

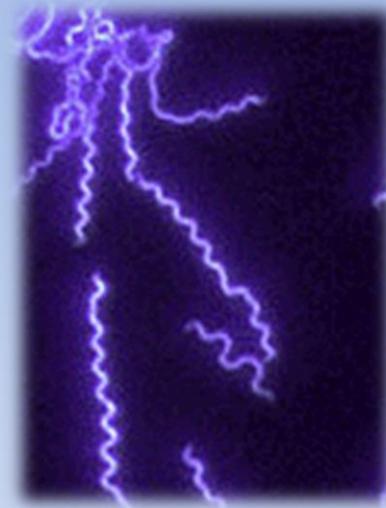
Two Western black-legged ticks (Ixodes pacificus) are shown on a dry, light-brown grass stem. The ticks have a reddish-brown, oval-shaped body and four pairs of dark, jointed legs. They are positioned vertically on the stem, one above the other. The background is a soft, out-of-focus brownish-green.

# Lyme Disease

Western black legged tick (*Ixodes pacificus* )

# *Borrelia burgdorferi*

- Spirochete
  - Host-associated helical bacteria
  - First identified in 1982 by W. Burgdorfer as spirochete\*
- *Borrelia burgdorferi* is etiologic agent of Lyme disease in U.S.\*\*
- Lyme disease is the most common vector-borne disease in the U.S.
- In California, *Ixodes pacificus* is the only tick that transmits Lyme disease\*\*\*



\* Burgdorfer et al, 1982. Science (216): 1317-9

\*\* Steere, 2006. Wien Klin Wochenschr. (118): 625-633

\*\*\* Lane et al. 2004 J. Med Entomol. (41): 239-248

# Symptoms of Lyme Disease



## Early Symptoms

- Non-specific “flu-like” symptoms
  - Headache
  - Myalgia
  - Fever
  - Malaise
- Erythema migrans (EM) rash

## Later symptoms

- Facial palsy (Bell’s palsy)
- Arthritis in one or more joints
- Rare cardiac involvement



**EM Rash**

Source: Ross Ritter



**Attached tick and reaction**

Source: Lake County HD

# Tick Bites and Lyme Disease

- Erythema migrans (EM) rash
  - EM rash is slowly expanding and sometimes has central clearing
  - Rash typically develops 7-10 days following tick bite (range 1-30 days)
  - Rash is rarely pruritic
    - (Wormser, N Engl J Med 2006;354:2794-801)
  - Reported in ~60% of CA cases
  
- Rash should not be confused with tick-bite lesions (or allergic response)
  - Occurs within 1-24 hrs and does not spread



