Endemic and (Re)Emerging Tick-borne Diseases in California

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Introduction

- California home to at least nine endemic tick-borne diseases.
  - Known endemic - those with known tick-vector species, fairly predictable geographic risk and stable incidence
  - Emerging or re-emerging
    - More precise diagnostic tests
    - Newly recognized symptoms
    - Tick vector changes
    - Active surveillance based on knowledge of agents in local ticks

Known Endemic Tick-Borne Diseases

Disease	Principal Reservoir	Vector
Lyme disease *Borrelia burgdorferi*	Woodrats, deer mice, squirrels, etc	*I. pacificus*
Tick-borne Relapsing fever *Borrelia hermsii*	Chipmunks, other small mammals	*O. hermsii*
Anaplasmosis *Anaplasma phagocytophilum*	Woodrats	*I. pacificus*
Babesiosis *Babesia duncani*	Large ungulates (deer)	*D. albipictus*
Colorado tick fever CTF virus	Unknown	*D. andersoni*, *D. occidentalis*
Tularemia *Francisella tularensis*	Rabbits, squirrels, etc..	*Dermacentor* spp.

(Re)emerging tick-borne Diseases

Disease	Principal Reservoir	Vector
Hard tick-borne relapsing fever *Borrelia miyamotoi*	deer mice	*I. pacificus*
Rocky Mountain spotted fever *Rickettsia rickettsii*	Small rodents; dogs potentially	*D. occidentalis, D. andersoni, D. variabilis, R. sanguineus*
Spotted fever group *Rickettsia* 364D (*R. philipii* proposed)	Unknown	*D. occidentalis*

Number of Reported Tick-borne Disease Cases Reported in CA, 2013 - 2022

Disease	# Reported Cases	# With NO out-of-state travel history (% total reports)	California Incidence per 100,000 population (total cases)
Lyme disease*	840	477 (57%)	0.22
Tick-borne relapsing fever**	93	85 (91%)	0.02
Anaplasmosis***	82	42 (53%)	0.02
Tularemia***	27 (10 tick-related)	25 (93%)	0.007
Pacific Coast Tick Fever*** (*Rickettsia philipii*)	13	13 (100%)	0.003
Babesiosis*	36	1 (3%)	0.009
Rocky Mountain spotted fever*	10	4 (40%)	0.003

* Confirmed only
** Confirmed, probable and suspect
*** Confirmed and probable

GUIDE TO TICKS AND DISEASES THEY TRANSMIT IN CALIFORNIA

VECTOR-BORNE DISEASE SECTION

	American Dog Tick	Brown Dog Tick	Pacific Coast Tick	Western Blacklegged Tick		Soft Tick
	 Female Male	 Female Male	 Female Male	 Female Male Nymph		 Female
Anaplasmosis						
Lyme Disease						
Pacific Coast Tick Fever						
Rocky Mountain Spotted Fever						
Tularemia						
Tick-borne relapsing fever (*Borrelia hermsii*)						
Geographic Distribution	Throughout California	Throughout California	Primarily coastal and foothill regions throughout California	Primarily coastal and foothill regions throughout California		High elevation (>3000 ft.)

California Endemic Tick-Borne Diseases At-a-Glance

Disease/Agent	Tick Vector (link to images below)	Confirmed Cases 2010 - 2020 (range per year)	Tick Habitat (examples)
Lyme disease *Borrelia burgdorferi*	Western blacklegged tick (*Ixodes pacificus*)	936 (35 – 107)	a, c, d
Tick-borne relapsing fever *Borrelia hermsii*	Soft tick (*Ornithodoros hermsii*)	62 (3 – 10)	e
Anaplasmosis *Anaplasma phagocytophilum*	Western blacklegged tick (*Ixodes pacificus*)	29 (1 – 9)	a, c, d
Pacific Coast tick fever *Rickettsia* 364D (*Rickettsia philipii*)	Pacific Coast tick (*Dermacentor occidentalis*)	16 (0 – 4)	a, b, c, d
Rocky Mountain spotted fever *Rickettsia rickettsii*	American dog tick, Pacific Coast tick, Brown dog tick (*Dermacentor* spp. and *Rhipicephalus sanguineus*)	12 (0 – 3)	a, b, c, d, f
Babesiosis *Babesia duncani*	Winter tick (*Dermacentor albipictus*)	2 (0 – 2)	a, b, c, d
Colorado tick fever Colorado tick fever virus	Wood tick (*Dermacentor andersoni*)	1 (0 – 1)	e

Tick Habitats

a. Dense woodlands, e.g., oak, madrone

b. Chaparral

c. Mixed forest

d. Coastal scrub

e. Conifer/evergreen forest, typically cabin-associated

f. Urban or rural, typically dog-associated

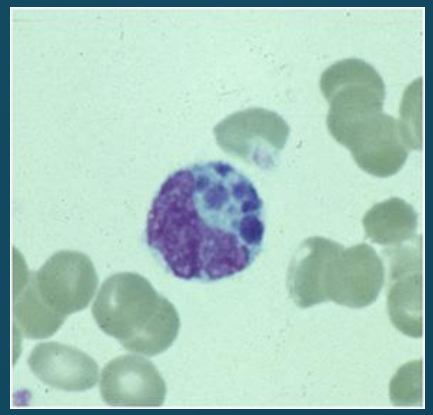
https://bit.ly/TickBorneDiseasesCDPH

https://bit.ly/CommonCATicks

Today will take both a tick-based and agent-based approach

- Western Black-legged tick (*Ixodes pacificus)* transmitted diseases
  - Anaplasmosis (*Anaplasma phagocytophilum)*
  - Lyme disease (*Borrelia burgdorferi*)
  - Hard tickborne relapsing fever (*Borrelia miyamotoi*)
- Soft tick transmitted disease *Ornithodoros hermsi*
  - Soft tickborne relapsing fever (*Borrelia hermsii)*
- Rickettsial diseases
  - Rocky Mountain spotted fever (*Rickettsia rickettsii)*
  - *Rickettsia* 364D
- *Babesia* spp
- A word about alpha-gal hypersensitivity
- Prevention

Anaplasmosis



- *Anaplasma phagocytophilum*
- Signs/Symptoms: fever, headache, fatigue, muscle aches, and nausea (rash, vomiting, cough, confusion)
- Diagnosis: blood smear, serology, PCR
- Treatment: doxycycline
- Vector: western black-legged tick (*Ixodes pacificus*) – ecology similar to Lyme disease in California
- Reservoirs: squirrels, chipmunks, wood rats

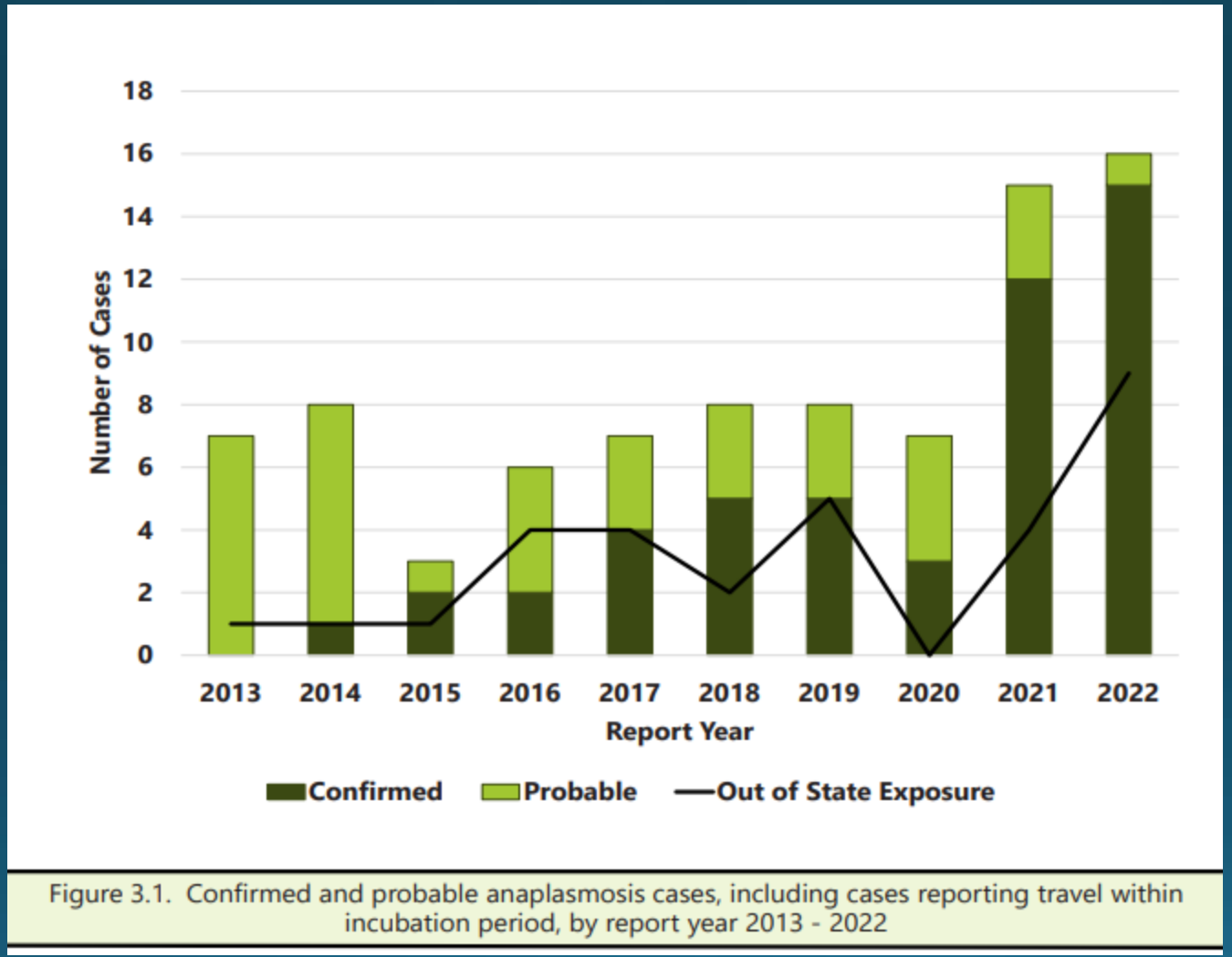
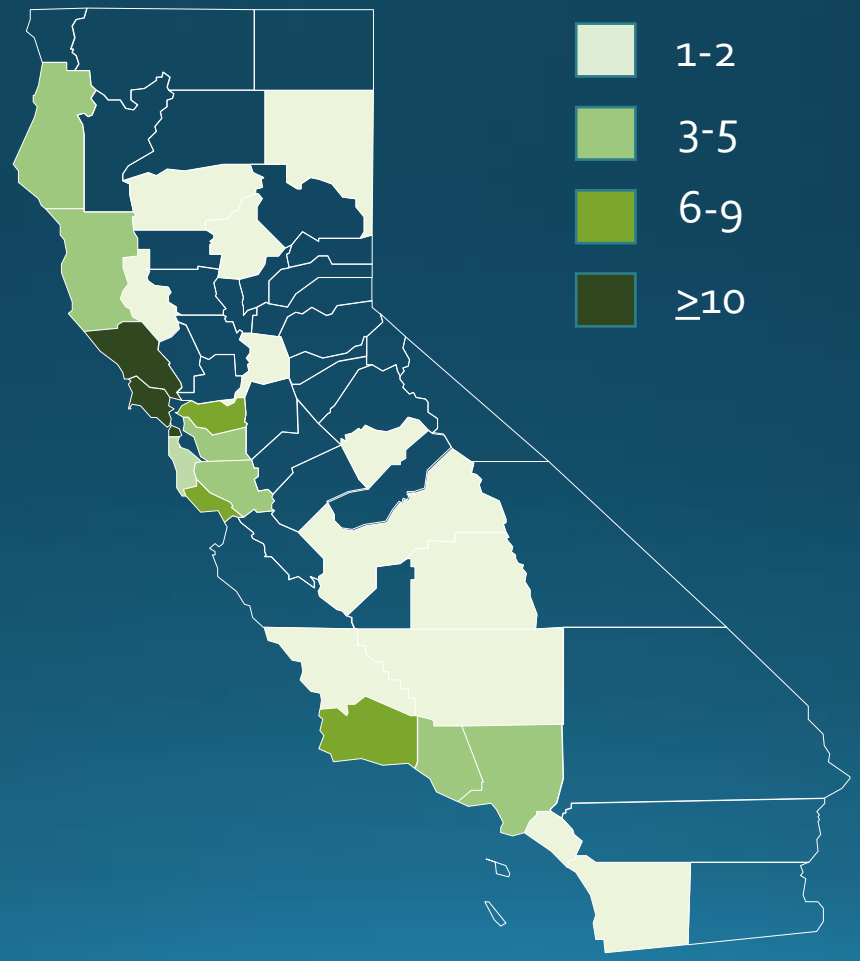


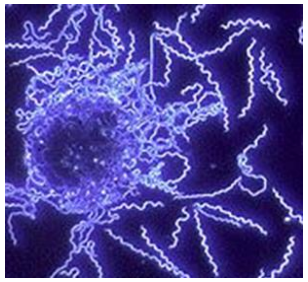
Figure 3.1. Confirmed and probable anaplasmosis cases, including cases reporting travel within incubation period, by report year 2013 - 2022

Anaplasmosis by County of Residence 2004 - 2022

- Average 4 cases reported each year (range 1 – 16)
- "hot spots" in north coastal counties
- Two reports of Lyme-anaplasmosis co-infection acquired in CA
- About ½ of cases have out-of-state exposure to eastern US and upper Midwest

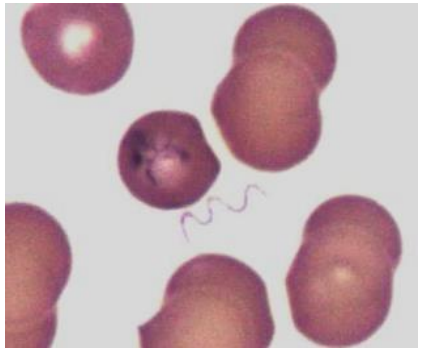


Borrelia found in California Ticks



California Borrelia

- Borrelia burgforferi s.l.
  - B. burgdorferi s.s.
  - B. bissettii
  - B. californiensis
  - B. americana
- RF Borrelia
  - B. miyamotoi
  - B. coriaceae
  - B. hermsii
  - B. parkeri
  - B. turicatae



