

Unwelcome Visitors to America's Most Beautiful Place: Lyme Disease in Michigan's Most Visited National Park



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 Kellogg Hotel and Conference Center
May 16, 2012 - East Lansing, MI

Outline



- ☐ America's Most Beautiful Place
- ☐ Motivation for study
- ☐ Lyme disease Epidemiology
in Michigan
- ☐ A note on human case
investigation
- ☐ Study results

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Well Deserved Recognition

Sleeping Bear Dunes
**AMERICA'S MOST
BEAUTIFUL PLACE**
ABC's Good Morning America

Based on over 100,000 votes, Sleeping Bear Dunes National Lake Shore was named America's Most Beautiful Place by Good Morning America in 2011.

America's Most Beautiful: Sleeping Bear Dunes in Michigan ready to get even busier

Sunday, September 04, 2011
By Patricia Montemurri, Detroit Free Press



An overlook along Pierce Stocking Scenic Drive offers a stunning view from 450 feet above Lake Michigan in Sleeping Bear Dunes National Lakeshore in Michigan. CRAIG PORTER

Sleeping Bear Dunes attendance climbs after 'most beautiful' honor

Published: Thursday, September 15, 2011, 12:07 PM Updated: Friday, September 16, 2011, 6:44 AM
By Julie Hoogland | The Grand Rapids Press



EMPIRE -- Dune climbers aren't the only thing rising at Sleeping Bear Dunes.

Attendance is up after the national lakeshore on Aug. 17 was declared "Most Beautiful Place in America" in a Good Morning America voting contest, park officials said, citing new attendance tallies.

"We definitely saw a bump (in attendance numbers)" from the honor, Deputy Park Superintendent Tom Ulrich said.

"We had a huge August, and we are on pace for one of our biggest years ever."

In early August, the park's numbers



Courtesy photo: Pure Michigan

SBDNL Park Statistics

- ❑ Est. 1970
- ❑ Annual Visits - 1,143,857
- ❑ Employees - 46 permanent, 84 seasonal
- ❑ Volunteer Hours - 29,595 from 850 volunteers
- ❑ Area - 71,199 acres
- ❑ Lake Michigan Shoreline - 65 miles (35 miles on the mainland)
- ❑ Campgrounds - 9 (357 sites)
- ❑ Miles of trails - 105



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Unwanted Visitors

- ❑ MDCH and MSU have been conducting collaborative surveillance for blacklegged ticks and Lyme disease since the 1980's
- ❑ In the Lower Peninsula the Lake Michigan shoreline has the highest blacklegged tick populations, but historic tick surveys have so-far shown little risk at southern sites at SBDNL
- ❑ Since 2010 reports of blacklegged tick encounters have increased to NPS and MDNR from visitors and staff at SBDNL



Photo: Graham Hickling



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Motivation for Study

- ❑ Reported Lyme disease cases in Michigan (2010-2011) have been linked to potential exposure at SBDNL and specifically North Manitou Island
- ❑ SBDNL accommodates ~1.2 million visitors per year during the peak of tick season
- ❑ Michigan DCH, MSU, and NPS discussed need/plan to evaluate risk on Manitou Islands and SBD mainland
- ❑ Documenting the presence and distribution of blacklegged ticks in the park will assist the NPS in worker protections and directing public education re: tick-borne disease prevention



Photo: Jen Sidge



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Project Approach: What and Where to Sample?

Objectives

1. Determine if *Ixodes scapularis* is present, and at what concentration at North and/or South Manitou Islands
2. Determine if *B. burgdorferi* is present in ticks and/or wildlife at four sites within the SBDNL
3. Compare findings with a positive control site within a Lyme disease endemic region of Michigan's Lower Peninsula
4. Provide recommendations to the NPS related to potential Lyme disease risk based upon survey results at SBDNL

Four experimental sites

Mainland SBDNL: Southern and Northern site

Manitou Islands: South and North islands

Control site

Van Buren State Park



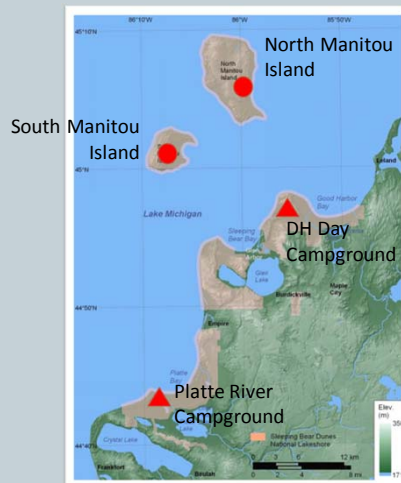
Photos: Jean Tsao

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SBDNL Sites



Dragging: along trails and transects: ~ 3000 m dragging per site/visit (June-October, 2011)

Rodent trapping: Two nights with 150 – 216 traps per night (June-September, 2011)

Hunter killed deer: Annual deer hunt October 29 – November 5, 2011



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Island Comparison – What we know going in

South	North
☐ Motorized vehicles allowed ☐ Organized campgrounds ☐ Village Area/Lighthouse ☐ Daytrips Common ☐ Higher visitation	☐ No motorized vehicles ☐ “Wilderness” camping ☐ No daytrips ☐ Lower visitation ☐ Potentially higher exposure to wooded environments

First Off.....