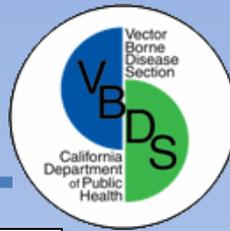
EM Rash

Source: Ross Ritter

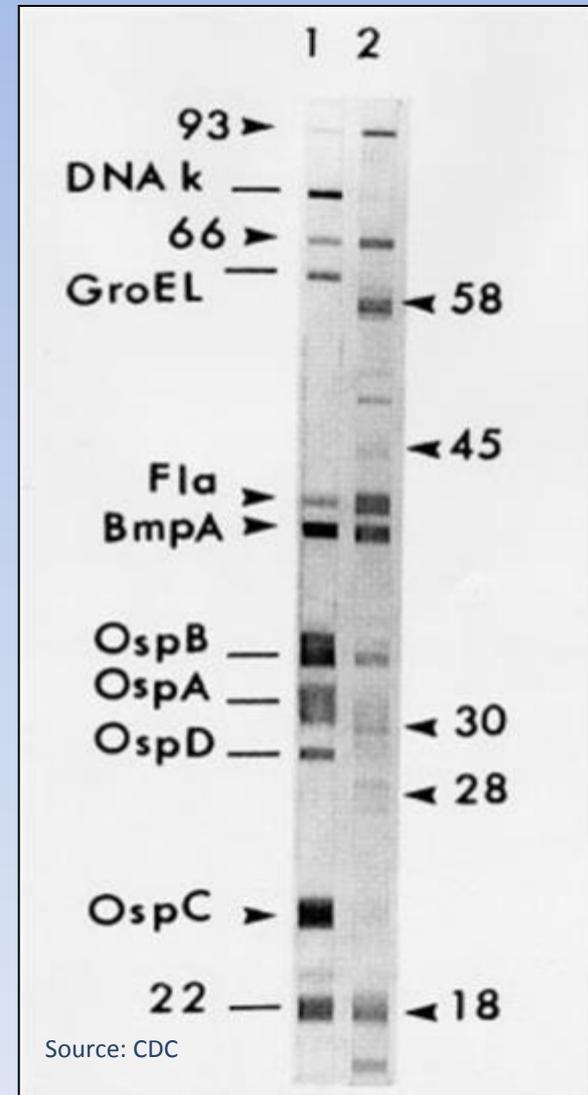


Source: Lake County HD

# Diagnosis



- Symptoms
  - EM rash, facial palsy
- Exposure potential
  - History of tick-bite or being in tick-infested area
- Serologic test: two-test approach
  - ELISA, IFA, or C6
  - If test positive, follow with confirmatory western blot



# Treatment

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- Early disease
  - Oral doxycycline
  - Oral amoxicillin
    - For children and pregnant women
- Late and/or neurologic disease
  - Intravenous ceftriaxone
- Slow recovery (i.e. weeks to months) can occur