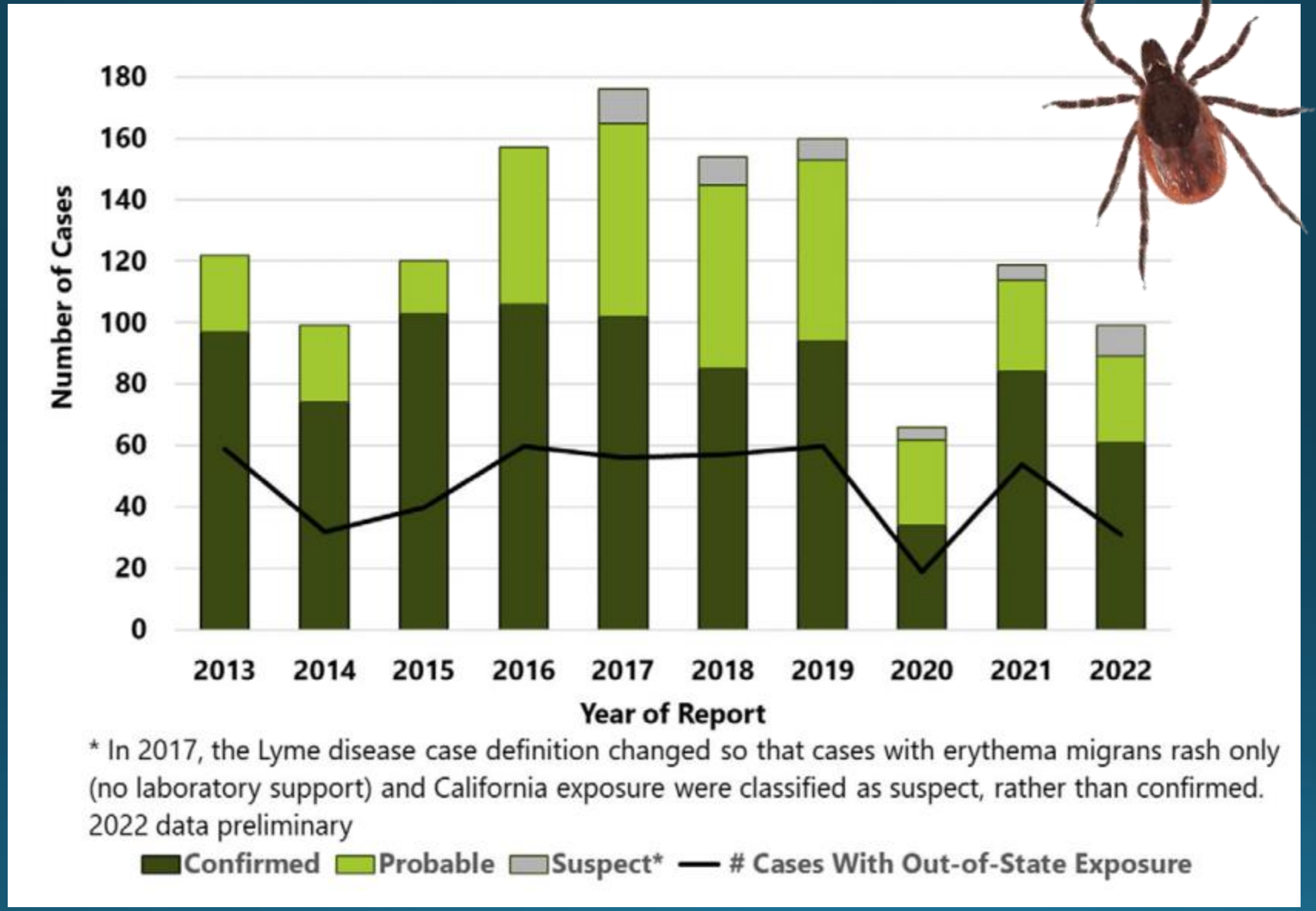
Lyme disease (*Borrelia burgdorferi)*

- Early Localized (3 to 30 days after a tick bite):
  - Erythema migrans
  - Fever, chills, malaise, headache, arthralgia
- Disseminated (days to months after tick bite):
  - Multiple EM rashes
  - Cranial neuritis (Bell's palsy most commonly)
  - Oligoarticular arthritis – transient migratory arthritis
  - Lymphocytic meningitis
  - Radiculoneuritis
  - Atrioventricular node block; myopericarditis
  - Rarely can be fatal
- Typically responsive to 14 days doxycycline

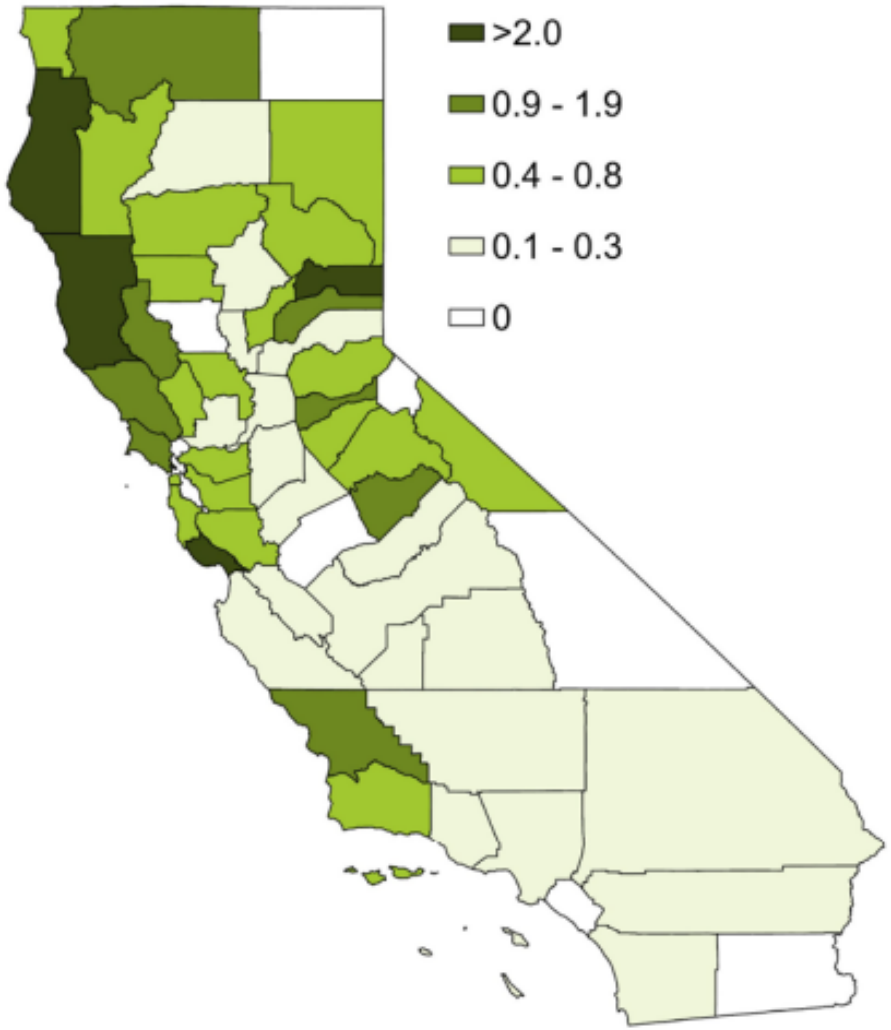
Courtesy Dr. Gary Green, Sonoma

Lyme disease diagnosis

- EM rash after being in an area where Lyme disease is common, Lyme disease should be diagnosed clinically (without diagnostic testing), as serologic tests may be negative during the first few weeks of infection before antibodies have developed.
- Two-step serologic testing is recommended using validated first- and second-tier tests
  - Standard two tier testing: EIA or IFA (if positive or equivocal) → western blot (IgM within first 30 days; IgG thereafter)
  - Modified two tier testing (newer): EIA (VlsE) (if positive or equivocal) → second EIA (whole cell). Tests must be FDA approved
- Important to order both tests (typically called reflex testing. If first neg, no need for second)
- IgM is interpretable only within 30 days from disease onset
- Tests do not reflect treatment "success"


180
160
140
120
100
80
60
40
20
0
Number of Cases
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year of Report
* In 2017, the Lyme disease case definition changed so that cases with erythema migrans rash only (no laboratory support) and California exposure were classified as suspect, rather than confirmed.
2022 data preliminary
Confirmed
Probable
Suspect*
Cases With Out-of-State Exposure

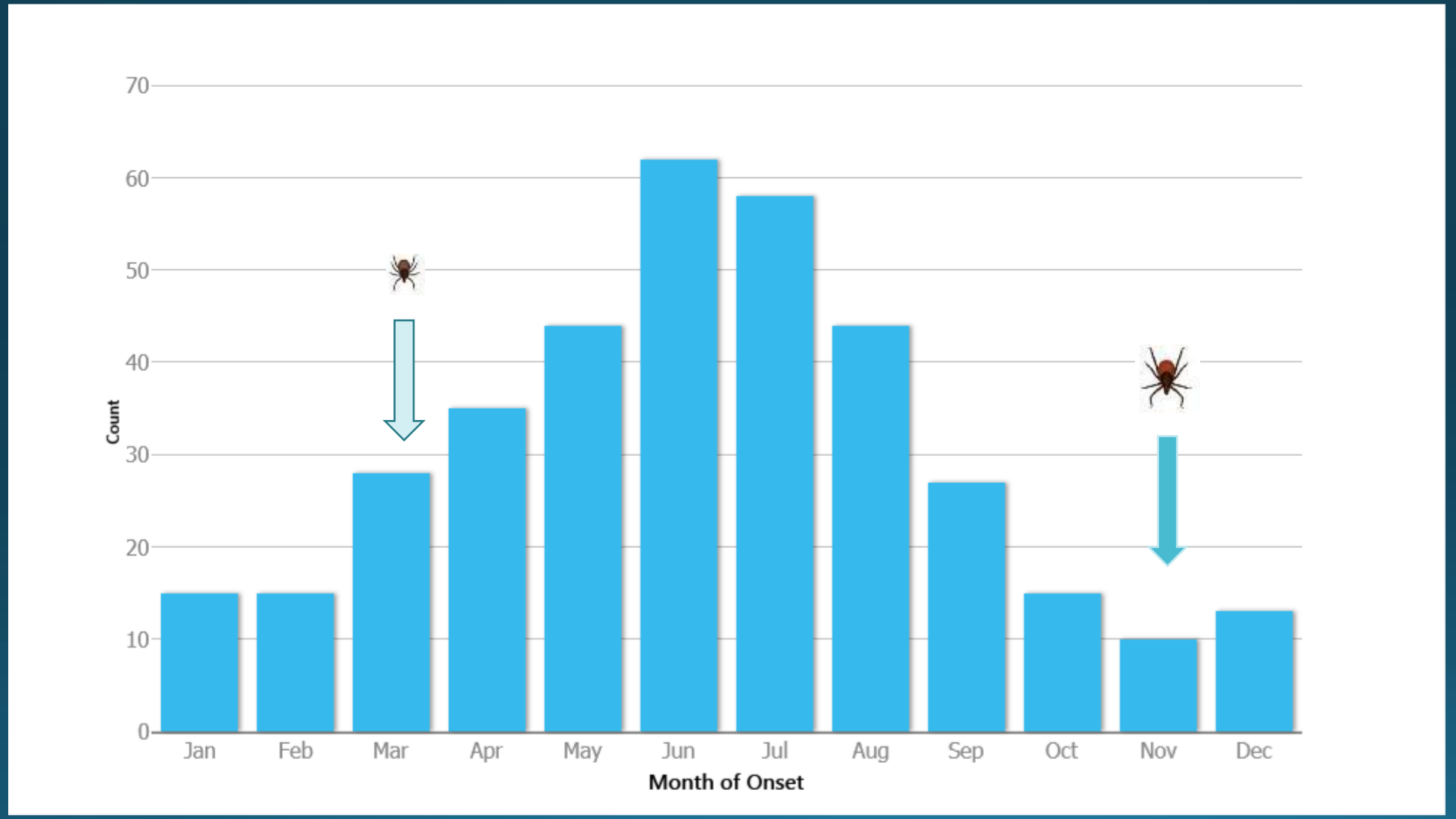
Reported confirmed Lyme disease cases per 100,000 person-years, 2013-2022



Sierra	3.1
Santa Cruz	3.0
Mendocino	2.8
Humboldt	2.2
Mariposa	1.7
Sonoma	1.4
Marin	1.4
Siskiyou	1.3
Amador	1.1
Lake	0.9
Nevada	0.9
San Luis Obispo	0.8
Napa	0.8

*Though Lyme disease cases have been reported in nearly every county, cases are reported based on the county of residence, which does not necessarily reflect the county of infection.