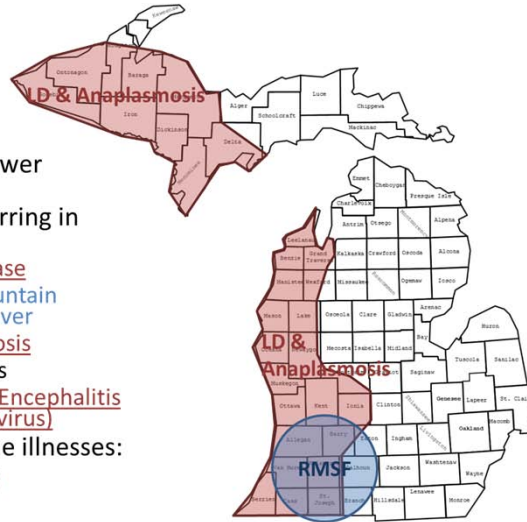
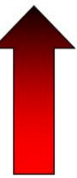
WHAT IS LYME DISEASE?
 HOW PREVALENT IS IT IN THE U.S. AND MICHIGAN?
 WHAT ARE THE RISK AREAS?

Tick-Borne Illness in Michigan

- Historically rare in the Lower Peninsula
- Tick-borne illnesses occurring in Michigan include:
 - » Lyme disease
 - » Rocky Mountain Spotted Fever
 - » Anaplasmosis
 - » Ehrlichiosis
 - » Powassan Encephalitis (Deer tick virus)
- Other potential tick-borne illnesses:
 - » Babesiosis
 - » Tularemia

MORE
COMMON

LESS
COMMON



**Diseases underlined in red are potentially transmitted by the Blacklegged tick



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What is Lyme Disease?

- Tick-borne disease transmitted by the Blacklegged tick, *Ixodes scapularis*
- Bacterial, spirochete, *Borellia burgdorferi*
- Transmission from tick to host takes 24-48 hours
- No person-to-person spread
- Range of potential symptoms and difficulties interpreting laboratory results makes reported Lyme difficult to characterize for public health surveillance purposes



pnh.cdc.gov



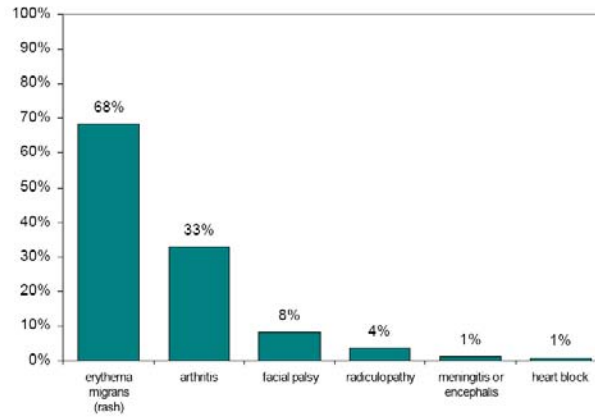
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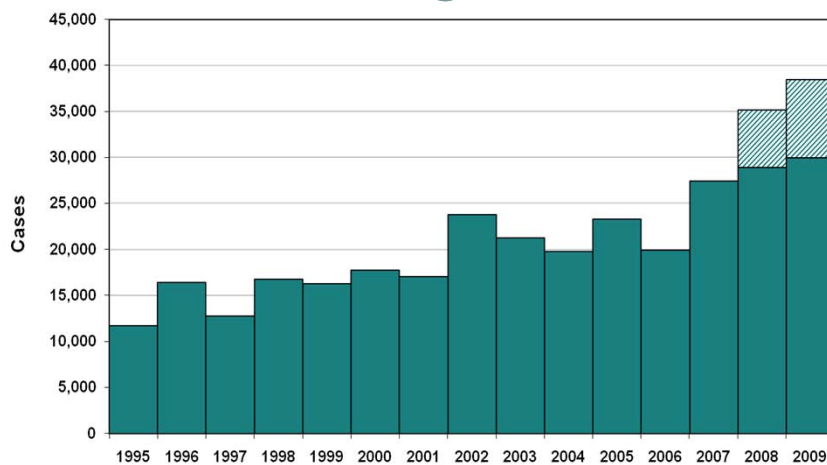
Clinical Findings, 1992-2004

Lyme disease is a nationally notifiable disease. The Centers for Disease Control and Prevention collect and analyze data from all states.