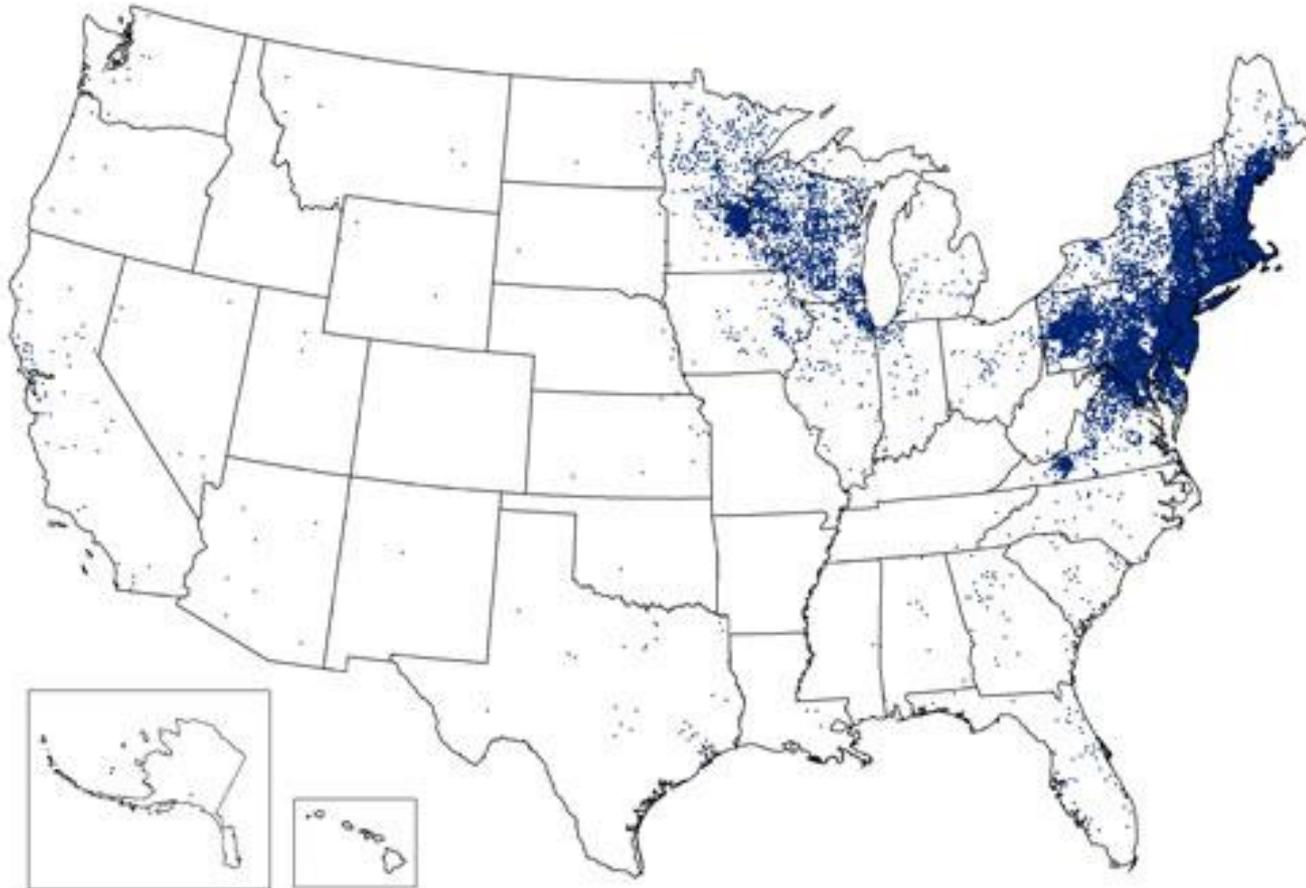
# History of Lyme Disease in California

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- First human case identified in 1978 in a hiker from Sonoma County
- Lyme disease became a reportable condition in 1989
  - In 2005, it became laboratory reportable
  - Since 1989, > 2,500 cases of Lyme disease reported through passive surveillance to the California Department of Public Health
- Western blacklegged tick is the only tick that transmits Lyme disease to humans in California