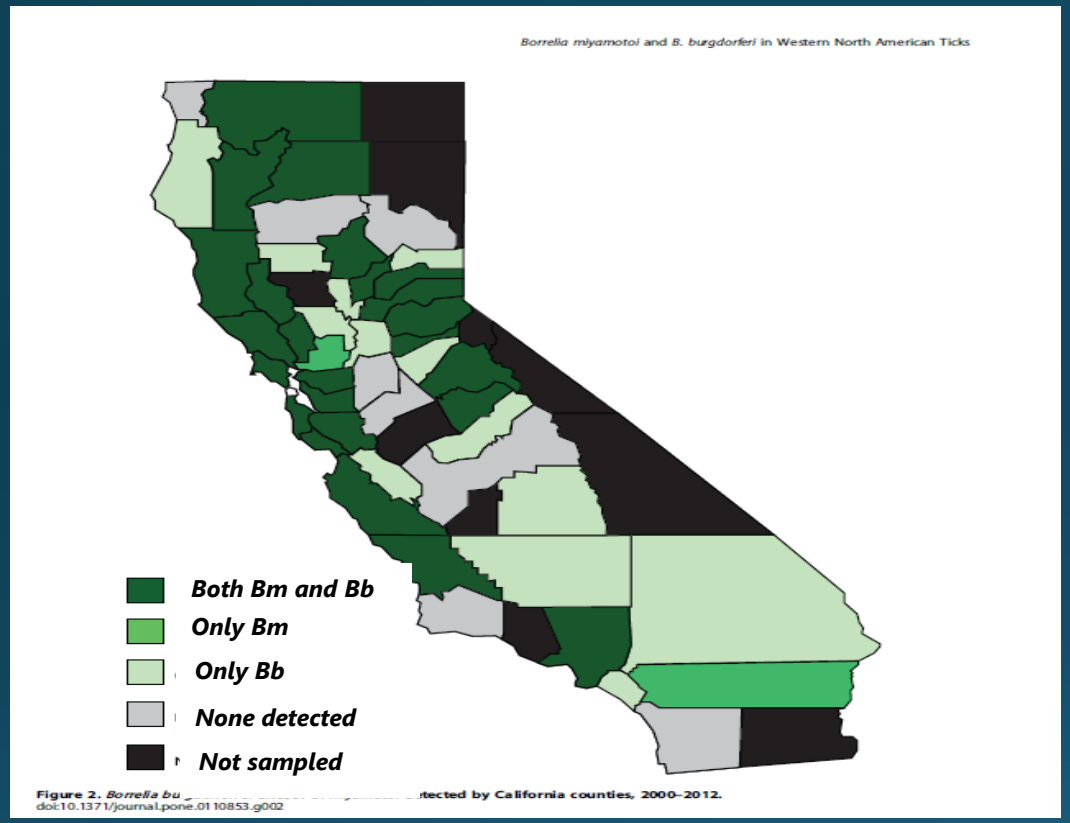
Month of Onset, CA-Acquired EM Rash



Hard tick relapsing fever: *Borrelia miyamotoi*

- Relapsing fever spirochete first identified in Japan in 1995 *in Ixodes persulcatus* ticks, since been detected in other *Ixodes ticks*, including *I. ricinus (*Europe), *I. scapularis* in eastern North America, and *I. pacificus* in western North America.
- Human infection recognized in Europe, Japan, and the northeastern United States as an emerging disease.
- Symptoms may include:
  - Fever
  - Chills
  - Relapsing fever (10-40% of cases)
  - Fatigue
  - Arthralgia/myalgia
- Treatment = doxycycline

Borrelia miyamotoi and *B. burgdorferi* in *Ixodes pacificus* in California



- CDPH has detected *B. miyamotoi* in *Ixodes pacificus* ticks since 2000
- 2012 study evaluated ticks collected from 48 counties
- Only one co-infected tick found (nymph)

2009 - 2012	*B. burgdorferi*	*B. miyamotoi*	N
I. pacificus - Adults	0.6% (37)	0.8% (51)	6036
I. pacificus - Nymphs	3.2% (70)	1.4% (30)	2188

Padgett et al, PloS One 2014

RESEARCH ARTICLE

Borrelia burgdorferi and *Borrelia miyamotoi* seroprevalence in California blood donors

Sharon I. Brummitt[1]*, Anne M. Kjemtrup[2], Danielle J. Harvey[3], Jeannine M. Petersen[4], Christopher Sexton[4], Adam Replogle[4], Andrea E. Packham[5], Evan M. Bloch[6], Alan G. Barbour[7], Peter J. Krause[8], Valerie Green[9], Woutrina A. Smith[1]

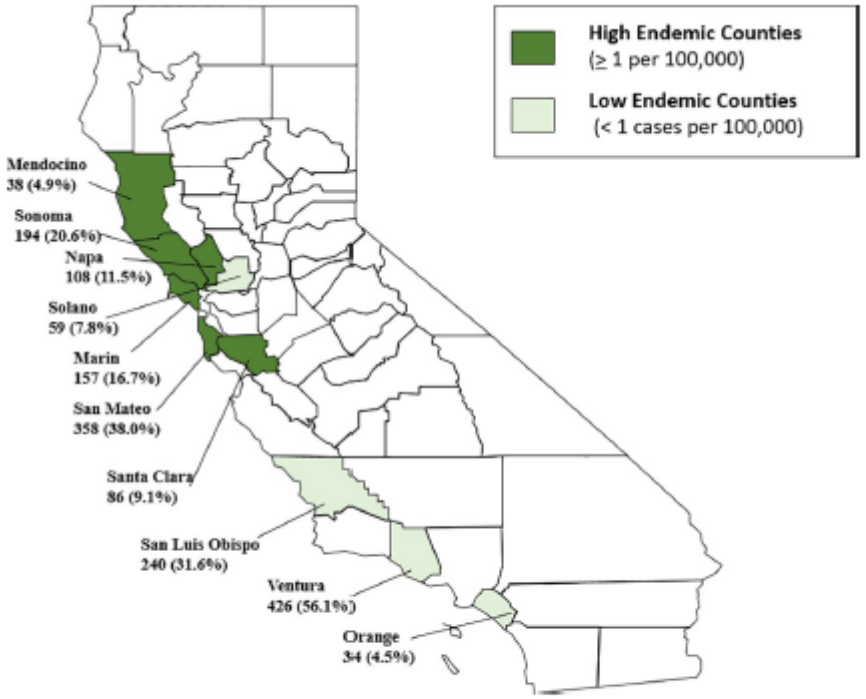


Fig 1. Counties in California in which samples were collected. The California counties in dark green represent high endemic counties for Lyme disease and those in light green represent low endemic counties for Lyme disease. Number and percentages of sera samples by county are provided. High endemic Lyme disease counties are defined as those with ≥ 1 case per 100,000 annually and low endemic Lyme disease counties are defined as < 1 case per 100,000 annually [16].

- 9/1700 (0.5 %) positive for *B. burgdorferi*
- 2/1700 (0.1%) positive for *B. miyamotoi*

Borrelia miyamotoi Infection in Immunocompromised Man, California, USA, 2021

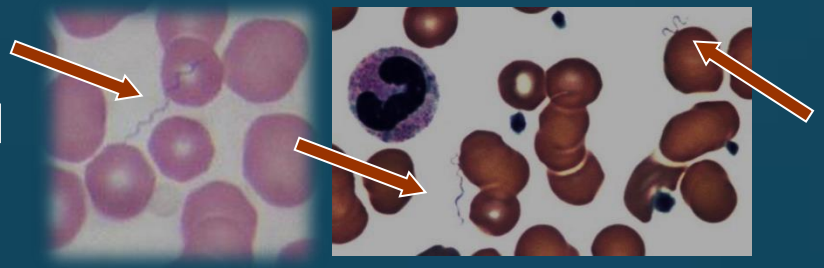
Luis Alberto Rubio, Anne M. Kjemtrup, Grace E. Marx, Shanna Cronan, Christopher Kilonzo, Megan E.M. Saunders, Jamie L. Choat, Elizabeth A. Dietrich, Kelly A. Liebman, Sarah Y. Park

- Adult northern California immunocompromised man presented with 3- month history of fevers up to 38.7°C
- Fevers lasted 1 day, occurred every 10–14 days, and were associated with night sweats, mild vision changes, and nausea.
- Work up for variety of infectious agents including Lyme disease negative
- Plasma mcfDNA sequencing ordered (Karius https://kariusdx.com). Results were positive for *B. miyamotoi* and PCR confirmed at CDC
- Successfully treated with 4 week course of doxycycline

Soft tick-associated Tick-Borne Relapsing Fever (STRF)

Agent

- *Borrelia hermsii*
- Visible on stained red blood smear



Source: Gary Green, M.D., Sonoma Co.

Vector

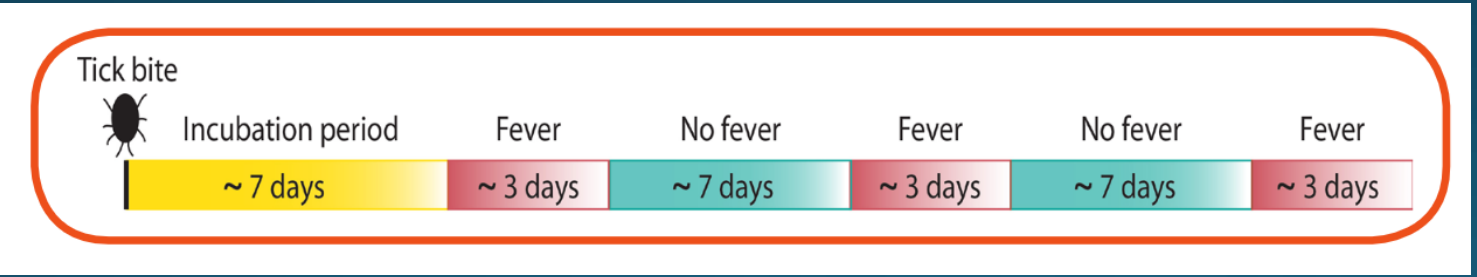
– Soft (Argasid) ticks, *Ornithodoros* spp.

Reservoir

– Peridomestic rodents
  - Chipmunks, squirrels, rats, mice
  - The tick itself

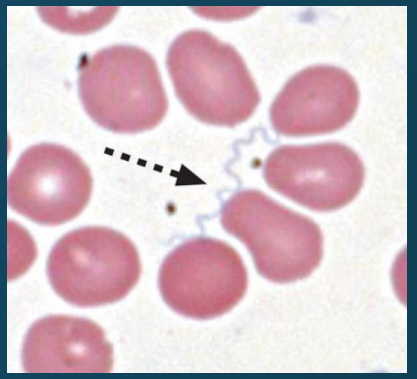
Clinical STRF

- The mean incubation period of STRF is 7 days (range, 4 to > 18 days)
- High fever (e.g., 103° F), headache, muscle and joint aches. Symptoms can reoccur, producing a telltale pattern of fever lasting roughly 3 days, followed by 7 days without fever, followed by another 3 days of fever.



Source: NEJM, case description

Soft Tick Relapsing Fever Diagnosis



- **Stained blood smear during febrile phase- easiest, fastest**
- PCR tests: if blood smear not an option or if want to confirm what observed in blood smear is *Borrelia*.
- CDC can do serology and PCR; samples should go through state labs (to access the 50.34 form). Good resource for confirmation

STRF Diagnosis

- A statement on what is available for commercial lab tests :
  - ARUP Relapsing Fever Borrelia PCR - Can detect *B. hermsii, B, turicatae, B. parkeri* and *B. miyamotoi*. Does not differentiate these species. This one would yield a Relapsing Fever PCR positive for all 4 species.
  - Quest - *Borrelia miyamotoi* PCR - likely to cross-react with *B. hermsii* and yield a *B. miyamotoi* PCR positive.
    - *Borrelia miyamotoi* serology, IgM/IgG - likely to cross-react with *B. hermsii* and yield a *B. miyamotoi* antibody positive
  - LabCorp - no tests for relapsing fever *Borrelia*
  - Mayo - *B. miyamotoi* PCR - this one is specific for *B. miyamotoi* based on melting temperature analysis of the PCR product.

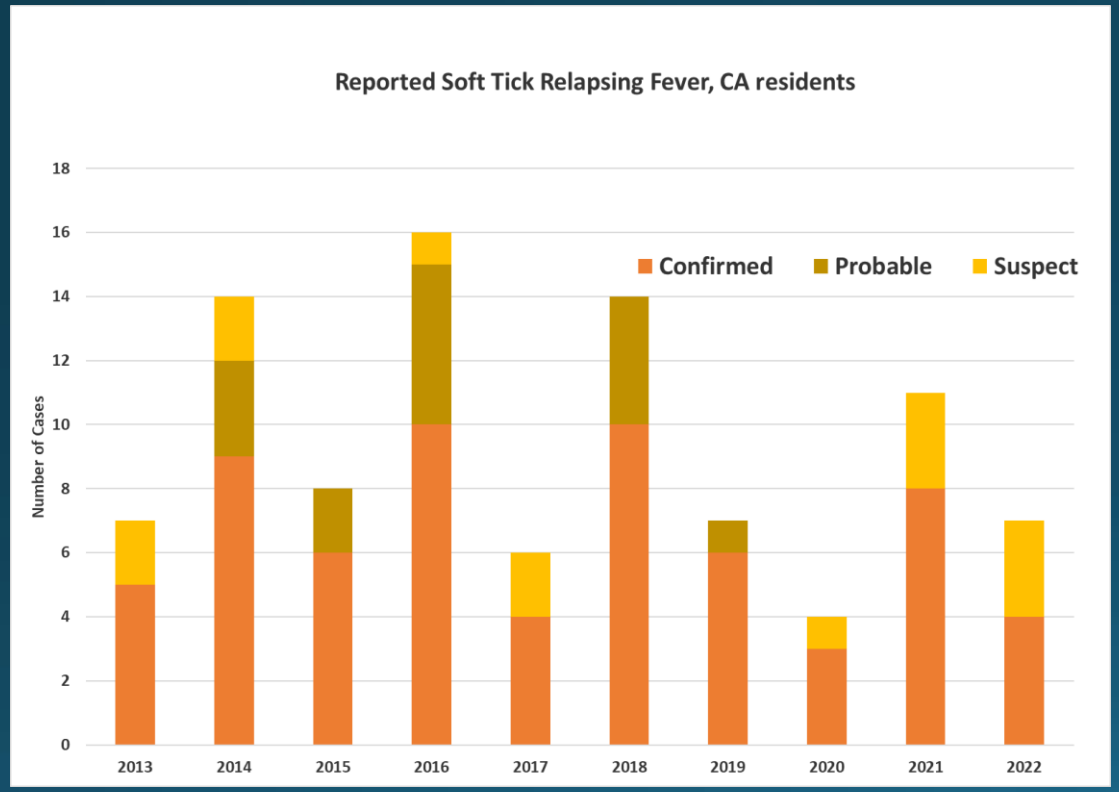
STRF Treatment and Treatment Complications

- Penicillin and other beta-lactam antimicrobials, tetracyclines, macrolides, and possibly fluoroquinolones.
  - CDC has not developed treatment guidelines; experts generally recommend **doxycycline 100 mg twice daily for 10 days** as the preferred oral regimen.
- All patients should be observed during the first 4 hours of treatment for a **Jarisch-Herxheimer reaction**.
  - a worsening of symptoms with rigors, hypotension, and high fever, occurs in over 50% of cases and may be difficult to distinguish from a febrile crisis.
  - In addition, acute respiratory distress syndrome requiring intubation has been described in several patients undergoing treatment for TBRF. https://www.cdc.gov/relapsing-fever/clinicians/index.html

