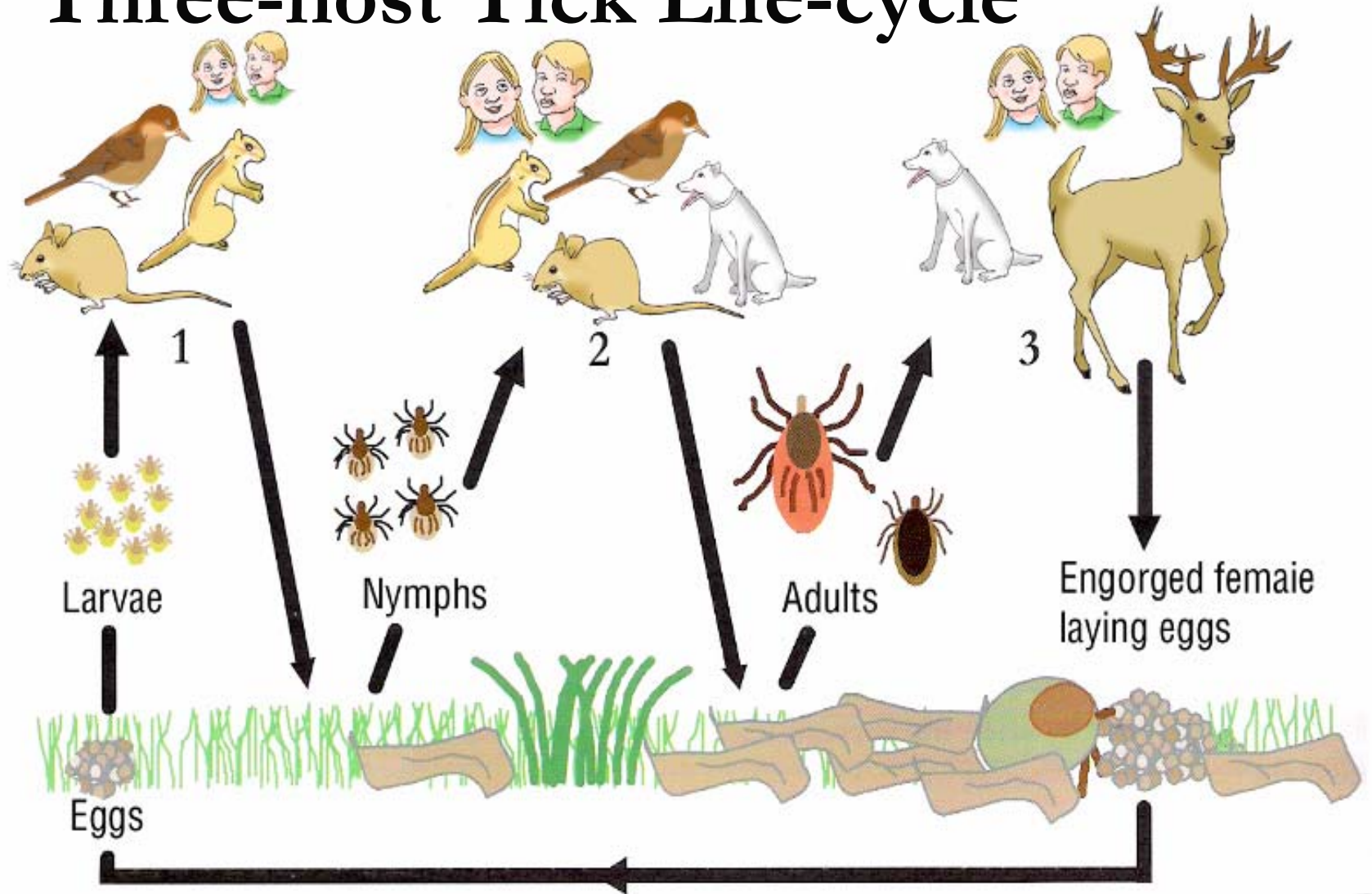


J. Occi





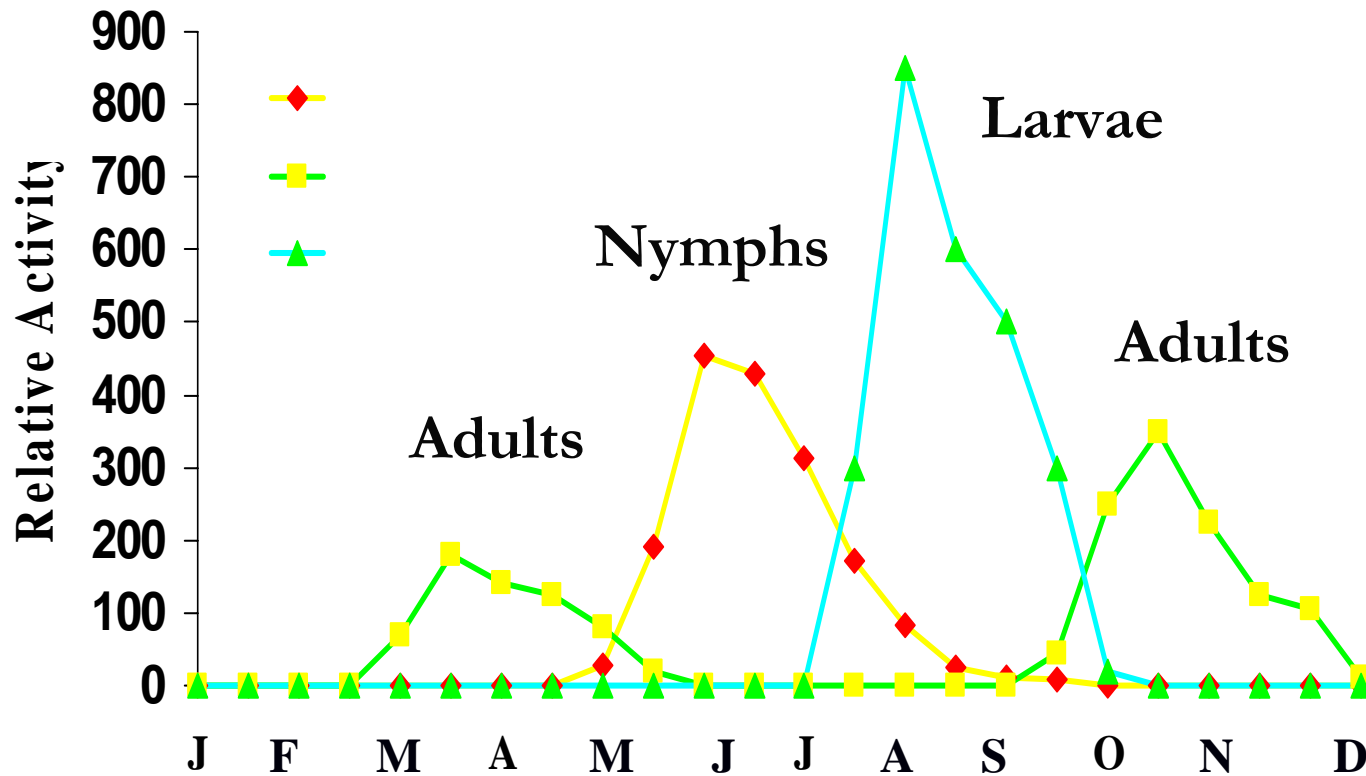
# Three-host Tick Life-cycle



Kirby Stafford, CT Agricultural Experiment Station



# Seasonal Activity of *Ixodes scapularis*





# *Ixodes scapularis* tested by CAES

by polymerase chain reaction (PCR) methods

Stage	Year	# identified	# positive/tested	% positive
Nymph	2005	3675	817/3654	22.4
Nymph	2006	1888	165/1032	16.0
Nymph	2007	954	228/620	36.8
<b>Nymph</b>	<b>Total</b>	<b>6517</b>	<b>1210/5306</b>	<b>22.8</b>
Female	2005	2234	789/2184	36.1
Female	2006	2835	355/1271	27.9
Female	2007	1544	251/767	32.7
<b>Female</b>	<b>Total</b>	<b>6613</b>	<b>1395/4222</b>	<b>33.0</b>