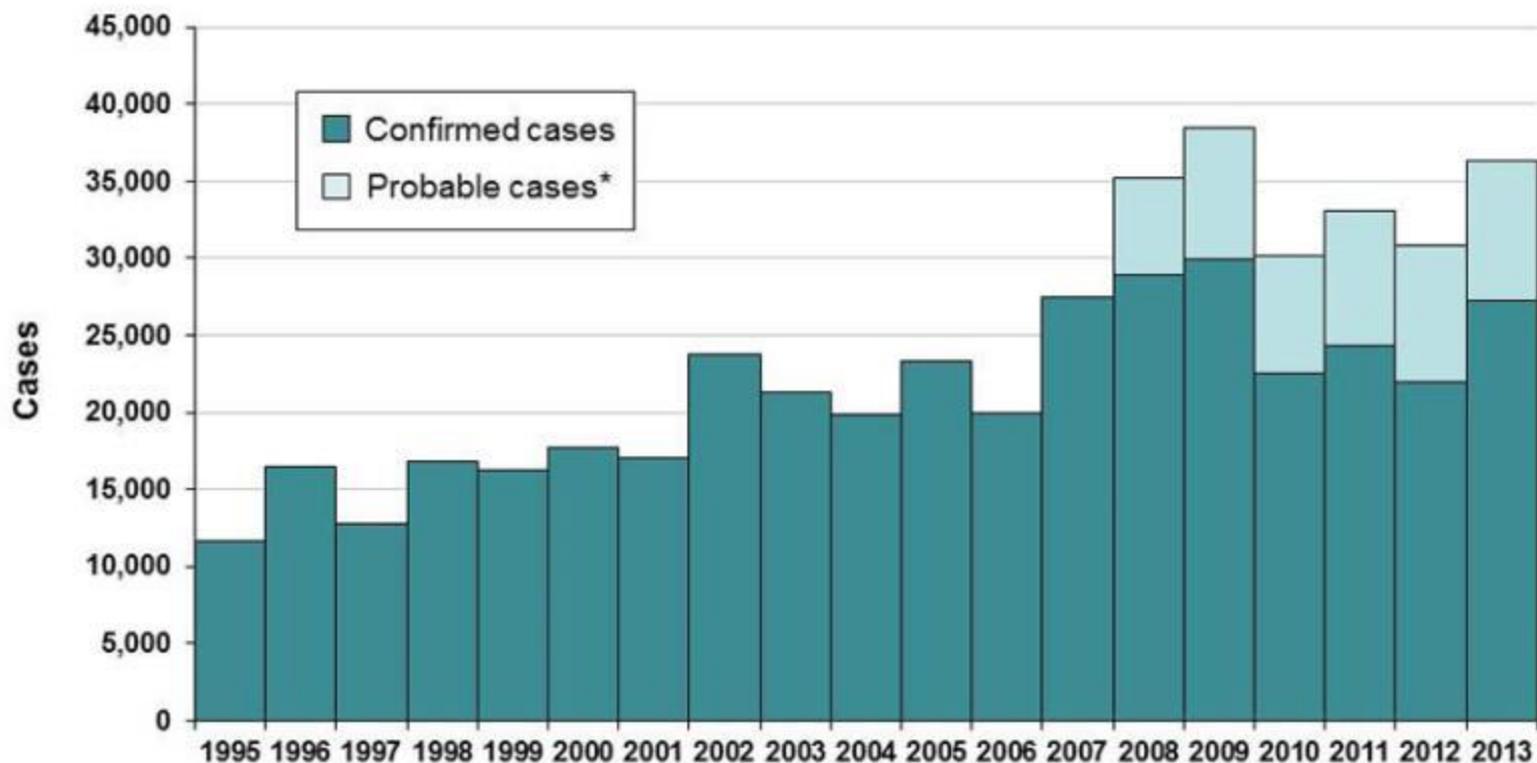


## Reported Cases of Lyme Disease -- United States, 2012



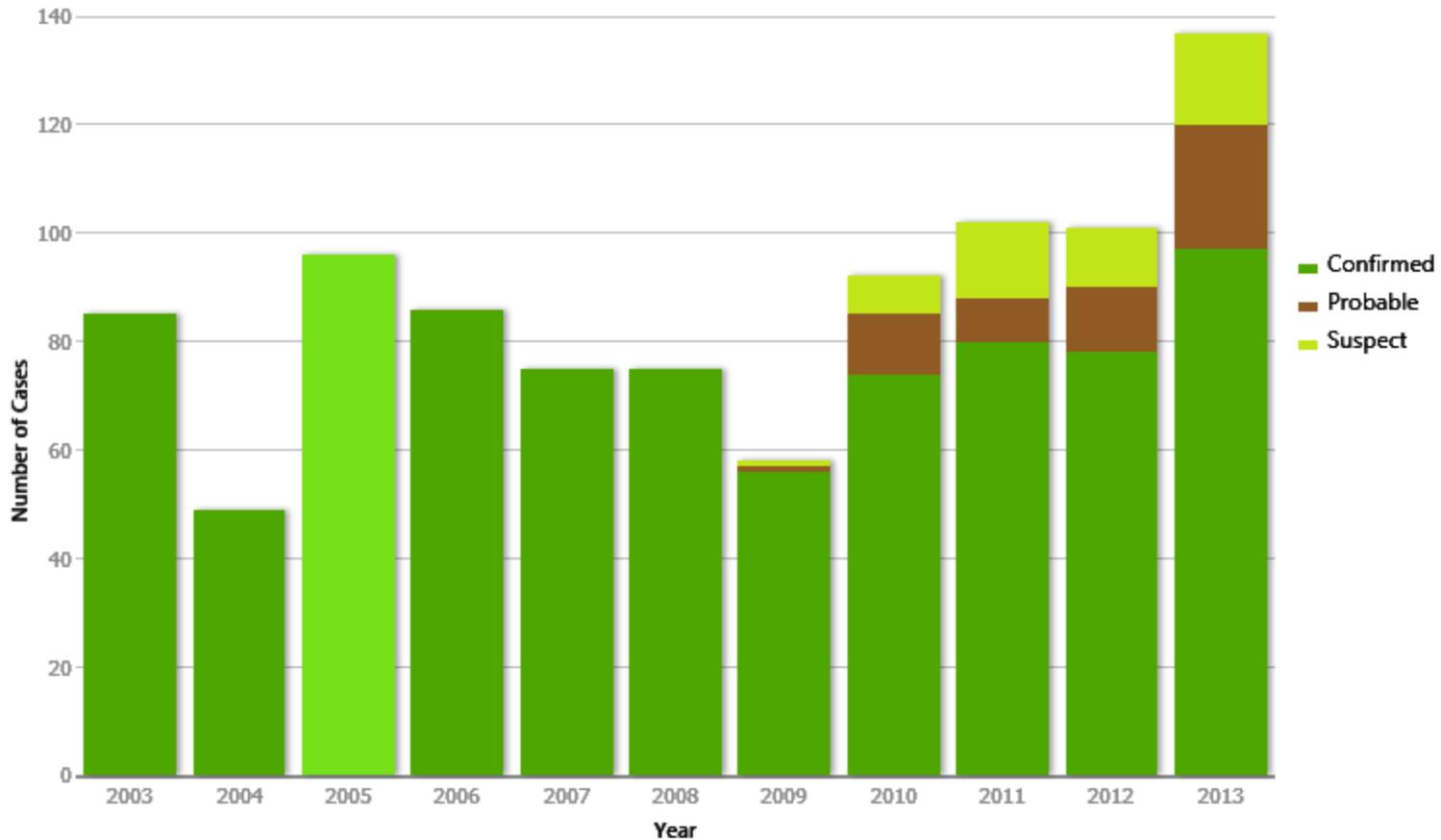
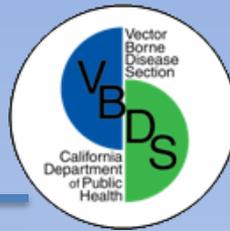
1 dot placed randomly within county of residence for each confirmed case