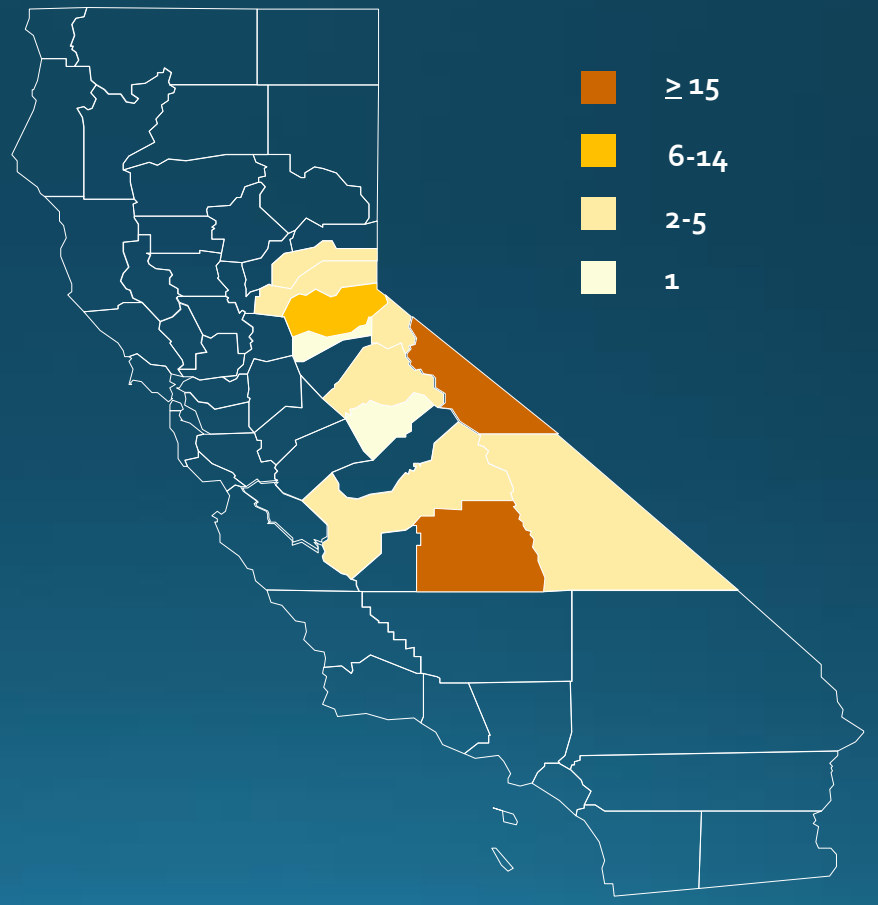
Ornithodoros characteristics

- Live in protected environment usually nest - 10 – 20 years!
- Life cycles: egg, single larva, several nymph stages then adult male or female.
- All stages are obligate blood feeders
- Feed within 15 to 90 minutes.
- The larvae and younger nymphs usually molt to the next stage after one blood meal, the larger nymphs may feed twice before molting.
- As adults, feed repeatedly and can live for many years in protected environments
- The females lay clutches of eggs after each blood meal.

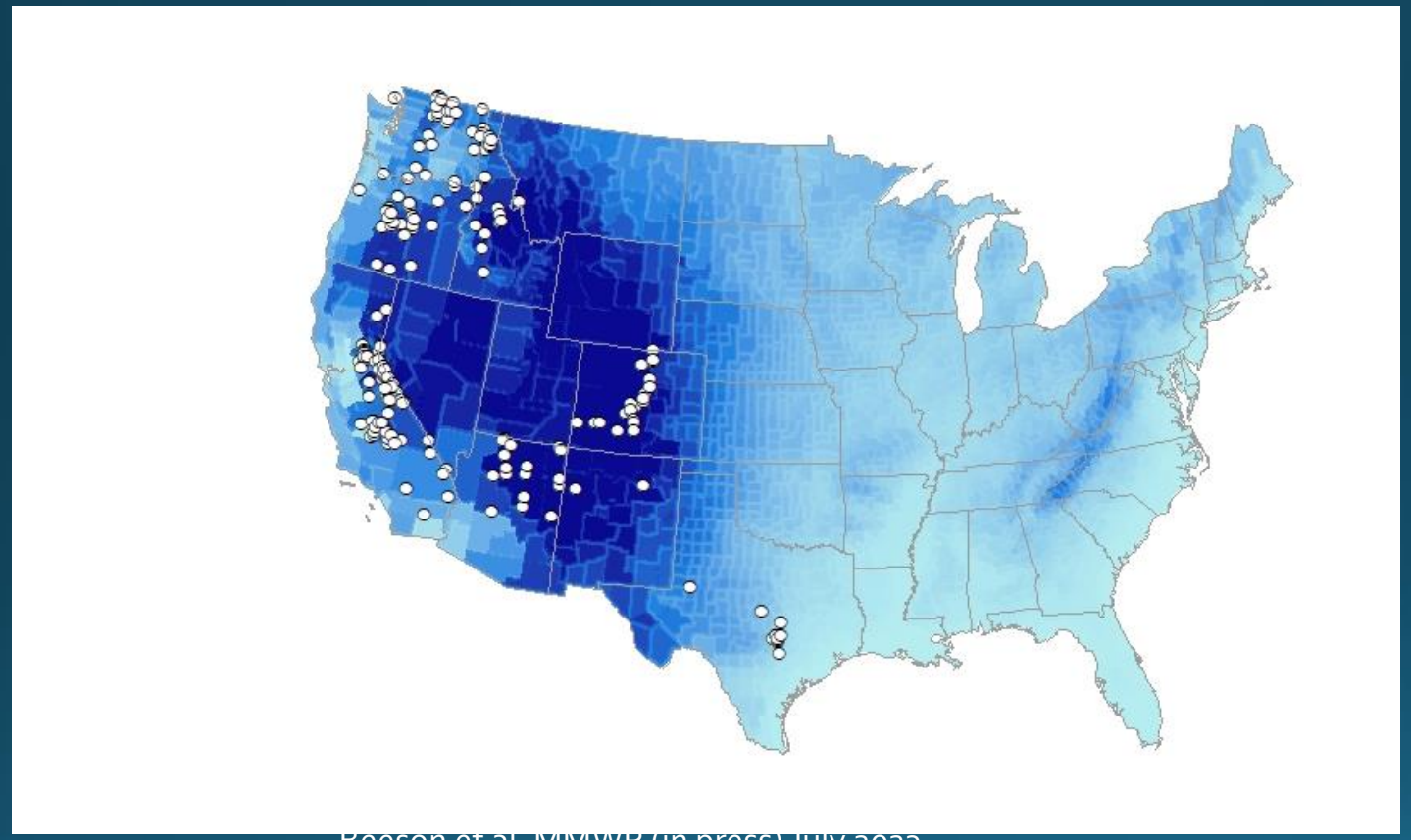
Soft tick relapsing fever, CA, 2013-2022



Number of cases exposed in county 2013 - 2022



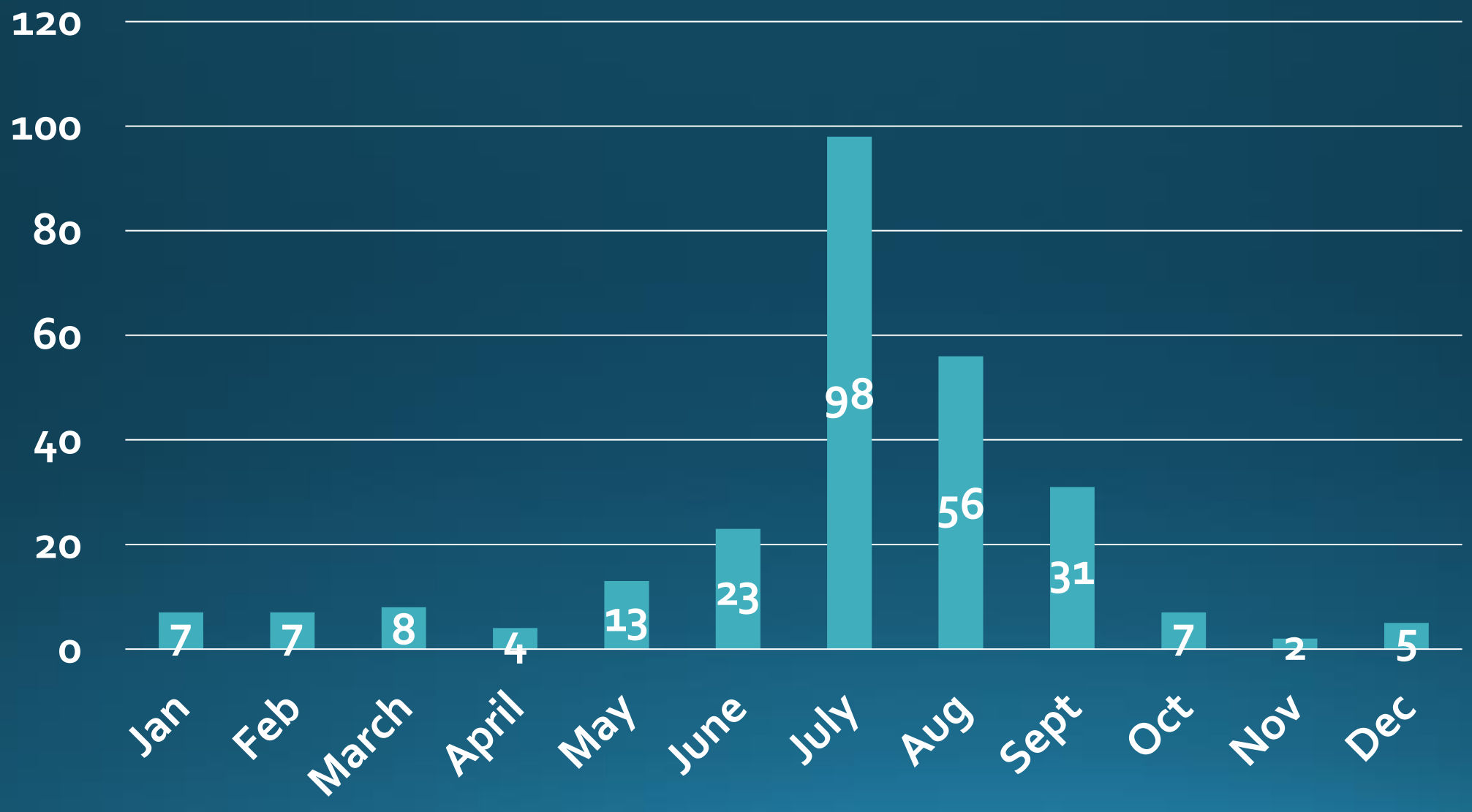
Soft tick relapsing fever- STRF- *Borrelia hermsii* in CA



Beeson et al, MMWR (in press) July 2023

In the United States, STRF reportable in: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming

Month of exposure, STRF cases California 1980 - 2018



Tick-borne Relapsing Fever Exposure

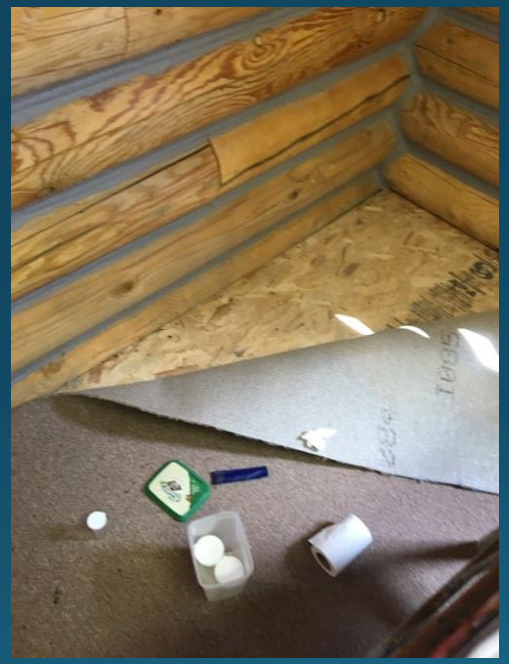
- High risk sites
  - Rodent-infested cabins 3000 - 9000 feet elevation
  - Coniferous forest
- Soft ticks live in rodent nests in building
  - Seek out blood meal when rodents vacate nest
  - Humans vulnerable when sleeping on floor or in beds in contact with walls