The graph at right illustrates percent of clinical findings among 119,965 patients for whom at least one symptom was reported.

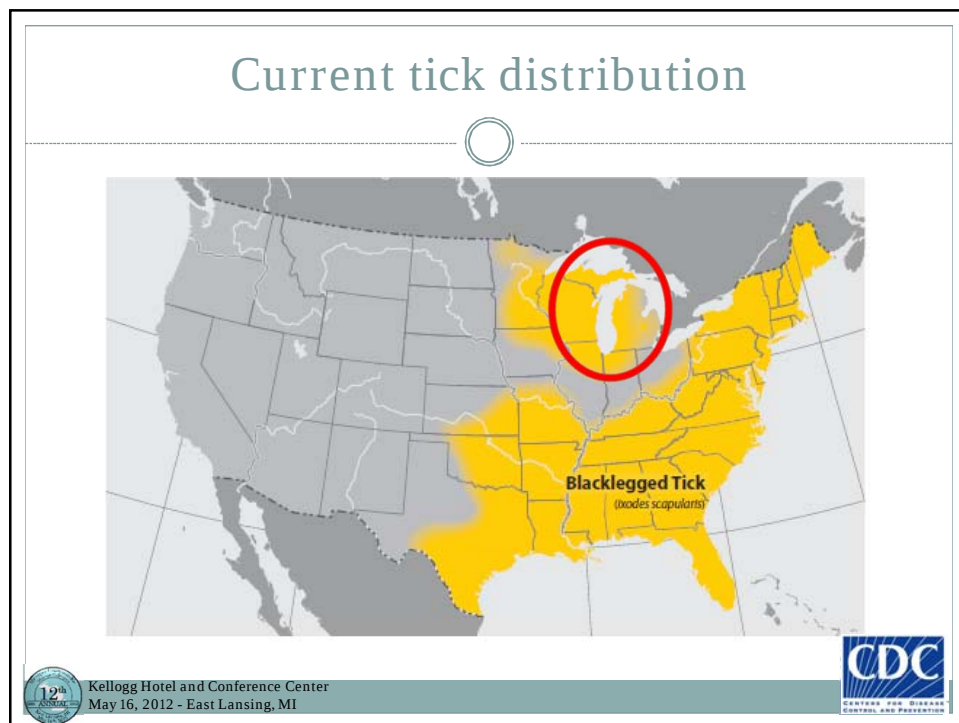
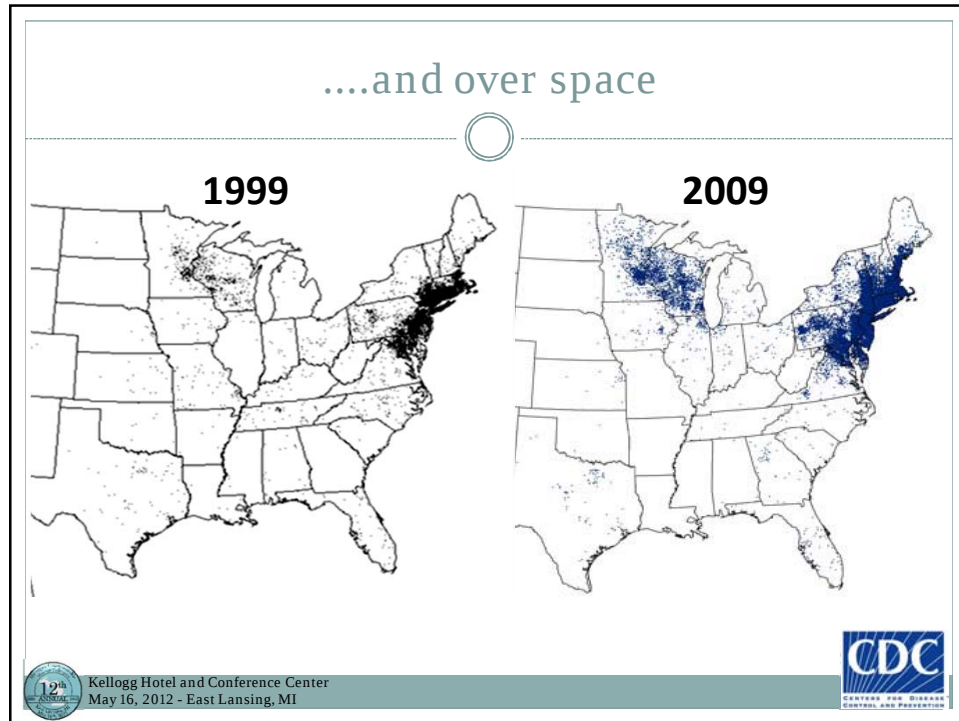