# Reported Cases of Lyme Disease by Year, United States, 1995-2013



\*National Surveillance case definition revised in 2008 to include probable cases; details at <http://www.cdc.gov/lyme/stats/chartstables/casesbyyear.html>

# Reported Cases of Lyme Disease per Year in California



# Reported Incidence of Lyme Disease, California, 2004-2013

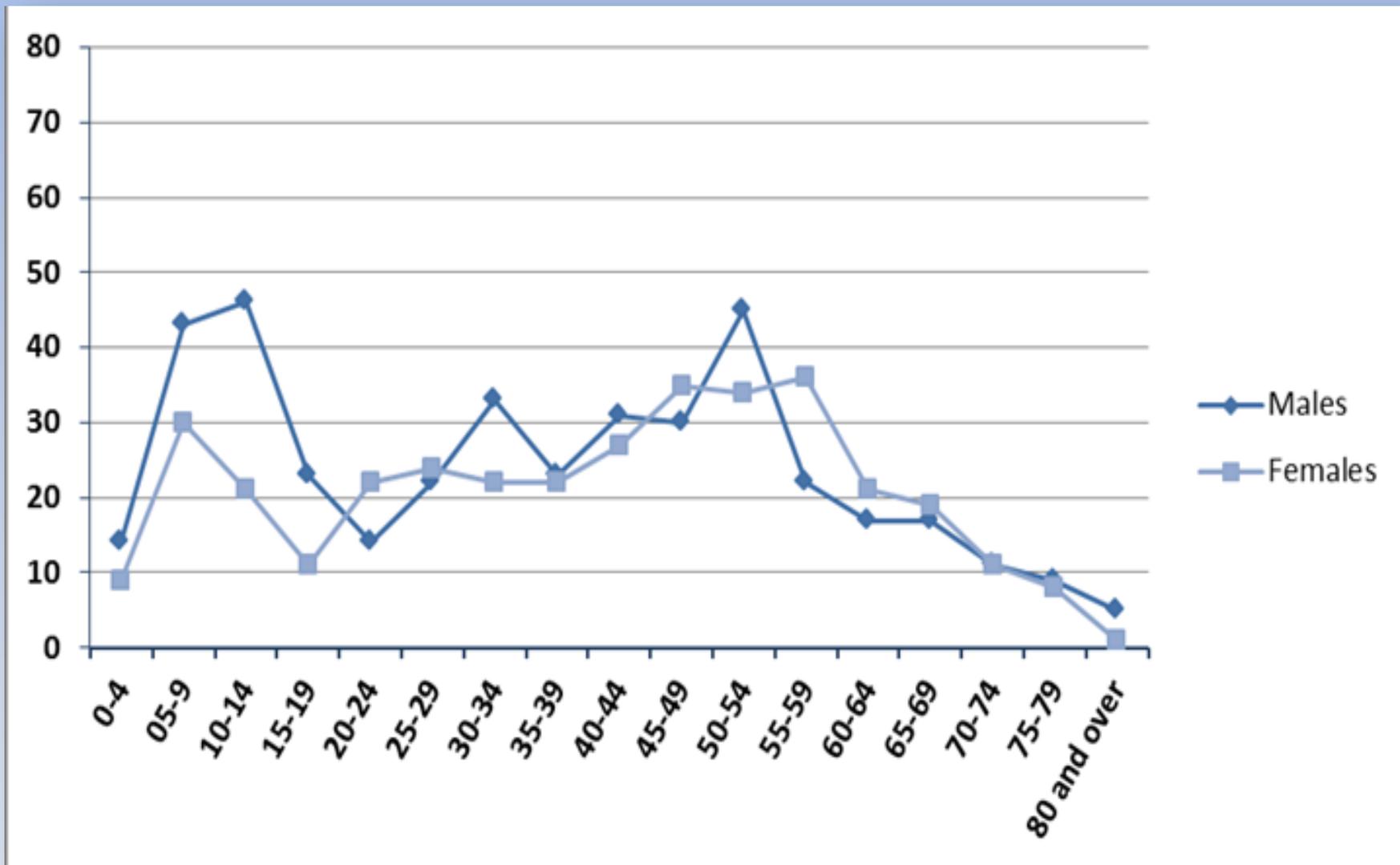


## Reported cases per 100,000 person-years

Trinity	5.9	≥ 5.0	
Humboldt	4.3		
Mendocino	4.0	3.0 – 4.9	
Sierra	3.1		
Nevada	2.4		
Mono	2.0		
Santa Cruz	1.7	1.0 – 2.9	
Mariposa	1.7		
Amador	1.6		