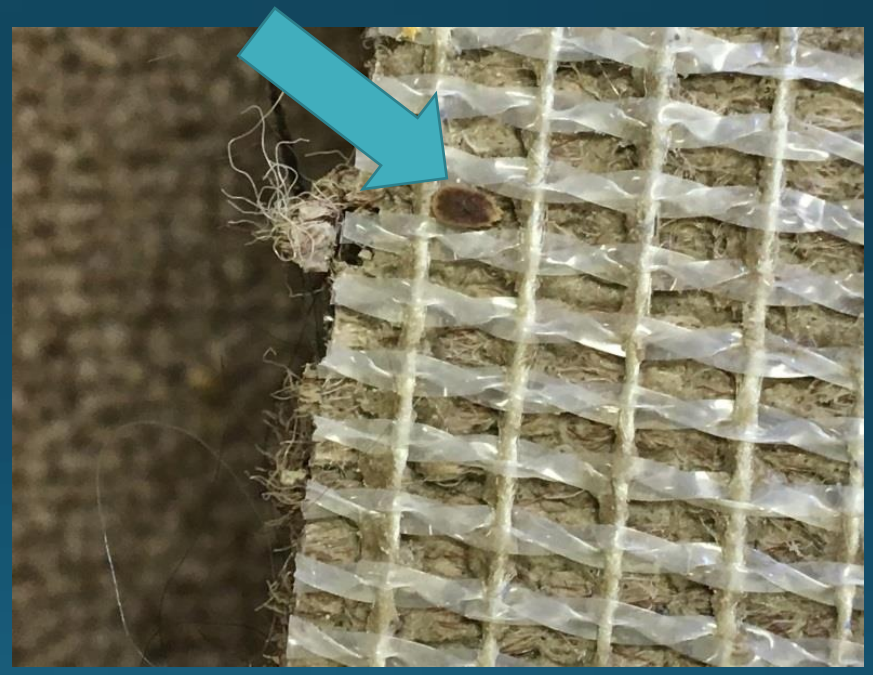
Rodent nest in crawl space

Investigation: Research Station

Bed where patient slept pulled away from wall for investigation

Carpet pulled up





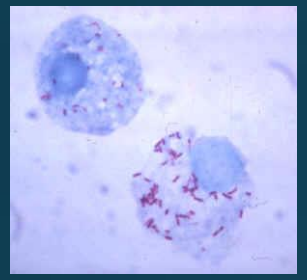
Tick found under carpet weaving

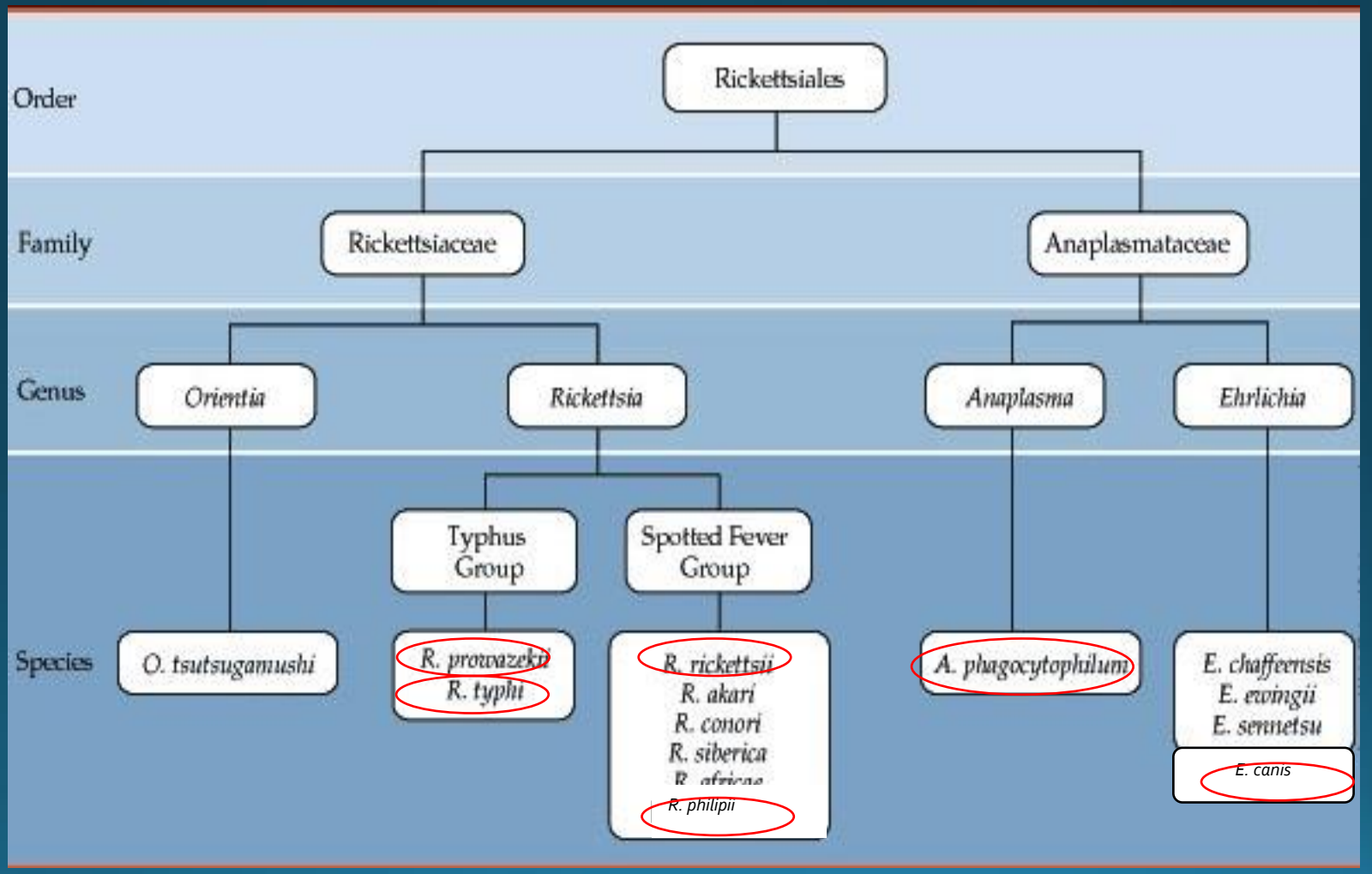
Preventing Tick-borne Relapsing Fever

- Prevent rodent infestations of dwellings
- Discourage feeding of chipmunks and squirrels
- Store firewood away from dwelling
- Beds should away from the walls
- Removal of rodents from structure without ectoparasite control may increase disease potential
  - Important to attempt to identify and remove rodent nests
  - May be some benefit to chemical control, though cracks and crevices difficult to penetrate

Tick-borne pathogens in Rickettsiales order

"Spotted fever group" Rickettsial diseases are so named because rashes are typically seen with infections with these bacteria





= agent found in CA

Spotted Fever Group Rickettsia are transmitted by 2 genera of ticks

Rocky Mountain spotted fever (*Rickettsia rickettsia*)

Wildlands cycle
- *Dermacentor* spp. ticks

Urban cycle
- Brown dog tick (*Rhipicephalus sanguineus)*

Rickettsia* 364D, aka *R. philipii

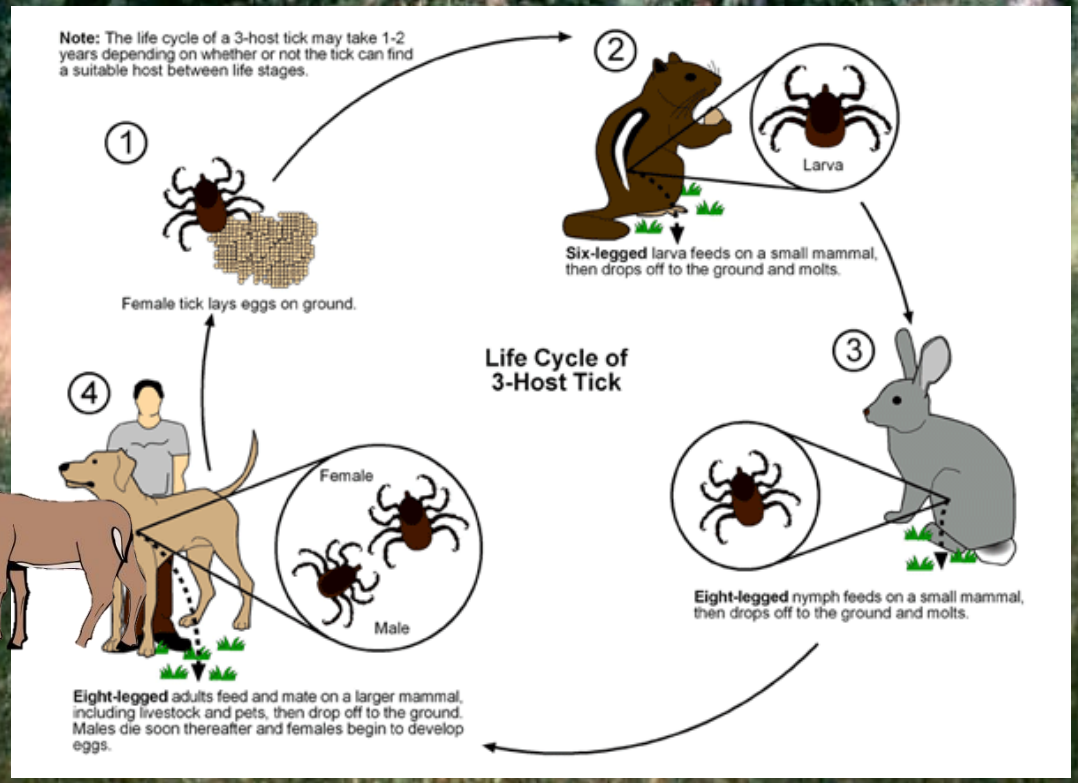
- Pacific Coast tick (*Dermacentor occidentalis)*

Dermacentor spp
American Dog tick
Pacific Coast tick
Rocky Mountain wood tick

Rhipicephalus sanguineus
Brown Dog Tick

- Mammalian reservoir (dogs, rodents, other)
- Tick vector – once tick infected remains infective through life stages - tick may also be reservoirs
- Ticks capable of transmitting organism as soon as they begin to feed

Typical *Dermacentor* spp Life Cycle (Wildlands cycle)



Brown dog tick (*Rhipicephalus sanguineus*) – Urban cycle

- Mexico
- Arizona
- S. California

"*In the Mexican state of Baja California, there were 92 cases in 2022, more than double the previous year, according to state data.*"

The Washington Post
Democracy Dies in Darkness

08/30/2023

Brown dog tick habitat

Yaglom PPT, 2015

https://www.epa.gov/sites/production/files/2016-02/documents/rmsf_on_the_border_where_children_contagion_and_climate_converge.pdf

Expansion of multiple lineages of brown dog ticks in CA (Vilarreal et al., J Parasitology, 2018)

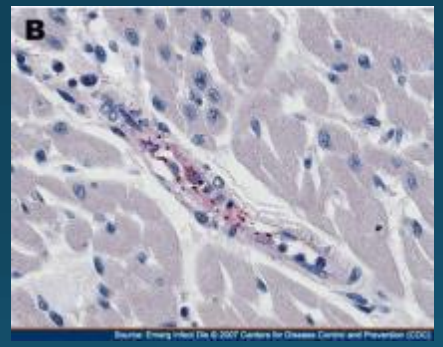
- -Two lineages: temperate from Arizona and tropical from Mexico
- -Northern CA has mostly temperate; tropical extends into S. California
- -Both associated with RMSF

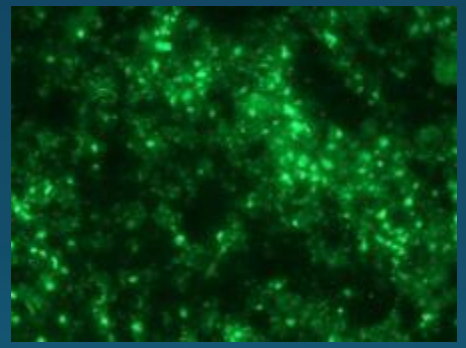
RMSF in Humans

- **Clinical:**
  - Nonspecific (can be difficult to diagnose)
  - Fever, headache, nausea, muscle aches 2-14 days after tick bite
  - Rash develops 3-5 days after fever
  - Decreased clotting cells leading to severe complications: Acute respiratory distress syndrome (ARDS), abdominal pain (leading to surgery), neurologic or bleeding disorders, loss of circulation (gangrene)
  - **Case fatality reports ranging from 5-90%**

RMSF in Humans

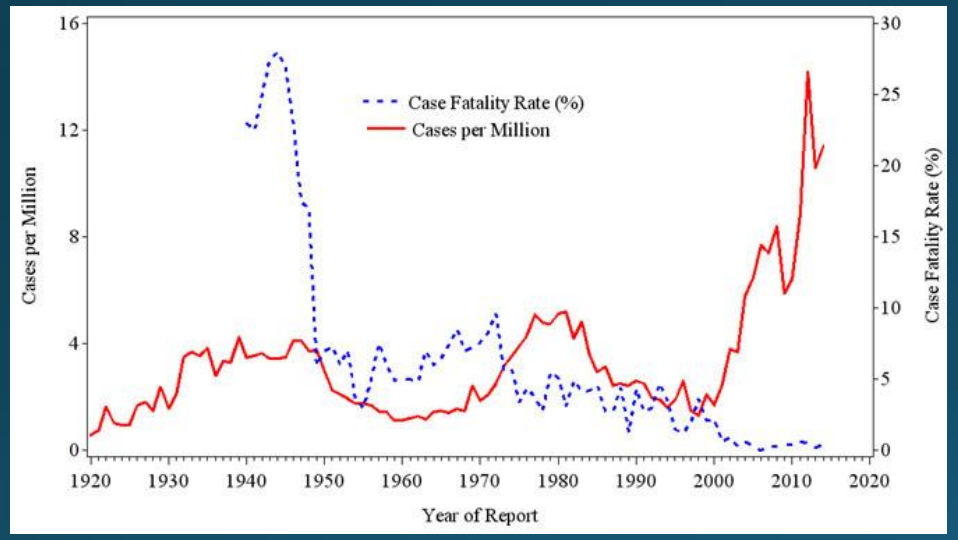
- **Diagnosis:**
  - Serology: Rising antibody titers (4X change in acute and convalescent samples). IFA or ELISA tests.
  - PCR, immunohistochemical staining of tissue, culture: (tissues difficult to obtain)

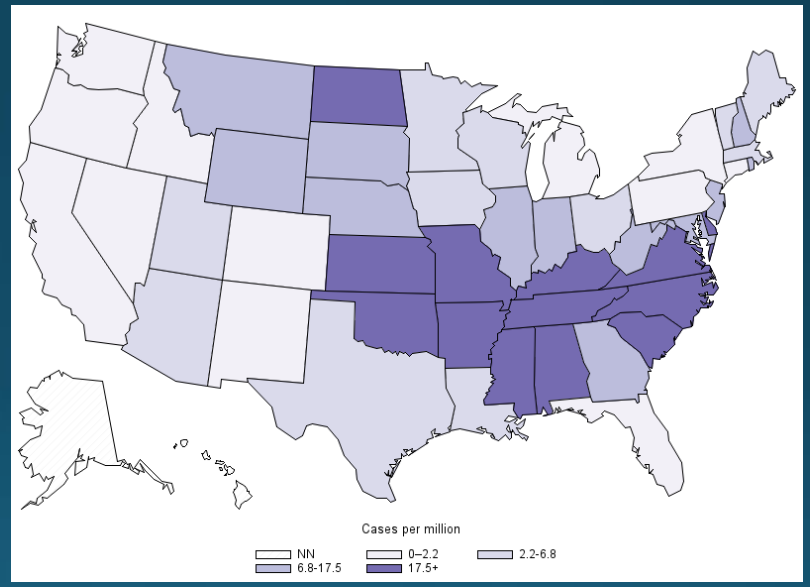




- **Treatment: Doxycycline**
  - adults and children
  - **Can not wait for diagnosis – must treat on suspicion**