# Tick Management

- Personal Protection Measures
- Host reduction or exclusion
- Host-targeted acaricides
- Habitat or vegetative modifications
- Area-wide chemical control
- Biological & natural control

## Tick Management Handbook

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

Revised Edition

Prepared by:

Kirby C. Stafford III, Ph.D.  
Vice Director, Chief Entomologist  
Connecticut Agricultural  
Experiment Station, New Haven



Support for printing this revised edition provided by  
The Connecticut Agricultural Experiment Station  
The Connecticut General Assembly

Bulletin No. 1010





# Bite Prevention

# Tick Checks





# Host-targeted Tick Control



1. Exclusion (1991-1992)
2. Reduction (1992-2002)
3. Treatment (1997-2004)

Treatment (2001-2006)





# Lyme Disease in northeast primarily a residential risk

**Estimated 75% picked up outdoors at home as follows\*:**

**Play 47%**

**Yard Work 18%**

**Gardening 12%**

**Neighborhood 4%**



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



\*Data: Stamford Health Department







Photograph: Kirby Stafford



## Area-Wide Application of Acaricides

CAES--Spring 2008 Open House





# Potential Entomopathogenic Fungi for Tick Control

- Fungus *Beauveria bassiana*
- Fungus *Metarhizium anisopliae*

Wide host range.

Produce conidia (asexual spores)

Conidia adhere to cuticle, germinate,  
penetrate and produce hyphae and  
toxins.



*M. anisopliae* on female  
*I. scapularis* (Photo: Stafford)





# Applications with Commercial Formulations of the Fungus *Beauveria bassiana* and *Metarhizium anisopliae* Strain 52



	Average % reduction		
	1999	2000	2002
Naturalis T&O ( <i>B. bassiana</i> )	73.7	38.0	-
BotaniGard ES ( <i>B. bassiana</i> )	74.5	50.4	-
Pyrethroid bifenthrin (Talstar)	85.0	85.4	-
Tick-Ex ( <i>M. anisopliae</i> ) (70%)	-	-	85.0
Tick-Ex ( <i>M. anisopliae</i> ) (70%)	-	-	81.6
Tick-Ex ( <i>M. anisopliae</i> ) (48%)	-	-	17.0

\*

\*0% reduction in second trial, 71% nymphs one plot

Stafford, K.C. unpublished data.



# Press Release

October 2, 2006

## **Novozymes Expands Product Portfolio with Efficacious Biological Insecticide for Deer Ticks, Lyme Disease**

- Novozymes Biologicals Inc. acquired Connecticut-based Earth BioSciences, Inc.
- Novozymes incorporate EBS into ROOTS® Plant Care Group.
- Includes *Metarhizium anisopliae*-based microbial bioinsecticides, which will strengthen Novozymes' position in ....natural pest technologies.
- Company will make additional investments to bring these new technologies to market and begin production.

# Tick-Ex EC

For Control of Ticks and Grubs

	% w/w
<b>Active Ingredient</b> <i>Metarhizium anisopliae</i> Strain F52*	11.0%
<b>Other Ingredients</b>	89.0%
<b>TOTAL</b>	100.0%

\* Contains  $5.5 \times 10^9$  Colony Forming Units (CFU)/mL of Tick-Ex EC.

## First Aid

**If Swallowed:** Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger, or, if available, by administering syrup of ipecac. If person is unconscious, do not give anything by mouth and do not induce vomiting.

**If on Skin:** Wash with plenty of soap and water. Get medical attention.

**If Inhaled:** Remove victim to fresh air. If not breathing, give artificial respiration, preferable mouth-to-mouth. Get medical attention.

**If in Eyes:** Flush eyes with plenty of water. Call a physician if irritation persists.

**KEEP OUT OF REACH OF CHILDREN  
CAUTION**

See back panel for additional Precautionary Statements and complete Directions for Use.