Sonoma	1.4	0.1 – 0.9	
Marin	1.0		
Others			
No cases reported			

- Although Lyme disease cases have been reported in nearly every county, cases are reported based on the county of residence, not necessarily the county of infection.
- The incidence of Lyme disease has remained consistent over the last 20 years
- Northwestern coastal counties are areas of highest risk

# Confirmed Lyme Disease Cases by Age and Gender 2002-2011

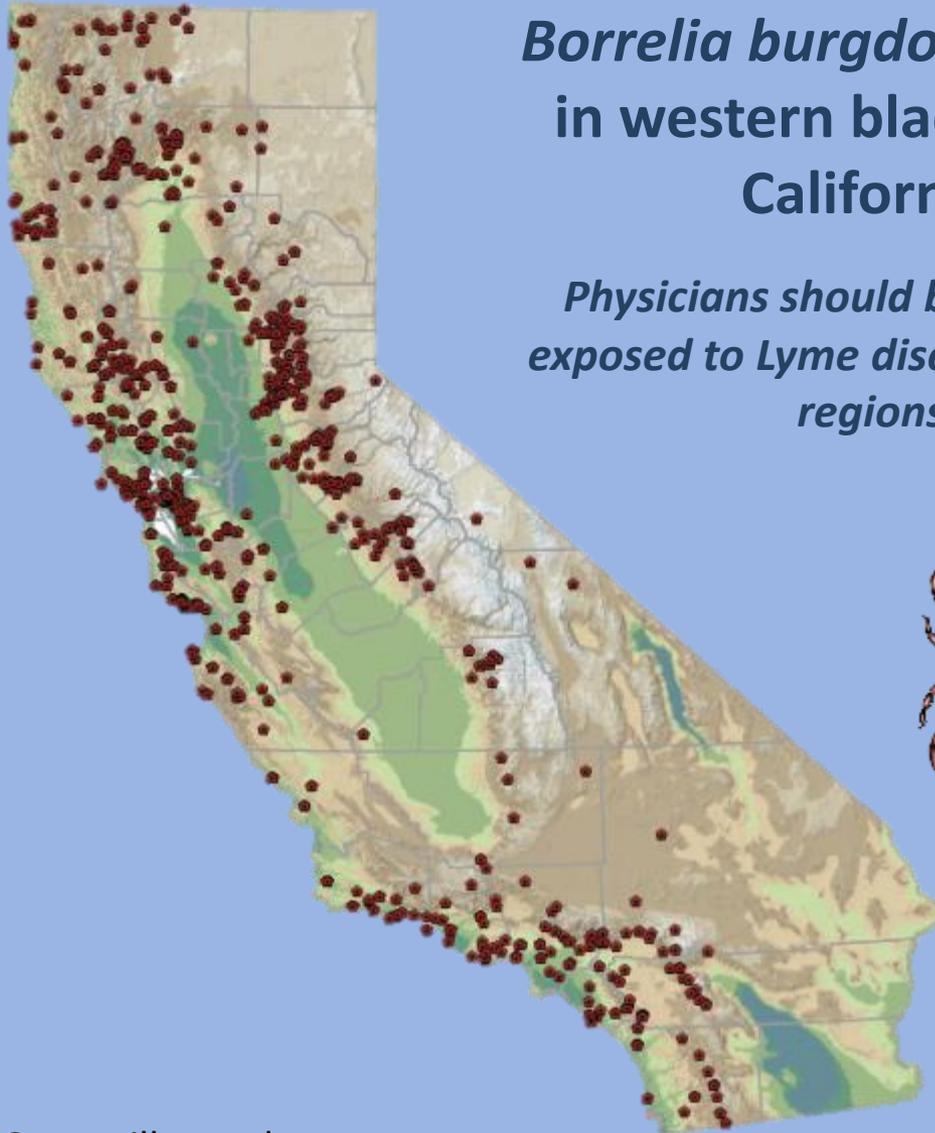


# Tick distribution



*Borrelia burgdorferi* has been found in western blacklegged ticks in 42 California counties\*