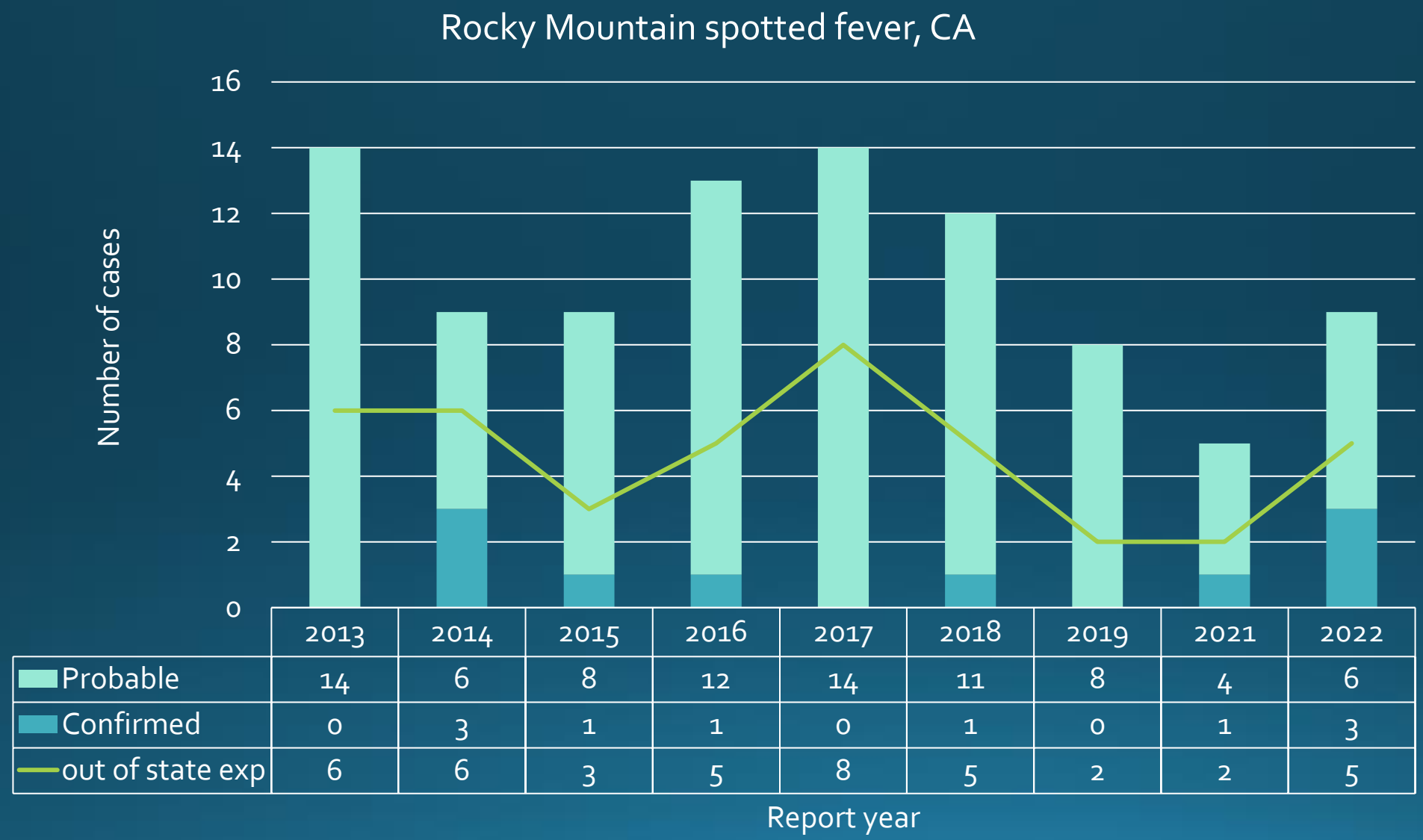
Rocky Mountain Spotted Fever Nationally





Source: https://www.cdc.gov/rmsf/stats/index.html

Rocky Mountain Spotted Fever in CA, 2013 -2022



	2013	2014	2015	2016	2017	2018	2019	2021	2022
Probable	14	6	8	12	14	11	8	4	6
Confirmed	0	3	1	1	0	1	0	1	3
out of state exp	6	6	3	5	8	5	2	2	5

RMSF — A Binational Issue

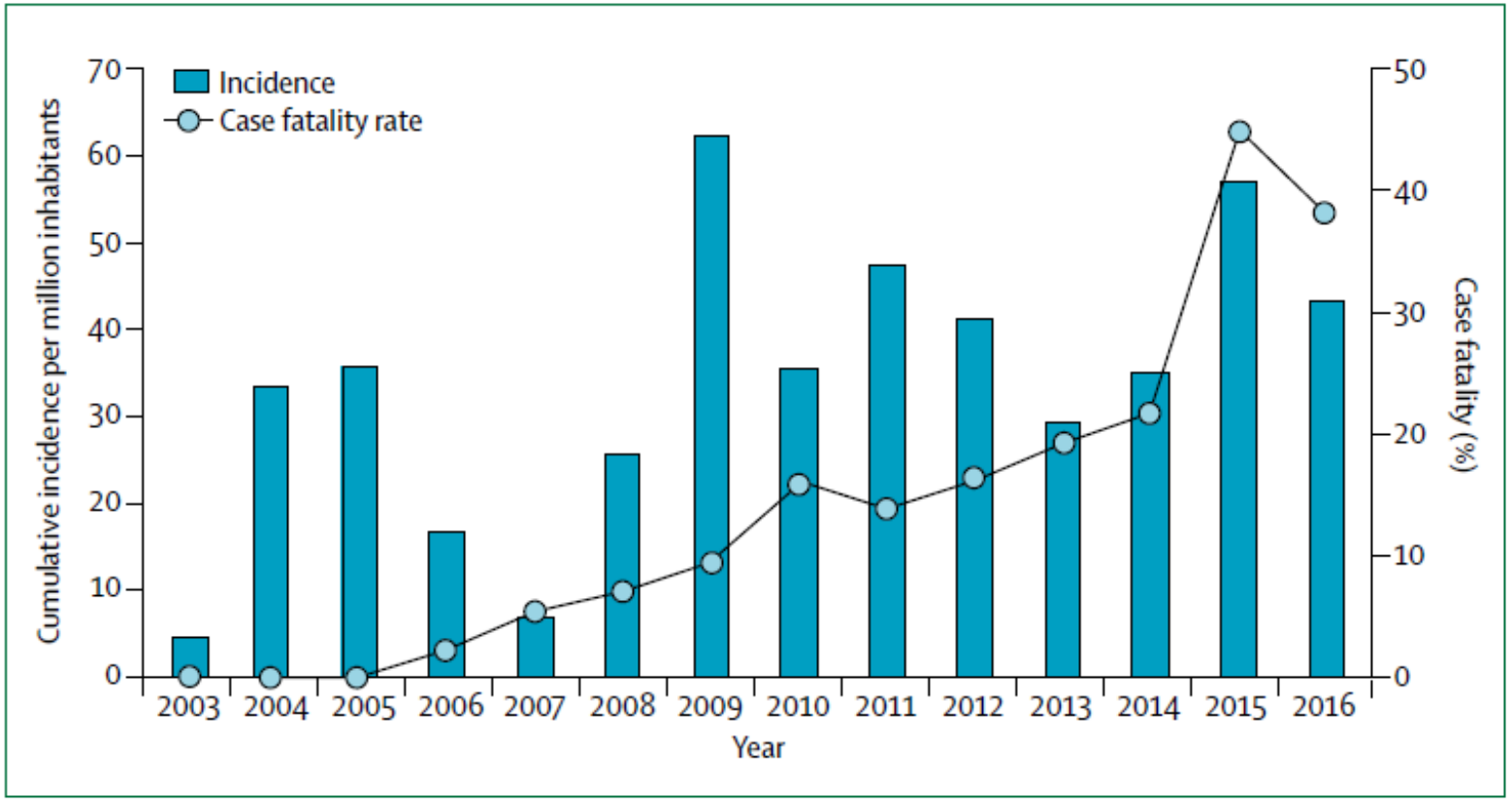
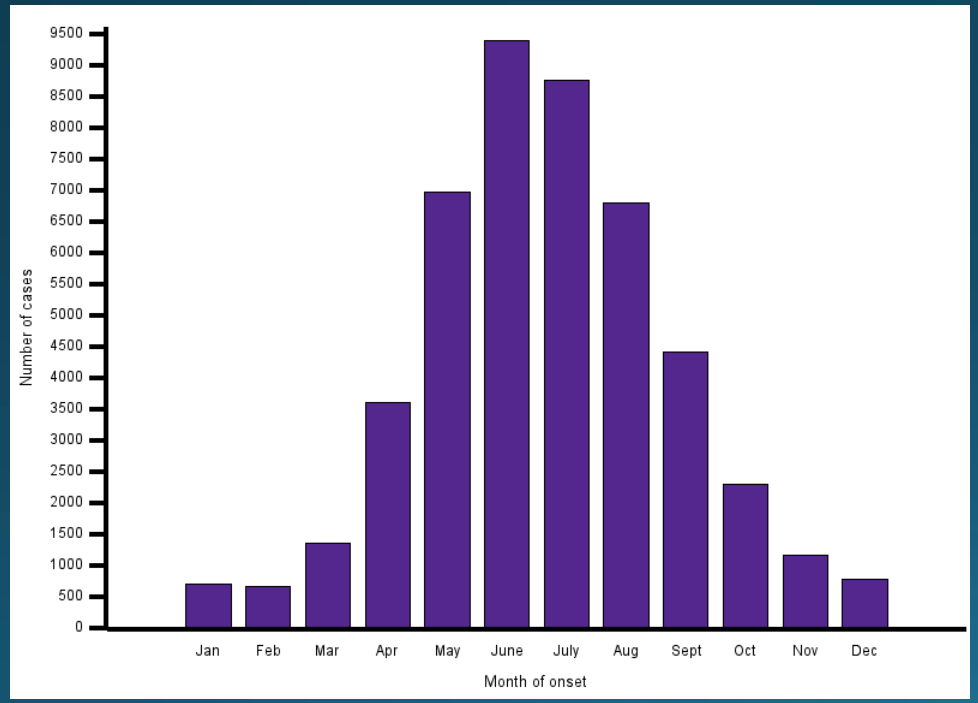


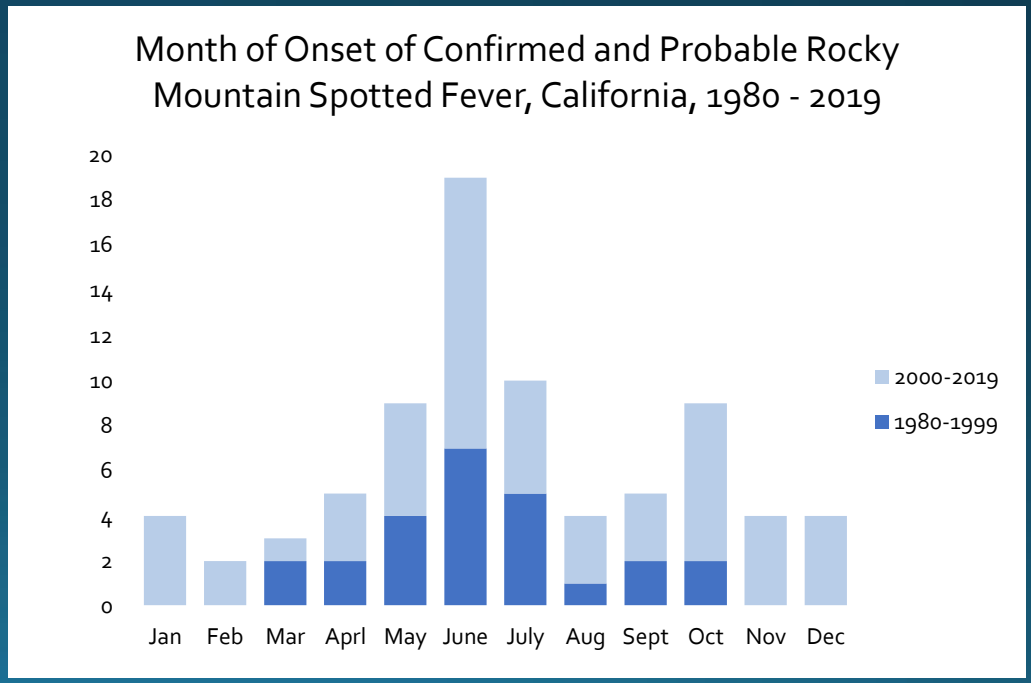
Figure 2: Cumulative incidence and case fatality rates of Rocky Mountain spotted fever in Sonora, Mexico, 2003–16

Data provided by the Epidemiological Surveillance System of the Sonora Ministry of Health.