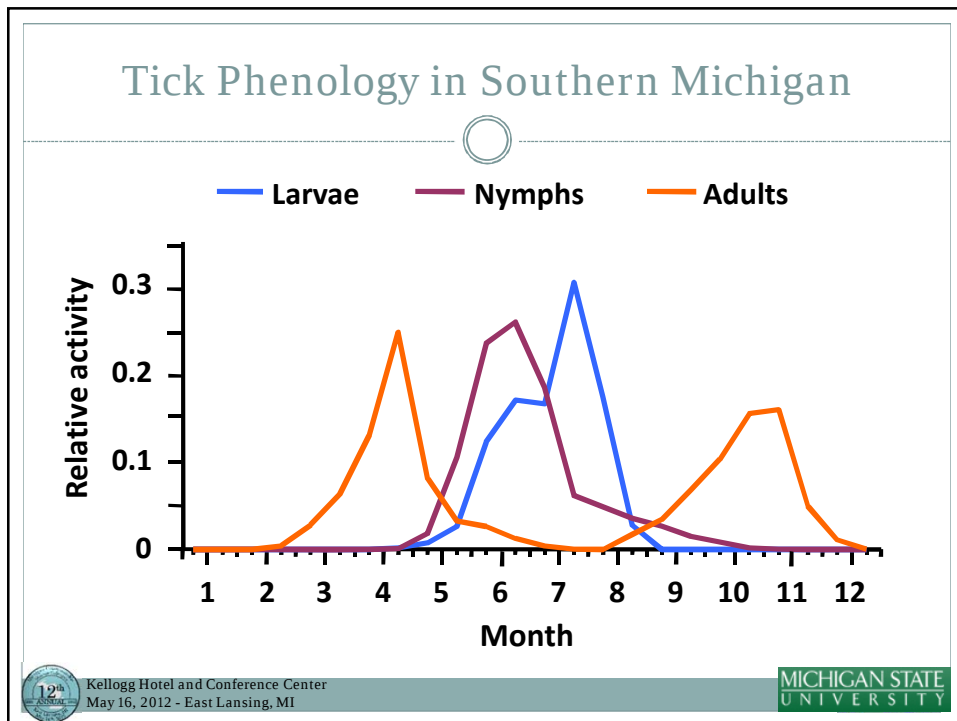
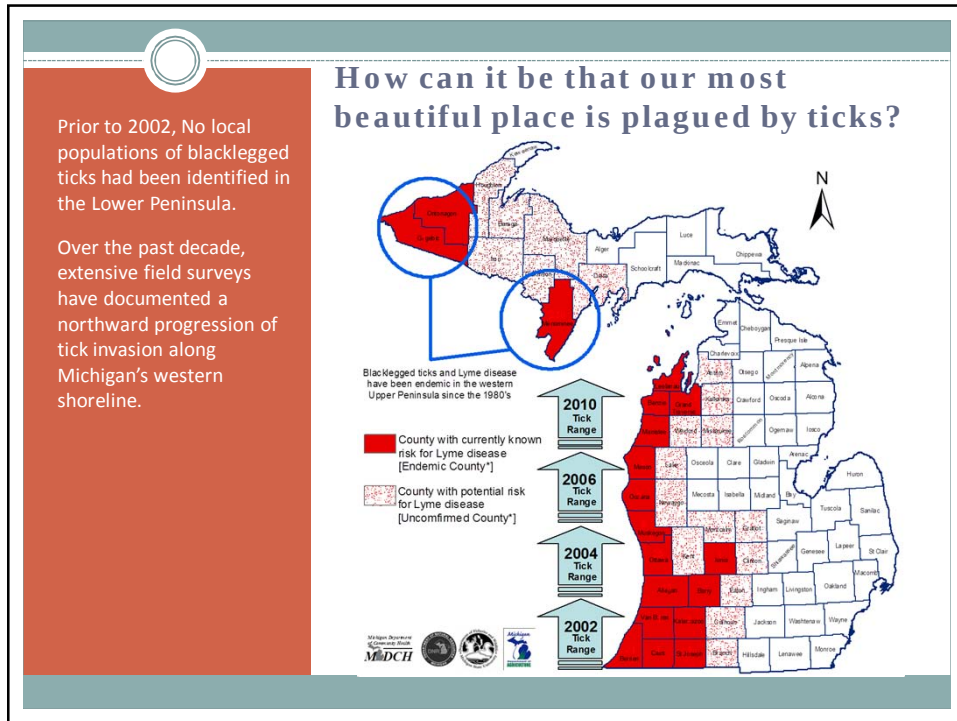
Lyme disease has emerged over time....