NET CONTENTS 1 GAL (3.785 L)



**novozymes**  **Novozymes Biologicals, Inc.**  
5400 Corporate Circle • Salem, VA 24153 • [www.novozymes.com/roots](http://www.novozymes.com/roots)

EPA Reg. No. 70127-10 EPA Est. No. 070127-VA-01

Made in USA

Expiration date:

- *M anisopliae* Strain52
- Save for non-targets  
honey bees  
green lacewings  
lady beetles  
parasitic Hymenoptera  
earthworms
- Company Plans:  
Launch 2009
- CAES  
Anuja Bharadwaj  
Kirby Stafford







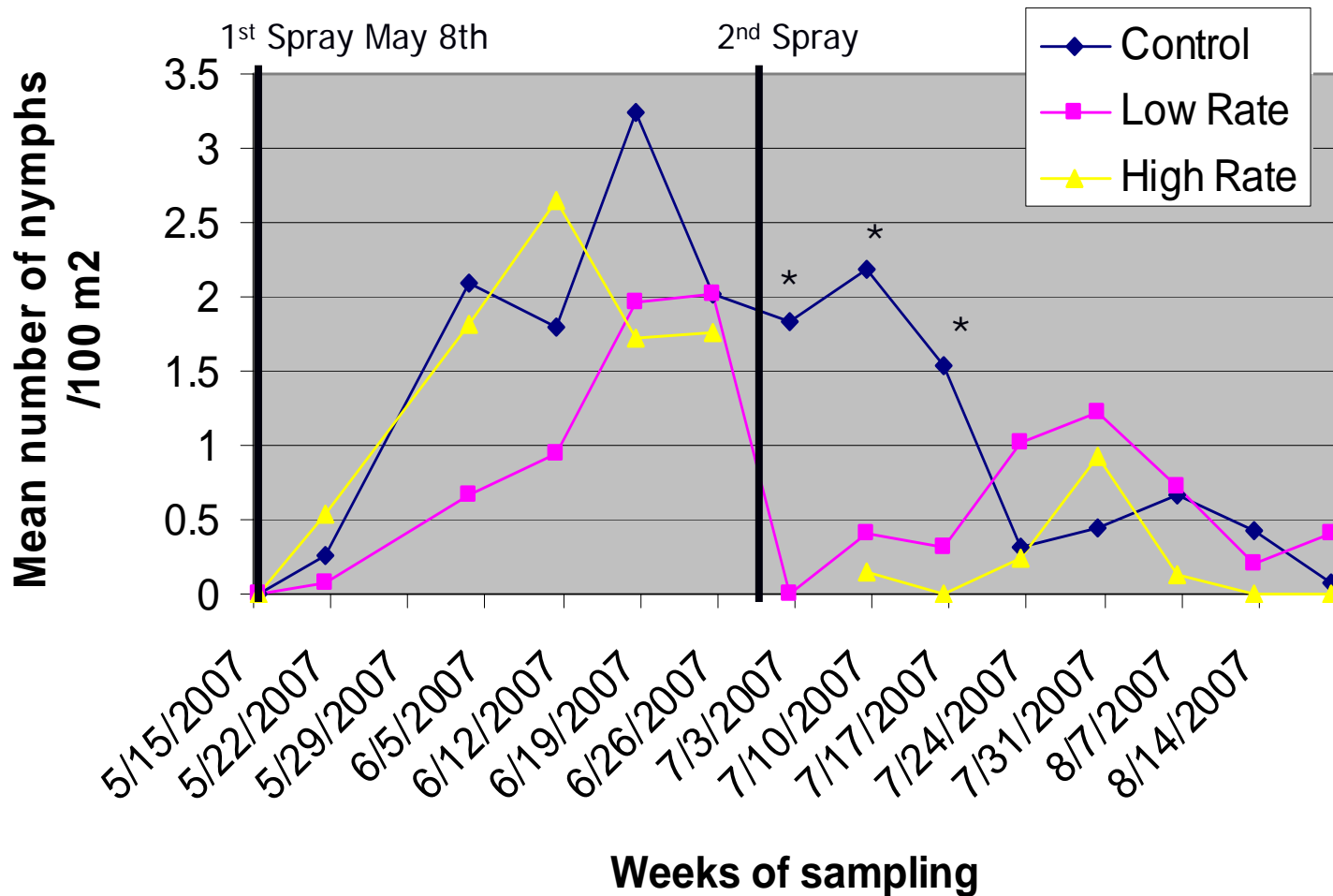
Mortality nymphal and adult *I. scapularis* walking on *Metarhizium anisopliae* EC treated surface, 30 minute exposure (2 rates shown) (Bharadwaj & Stafford)