RMSF Seasonality

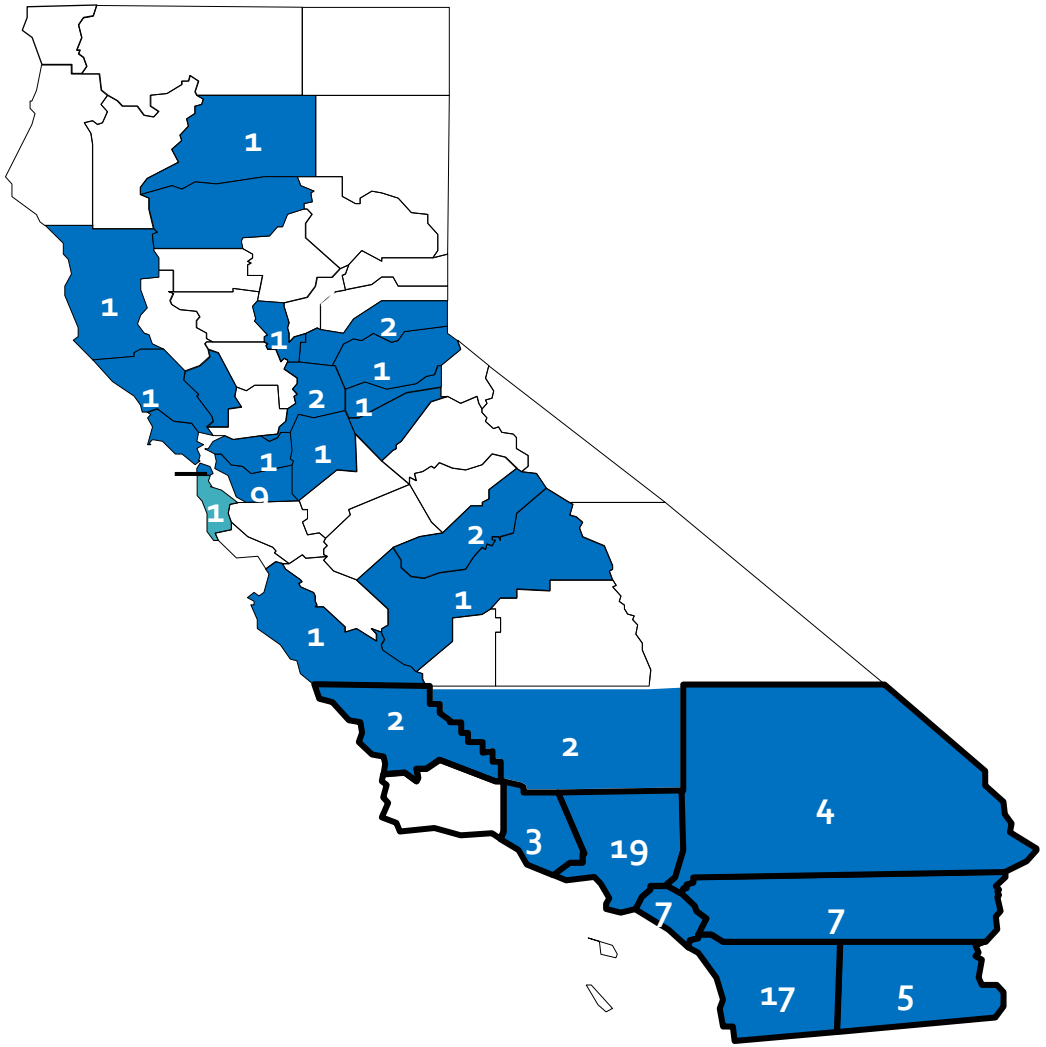
Nationwide, 2000-2017



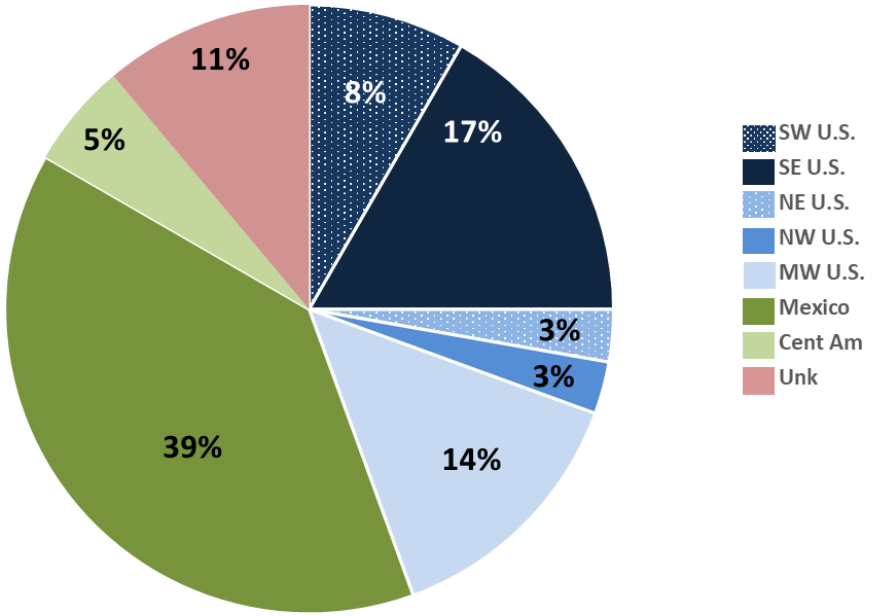


Rocky Mountain Spotted Fever in CA, 2013 -2022

County of Residence



Reported Locations of Out-of-State RMSF Exposure



Rickettsia 364D (proposed *R. philipii*)

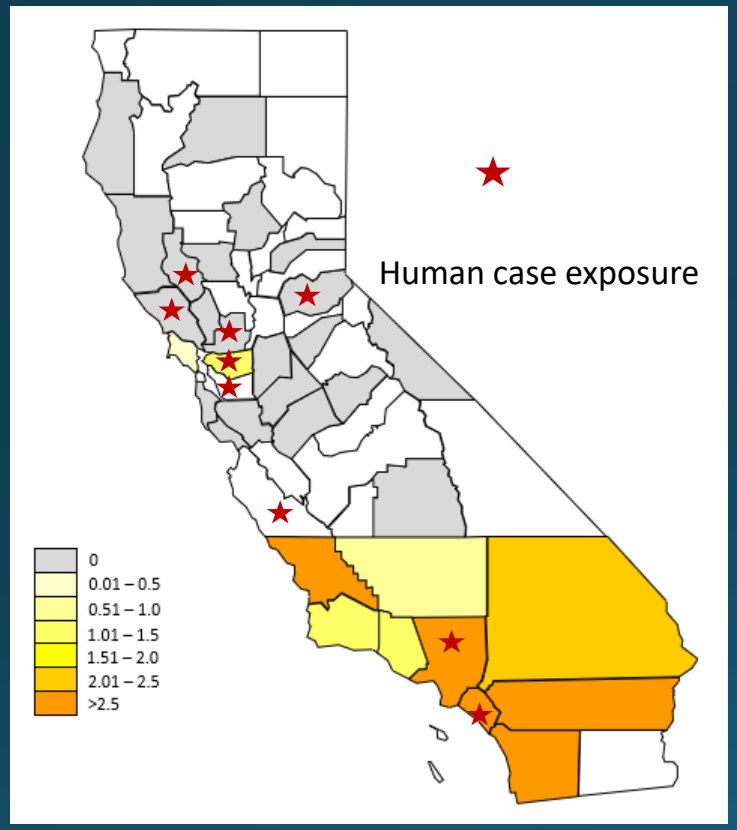
Multiple eschars

- Aka Pacific Coast Tick Fever (PCTF)
- First detected in ticks in 1966 in California
- To date, detected in *D. occidentalis* ticks only
- First human case
  - Lake County, California July 2008
- Common sign includes one or more local cutaneous eschar, not necessarily at tick-bite site
- Eschar or swab of lesion can be molecularly tested
- Treated with doxycycline

Single eschar

Pacific Coast Tick Fever Due to Rickettsia 364D

Rickettsia 364D in Ticks (2018 – 2022)



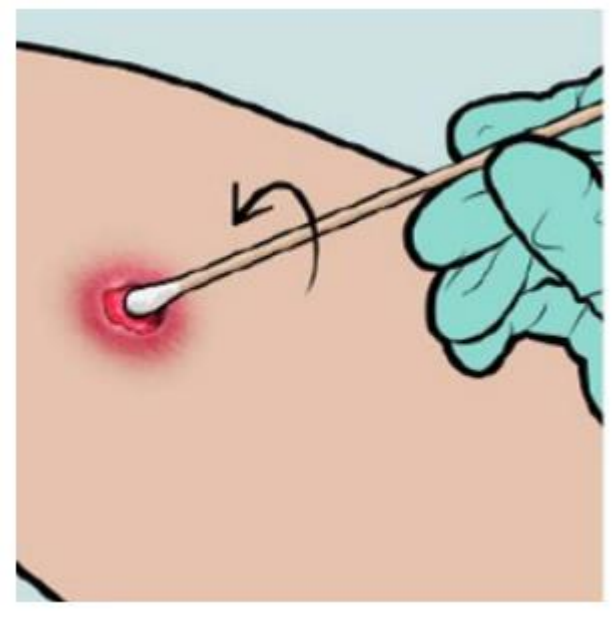
Dermacentor occidentalis

Human Cases (2011 – 2022)

2011: 6
2012: 4
2013: 3
2014: 1
2019: 1
2021: 3

https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/SpottedFeverGroupRickettsia-RMSFandPCTF.aspx

Testing for *Rickettsia* 364D: it's easy!



- Eschars can contain large amounts of rickettsial DNA.
- California Department of Public Health, Viral and Rickettsial Disease Laboratory can test the sample
- Obtain specimen before or within 24 hours of initiation of appropriate antibiotic therapy (i.e. doxycycline).
- Antibiotic treatment should never be delayed to obtain an eschar specimen.
- Contact your local public health laboratory or CDPH for submission instructions

Babesia spp.

- Tick-transmitted, intraerythrocytic protozoal parasites
  - Trophozoite, ring, and tetrad ("Maltese cross") forms

  - "Large" and "small" species

Routes of *Babesia* transmission to humans

- **Tick-borne**

- **Blood transfusion:** Babesiosis the most frequent transfusion-transmitted infection

- Transplacental – at least half dozen case reports of human transplacental transmission; known route of infection in equine, canine babesiosis

Clinical signs of human babesiosis

Asymptomatic — **Acute, fatal**

Objective symptoms

- -Fever, chills
- -Anemia
- -Thrombocytopenia

Subjective symptoms

- -Fatigue
- -Headache
- -Muscle pain
- -Vomiting

Diagnosis of Babesiosis

- In conjunction with clinical symptoms, the following tests are confirmatory or supportive of a diagnosis:
  - Parasites on Geimsa-stained thin blood smears (confirmatory)
  - Serology (IFA – supportive)
  - Immunoblot (commercially available for *B. microti* – supportive)
  - PCR (commercially available for *B. microti* - confirmatory)
  - Hamster inoculation (research lab, CDC - confirmatory)
- Tick bite exposure location (east/west coast) helpful to know which test to order

Zoonotic *Babesia* spp.

Species	Host	Vector	Locality	Est. number of cases	Mortality
B. microti	Mice	*I. scapularis*	Eastern, Midwestern U.S.	>3000	~5%
B. duncani and *B. duncani*-like	Deer, Bighorn sheep, other?	*D. albipictus*	Western U.S.	14	14%
B. divergens	Cattle	*I. ricinus*	Europe	>35	~40%
MO1, Ky1, Washington	Cottontail rabbits	*I. dentatus*	United States	4	33%