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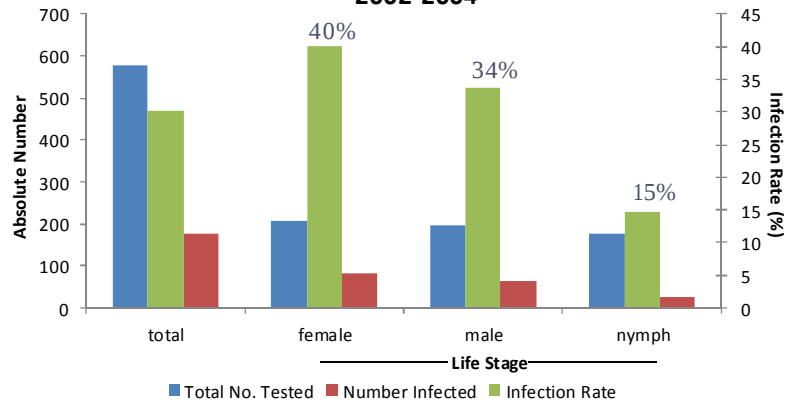






Historic Southern Michigan Infection Rates

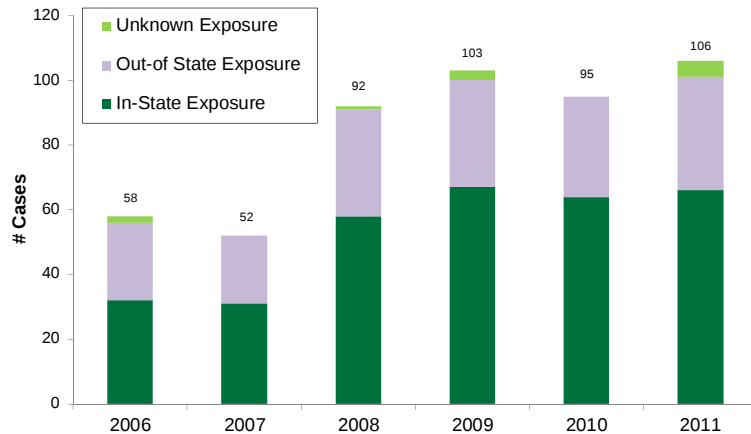
**Infection Analysis by Stage at a Southern MI Study Site:
2002-2004**



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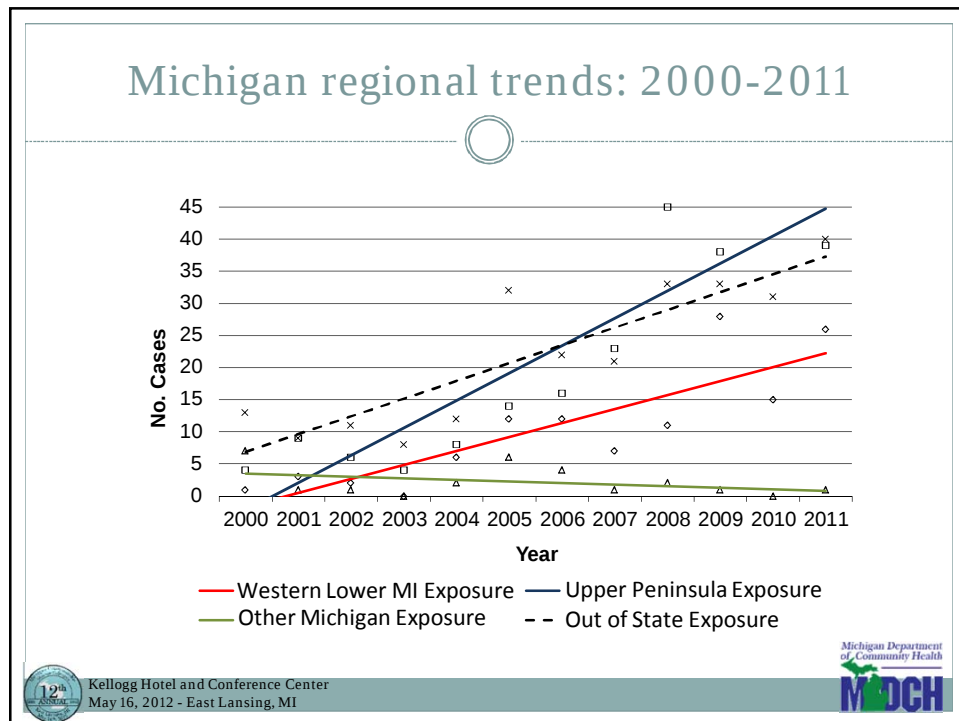
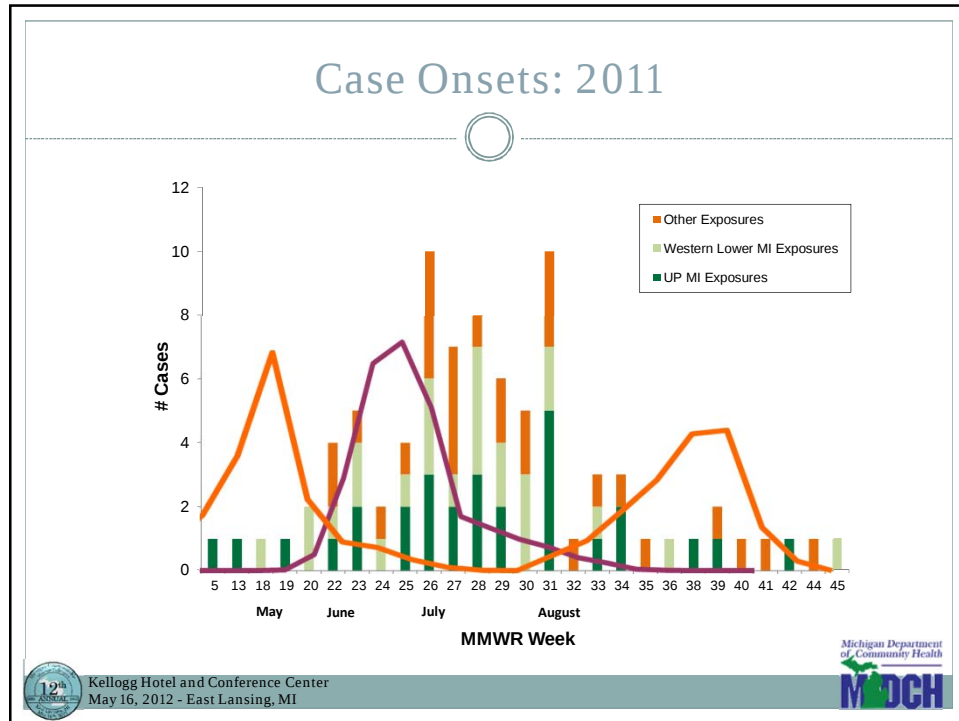