*Physicians should be aware that people can be exposed to Lyme disease-carrying ticks in many regions of California*

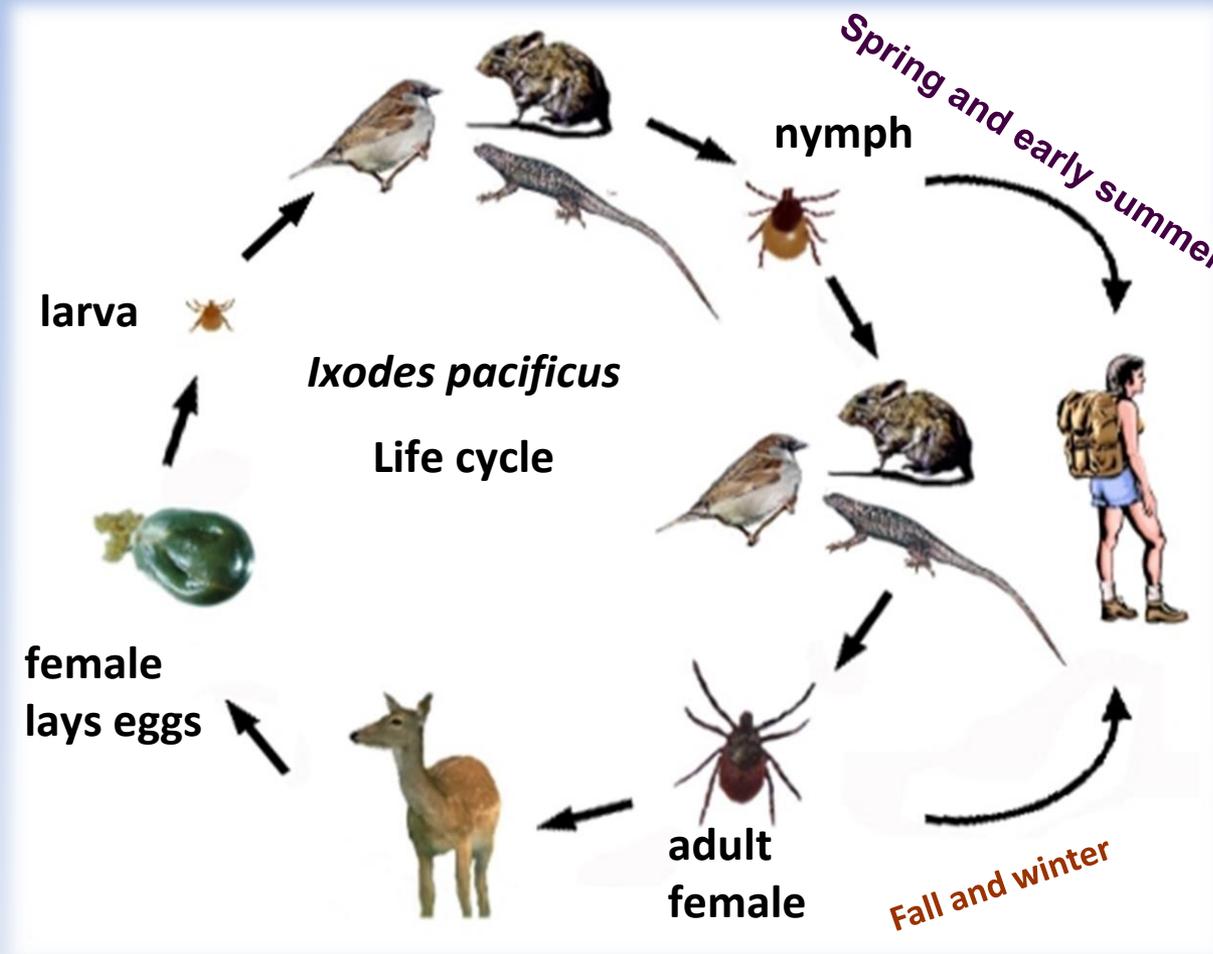


## Collection location

- Tick surveillance has not been conducted in all areas of California; ticks can be found in locations not identified on map.
- Locations where tick surveillance was conducted and no ticks were found are not identified on map.