Stage	Rate		Weeks posttreatment			
	Application		1	2	3	4
	cfu/cm <sup>2</sup>	(fl oz/1000 ft <sup>2</sup> )				
<b>N</b>	2.6 x 10 <sup>5</sup>	(1.1)	100.0	100.0	-	-
<b>A</b>	2.6 x 10 <sup>6</sup>	(11.0)	45.5*	90.9	100	100

\*Note: exposure at 2.6 x 10<sup>5</sup> resulted in 0% mortality for adults



# Mean number of nymphs/100 m<sup>2</sup> from control, low and high rate treated sites in 2007, May through mid August at TAHD, CT



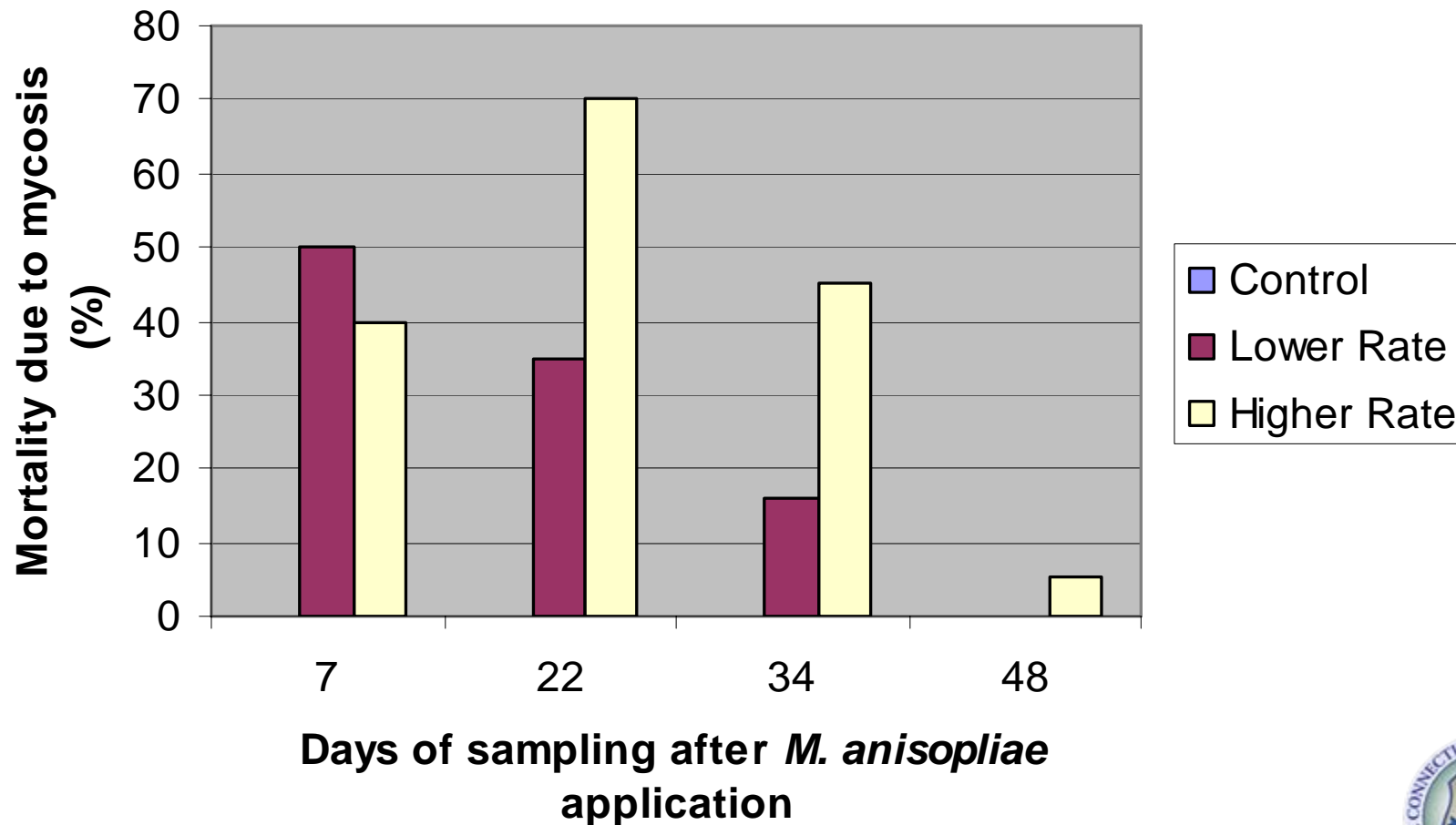


# Percent Control with *M. anisopliae*, 2007

	1 <sup>st</sup> Application May 8-9 (8 May-June 28) 7 weeks	2 <sup>nd</sup> Application June 30, July 2 (June 29-Aug 20) 8 weeks
Low Rate 11 sites	39.8	36.5
High Rate 9 sites	9.9	77.8



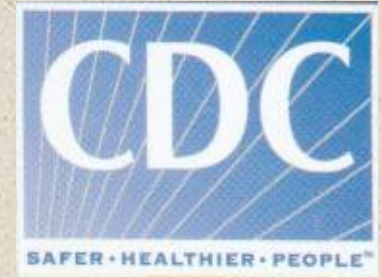
## Percent mortality due to mycosis in yellow mealworms at 30 days post collection of leaf litter from Torrington home sites following 1st spray application







# Current and Future Tick Control Research



- Current Options
  - Landscape practices
  - Chemical insecticides (environmental concerns for some)
  - Host-targeted acaricides (little implementation, cost)
  - Deer management (suitable some areas)
- Anti-tick vaccines to antigens in tick saliva (basic research)
- Oral Lyme disease vaccines via bait to reservoir hosts (rodent targeted vaccine)
- Biological & natural tick control
  - Entomopathogenic fungi