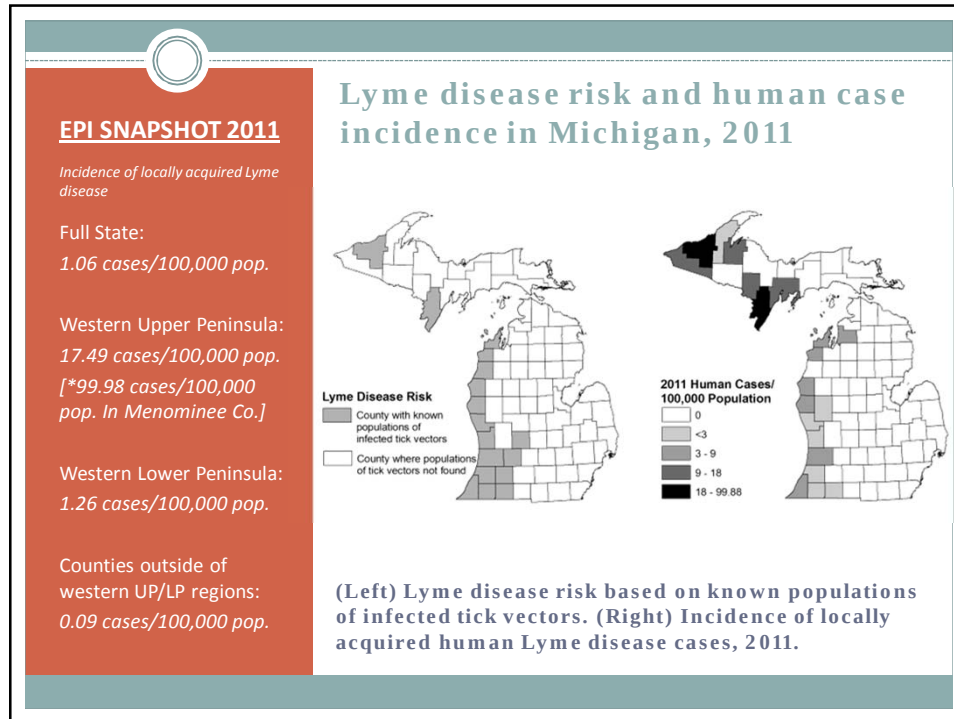
Michigan Human Cases 2006-2011



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Interesting Findings at Sleeping Bear.....