\* VBDS surveillance data

# Transmission of *Borrelia burgdorferi* to Humans in California



Larvae or nymphal ticks acquire the bacteria by feeding on infected mammal hosts

People are accidentally infected through the bite of an infected nymph or adult female western blacklegged tick

# Western Blacklegged Tick Infection Prevalence with *Borrelia burgdorferi*

- Adult western blacklegged tick: typically 1-5% infected
- Nymphal western blacklegged tick: typically 0-15% infected
  - In northern CA where studied (Mendocino, Placer, Yolo counties), prevalence is often higher in nymphal than adult ticks\*
- Larval western blacklegged tick: 0%
  - Larvae rarely bite people

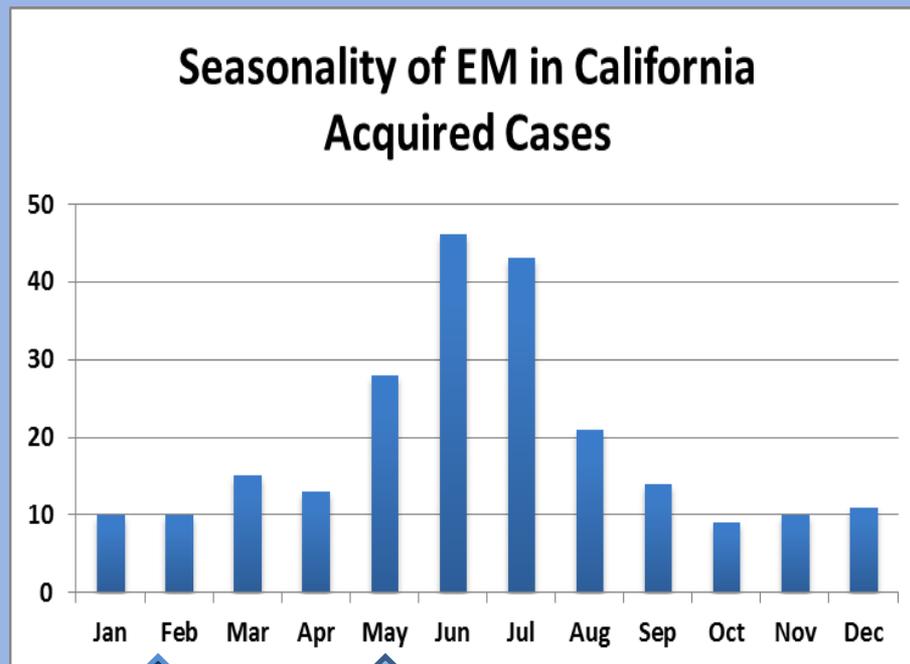


\* Clover and Lane 1995. J. Trop Med Hyg. 53: 237-240; Wright et al 1998. J. Med Ent 35: 1044-1049

# Seasonality of Acute Lyme Disease Cases, California

## 2001-2010

The greatest number of acute cases of Lyme disease acquired in California (as evidenced by EM rash) occurs in June, one month after the peak nymphal tick season



Approximate peak adult western blacklegged tick season



Approximate peak nymphal western blacklegged tick season

# Nymphal Tick Exposure Risk by Habitat



**Grassland (very low)**



**Chaparral (low)**



**Woodland-grass (low)**



**Dense woodland ( $\geq$ moderate)**

# California: Lizards and Lyme Disease



Western fence lizard



Alligator lizard



Nymphal and larval ticks on a western fence lizard

- Nymphal western blacklegged ticks feed on lizards
- A borreliacidal protein in lizard blood kills *Borrelia burgdorferi* spirochetes in the gut of infected nymphal ticks\*
- As a result, in some areas in California, the proportion of infected adult western blacklegged ticks is lower than in the nymphal western blacklegged ticks

\*Lane and Quistad 1997. J. Parasitol. 84: 29-34

-The blood meal from the lizard “cleaned” the tick



To find out more about Lyme disease in  
California,  
visit the CDPH website at:

<http://www.cdph.ca.gov/healthinfo/discond/Pages/LymeDisease.aspx>



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