  - Essential oils from Alaska yellow cedar



# RFP Lyme disease Research

<p><b>RFA-CK-08-001</b></p>	<p>National Center for Zoonotic, Vector-Borne, and Enteric Diseases (NCZVED)</p>	<p>Announcement 10/26/2007</p>	<p>Proposal Due 12/10/2007</p>	<p>Field Trials to Evaluate Efficacy of Natural Products for the Control of the Tick Vectors of Lyme Disease Spirochetes <b>Awarded CAES</b> <b>Start 4/1/2008</b></p>
<p><b>RFA-CK-08-002</b></p>	<p>National Center for Zoonotic, Vector-Borne, and Enteric Diseases (NCZVED)</p>	<p>Announcement 10/26/2007</p>	<p>Proposal Due 12/10/2007</p>	<p>Evaluation of Reservoir-Targeted Vaccine Formulations to Prevent Enzootic Transmission of <i>Borrelia burgdorferi</i> (Lyme Borreliosis)</p>

# Essential Oil Compounds from Alaska Yellow Cedar

- Nootkatone Alaska yellow cedar most effective
- Eremophilane sesquiterpene,  $LC_{50} = 0.0029\%$
- Nootkatone extract grapefruit also effective
- $LC_{50} = 0.0061\%$  (also good repellent activity)
- Carvacrol, monoterpene,  $LC_{50} = 0.0068\%$
- Nootkatone food grade flavor additive and essential oils cedar used in soap industry





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## Revised Edition

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PDF version available at  
[www.ct.gov/caes](http://www.ct.gov/caes)



Stephen Dunn photo



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