BROAD SUMMARY
INTERESTING DIFFERENCES
TANTALIZING SCIENCE

Preliminary Summary

- ❑ *Ixodes scapularis* ticks were found at all SBD sites surveyed
- ❑ *Borrelia burgdorferi* was isolated from ticks or animals at all sites EXCEPT South Manitou Island
- ❑ Mainland site tick densities and infection rates are indicative of initial invasion/ongoing colonization
- ❑ High adult questing density on NMI during October hunt
- ❑ Adult tick density and infection rate at North Manitou Island is comparable to an established, southern Michigan control site



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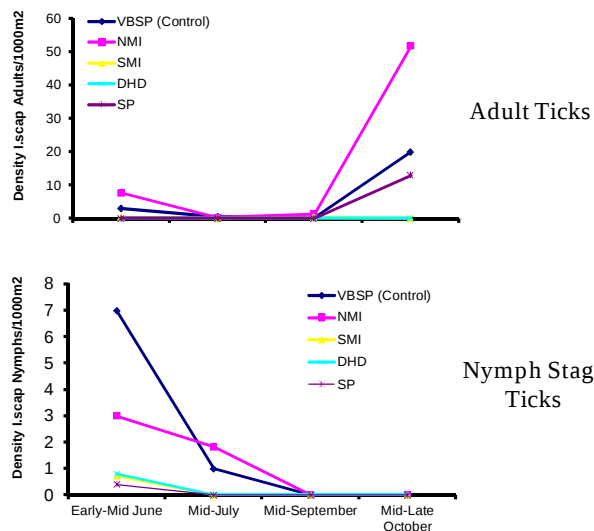
Results of >44,000-m² drag-sampling (>27 miles)



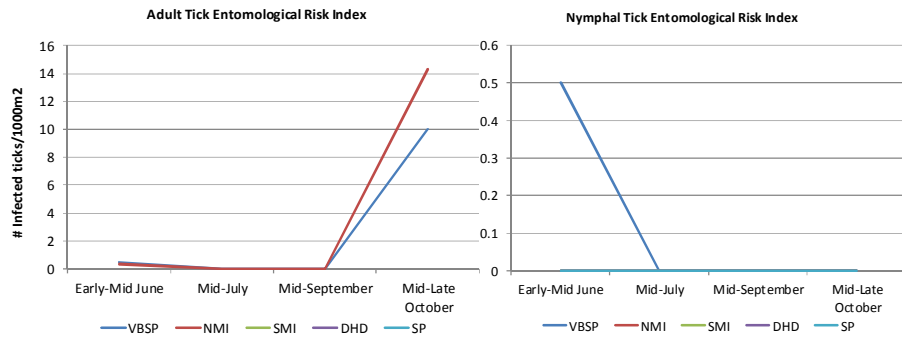
Tick Contact in the Environment

Ticks sampled by dragging a 1-meter x 1-meter corduroy cloth through forest understory

When compared with control site, NMI has highest adult and nymph stage tick density; densities as S. Platte have increased. Little activity at DH Day and SMI.



“Entomological Risk Index”



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Results of >3,400 trap nights

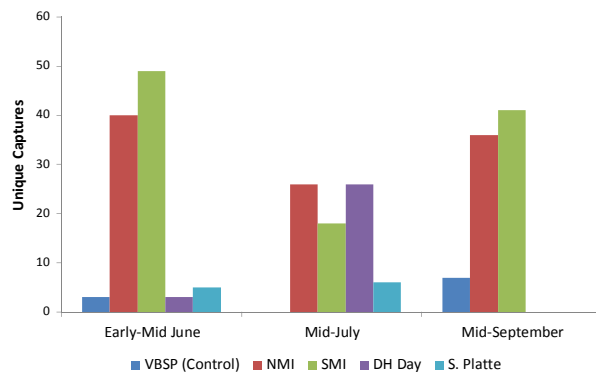
Eastern chipmunks are highly competent hosts for *B. burgdorferi* and previous studies point to high parasitism by nymphal blacklegged ticks.

North and South Manitou Islands have high populations of this important host species compared to a southern Michigan control site.



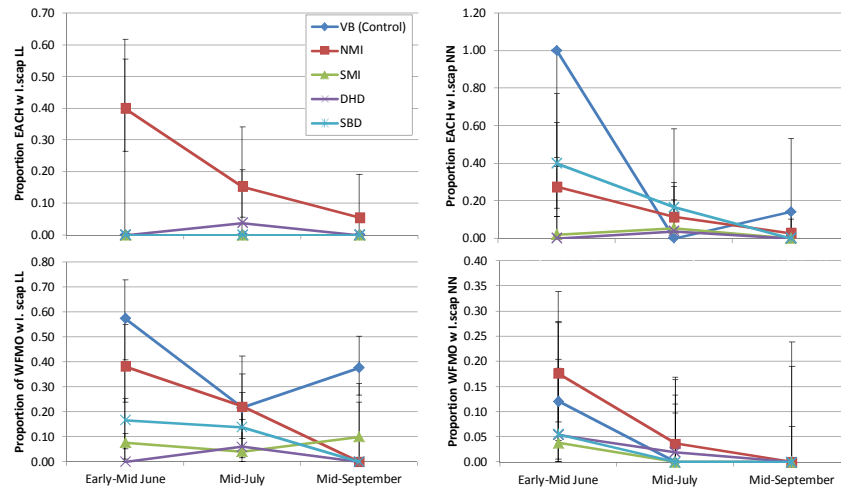
Photo: Jean Tsao

Eastern Chipmunk Captures - SBDNL Tick Survey Data 2011

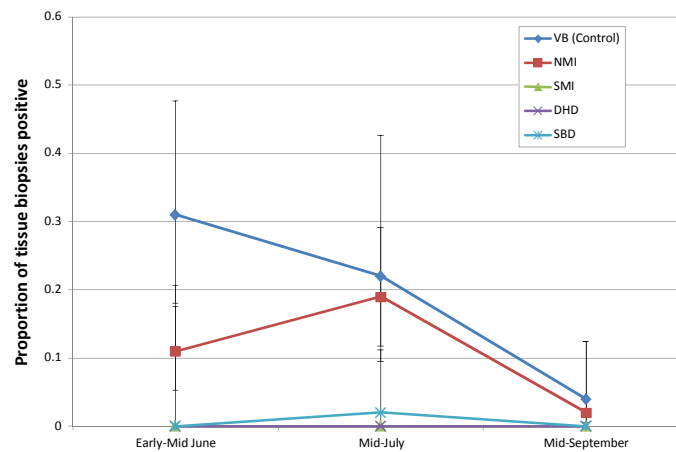


“The amount of chipmunks and breeding habitat for the nymphs (young ticks) is a perfect cocktail for the spread of Lyme disease at a alarming rate....”

Ticks on wildlife hosts



B. Burgdorferi infected animals



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Hunter Collected Ticks

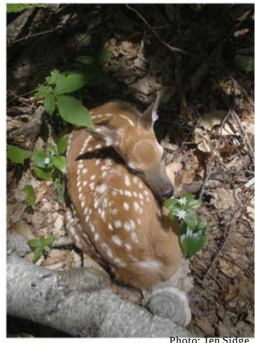


Photo: Jen Sledge

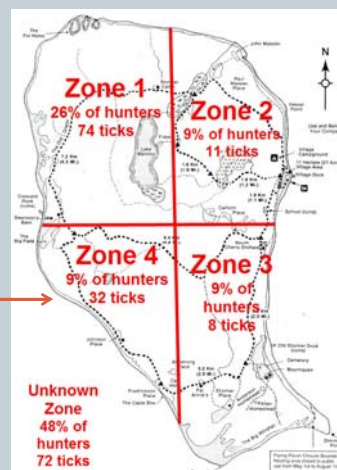
In October, 2011 hunters bound for the NMI annual hunt were recruited to collect ticks from themselves and harvested deer.

- ❑ Hunters were asked to participate in survey and briefed about ticks and Lyme disease risk while en-route to the island
- ❑ 40 collection kits were distributed including forceps, collection tube, instructions, data sheet, pen and gloves
- ❑ Hunters were given gift card to participate



Hunter collected ticks results

- ❑ 40 collection kits distributed
- ❑ 22 (55%) kits returned at the end of the hunt
- ❑ 196 ticks collected (all adult *I. scapularis*)
- ❑ Collection range was: 1 to 24 ticks with a mean of 9.38 ticks/hunter
- ❑ Probable tick collection locations were marked on a map by hunters
- ❑ **48% of ticks collected showed evidence of *B. burgdorferi* infection by PCR**



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Compare North vs. South Island

North Manitou

- ☐ High density small mammal hosts
- ☐ Mixed deciduous, sandy soils
- ☐ White-tailed deer population
- ☐ Other medium sized mammals (coyote)
- ☐ HIGH density ticks
- ☐ HIGH *B. burgdorferi* rate

South Manitou

- ☐ High density small mammal hosts
- ☐ Mixed deciduous, sandy soils
- ☐ NO White-tailed deer population
- ☐ Few to no other medium sized mammals
- ☐ LOW density ticks
- ☐ NO *B. burgdorferi*

How did *I. scapularis* ticks arrive on the islands?

Conclusions

- ☐ Lyme disease is the most commonly reported vector-borne disease in Michigan
- ☐ Tick populations and Lyme disease risk continue to expand geographically in Michigan, now encompassing the entire western shoreline of the Lower Peninsula
- ☐ More study is warranted to estimate the entomologic risk index (density *B. burgdorferi* infected nymphs/1000m²) at SBDNL as well as:
 - ☐ What factors contribute to differences in tick density and infection rate (NMI vs. SMI)?
 - ☐ Do birds play a role in introducing ticks to the islands?
 - ☐ Are the tick introduction rates similar between the islands?



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Michigan Classification Flowchart found at www.michigan.gov/cdinfo