Transtadial transmission
Babesia microti life cycle

Adult- potentially infected

Peromyscus leucopus

Deer

Sexual stage: tick gut

Ixodes scapularis

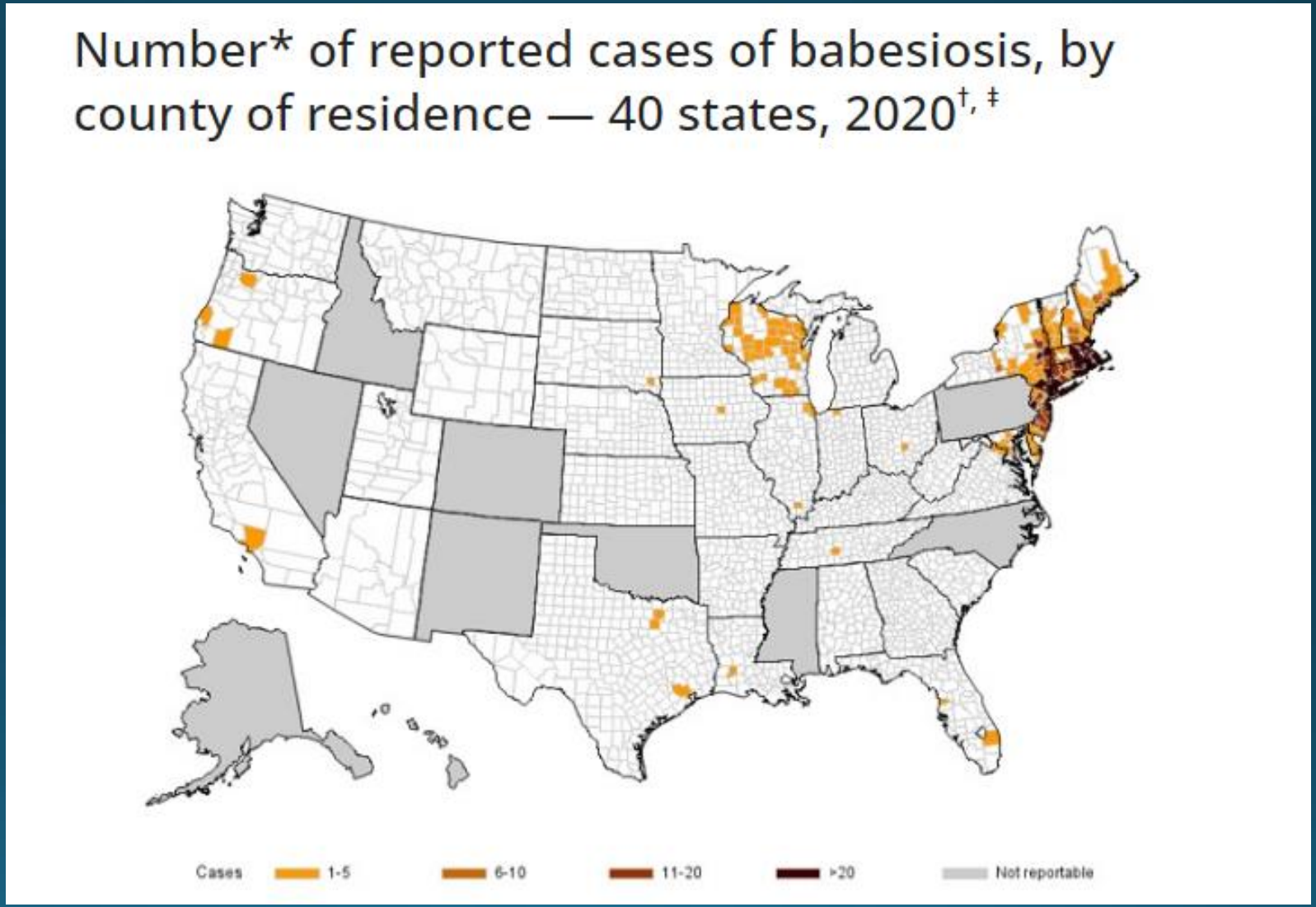
Nymph – potentially infected

Larva

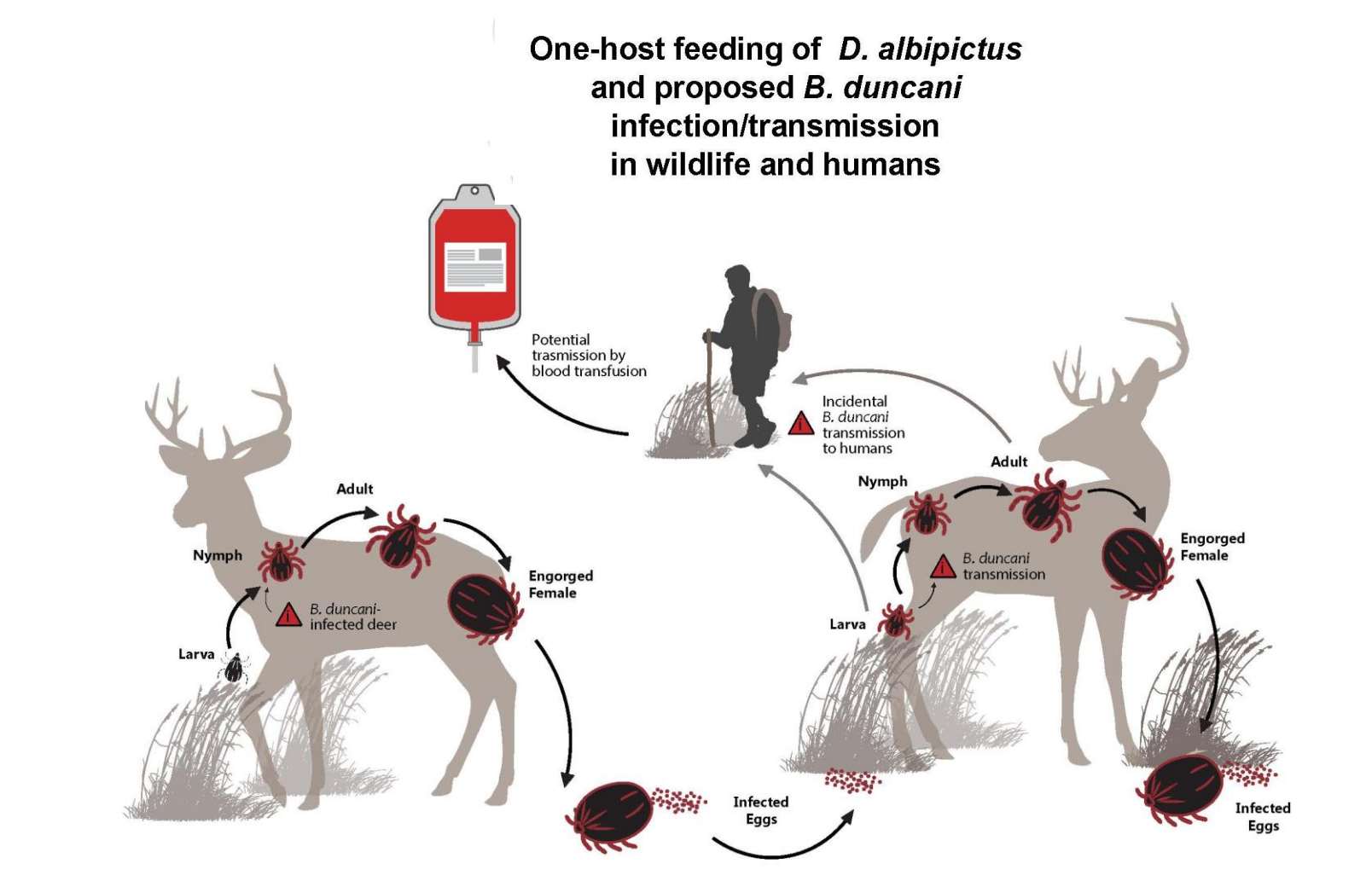
Egg-laying female- eggs not infected

Asexual stage: mammalian host

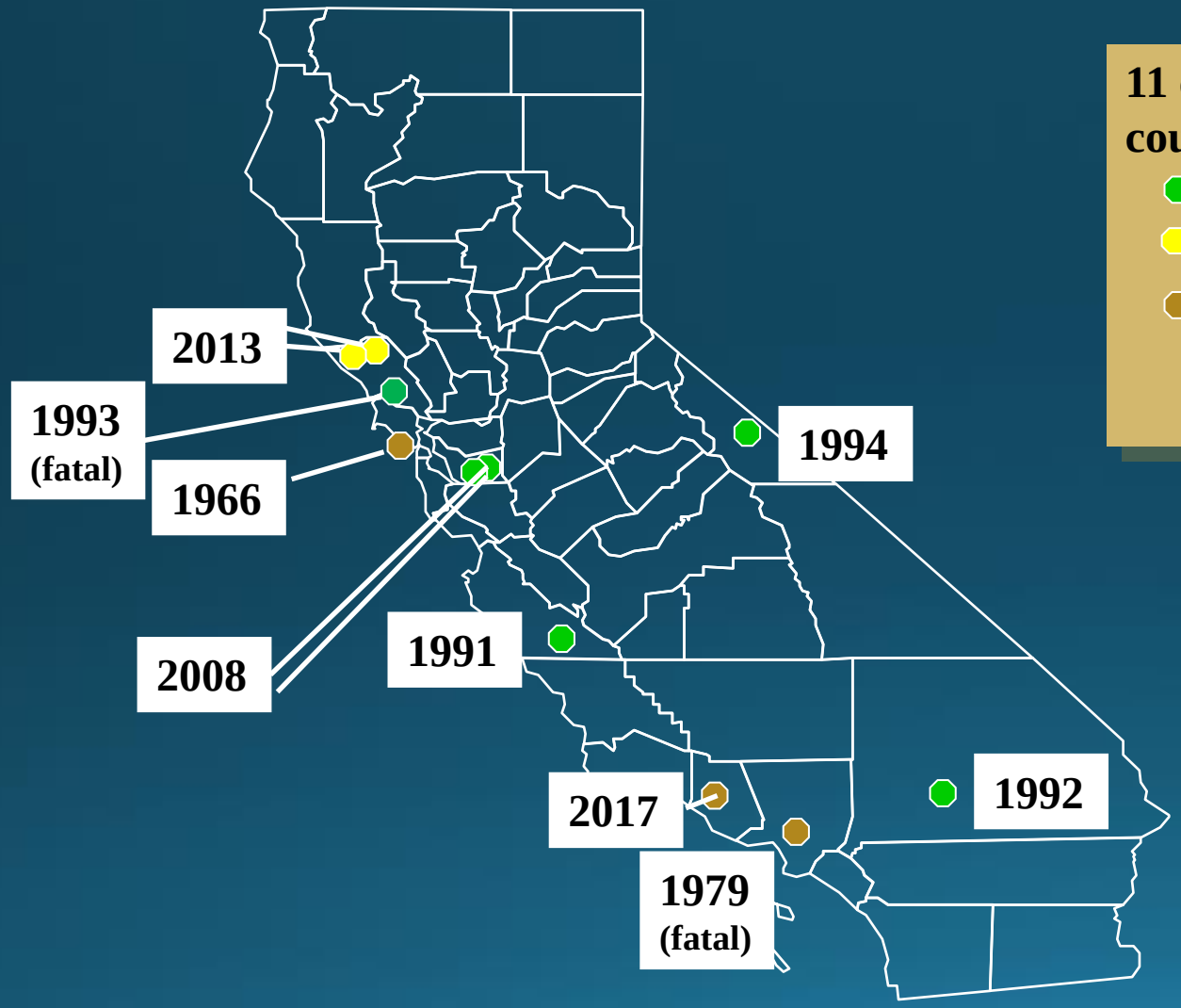
Distribution of Babesiosis, U.S.



Proposed tick vector for *B. duncani*: *Dermacentor albipictus*



Distribution of *Babesia duncani* cases, 1966-2018 CA



11 cases, reflects likely exposure county

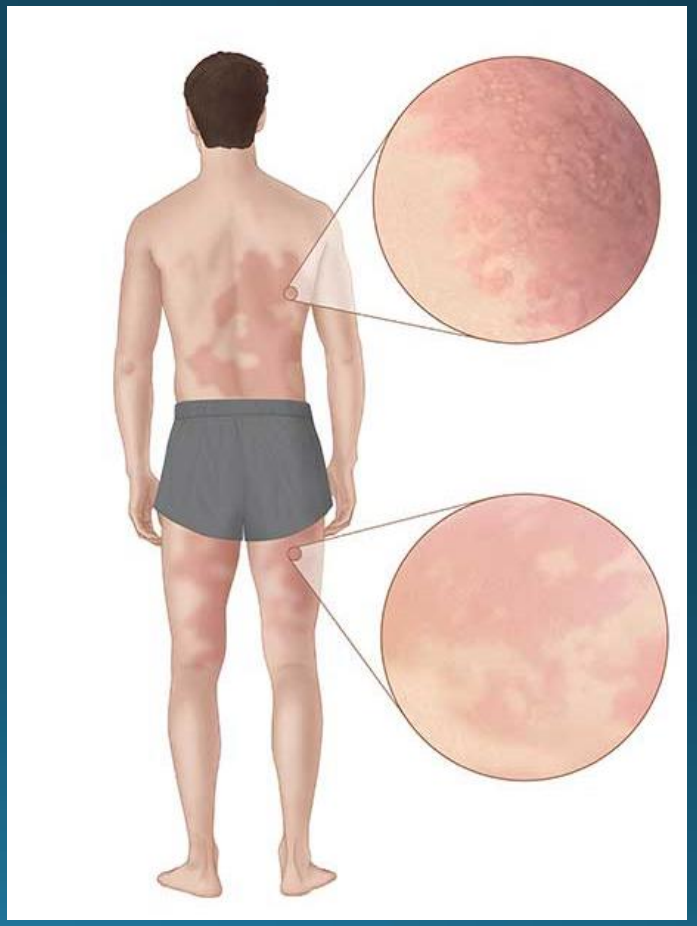
- **Confirmed (6)**
- **Probable (3)**
- ***Babesia* spp (3 -could not be speciated; lack of travel suggests *B. duncani*)**

Reported Babesiosis cases, California, 2013 - 2022

Year	*Babesia duncani*	*Babesia microti*	*Babesia species*
2013	2	5	0
2014	0	3	0
2015	0	5	0
2016	0	4	0
2017	0	4	1
2018	1	5	0
2019	0	2	0
2020	0	1	0
2021	1	5	0
2022	0	7	0
TOTAL	4	41	1

Emerging tick-bite associated condition: Alpha-Gal Syndrome (AGS)

- Alpha-gal (galactose-α-1,3-galactose) is a sugar molecule found in most mammals
- Evidence suggests that AGS may be triggered by the bite of *A. americanum* in the United States, but other kinds of ticks have not been ruled out. Other tick species have been connected with the development of AGS in other countries.
- Immediate or delayed allergic reaction may occur if sensitized to Alpha-gal after consuming red meat

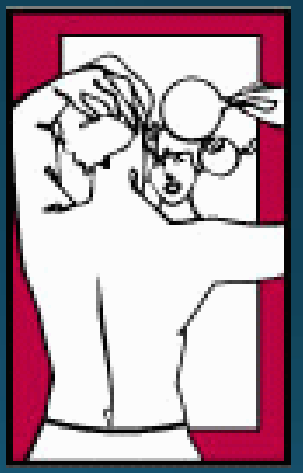



Prevention

Personal Protective Measures

- Wear proper clothing, repellents (minimum 20% of DEET or other EPA-registered insect repellent active - picaridin, IR3535, OLE)
- Treat clothing with permethrin acaracide

- Look for the ticks



- Shower, full body check at home

- Check pets/ use effective tick repellents on them

Patient Recommendations:

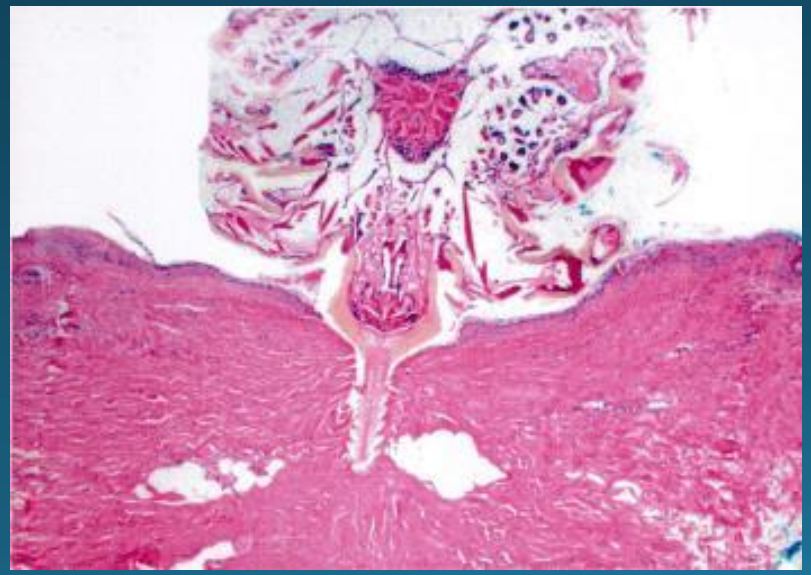
- Promptly remove tick
- Cleanse the area with soap and water
- If you develop any symptoms 1-30 days after bite, consult your physician
- Let your physician know that you were bitten by a tick

Physician recommendations:

- Prophylactic administration of 200mg doxycycline shown to be useful in highly endemic areas of eastern U.S.; not studied in CA and prevalence does not reach "highly endemic"
- Testing the tick for medical decision making not recommended by CDPH or CDC

Tick Removal Technique

- Place the tip of fine tweezers around the tick mouthpart
- Pull the tick firmly away from the skin (do not jerk, crush, squeeze or puncture the tick)
- Do not use insecticides, lighted matches, gasoline, petroleum jelly or liquid soaps to remove ticks, as these techniques may cause injury and are ineffective.



Rick Baier, MD, Yosemite Pathology

California Department of PublicHealth

I am looking for | I am a | Programs | A-Z Index

Home | Programs | Center for Infectious Diseases | Division of Communicable Disease Control | Tick-Borne Diseases

TICK-BORNE DISEASES

- Vector-Borne Disease Section
- California West Nile Virus Website
- Mosquito-Borne Diseases
- *Aedes aegypti* and *Aedes albopictus* Mosquitoes
- Lyme and Other Tick-Borne Diseases
- Hantavirus Infection
- Plague
- Typhus (Flea-borne)
- Public Health Pests
- Vector-Borne Disease

Ticks are small, spider-like creatures most often found outside in wooded or brushy areas with tall grass, rocks, logs, and fallen leaves. Ticks bite and feed by attaching to animals and humans, sticking their mouthparts into the skin, and sucking blood for up to several days. There are many different kinds of ticks in California, but only six kinds are known to commonly bite humans. Sometimes these ticks carry germs (like bacteria or viruses) that can spread to a person while the tick is attached and cause disease.

The best way to avoid getting tick-borne diseases is to prevent tick bites: use tick repellent when going outside in areas where ticks are common, and check for ticks often while outside and after you return indoors. If you find a tick attached to your skin, remove it right away with tweezers.

Learn more about preventing tick-borne diseases

Tick-Borne Diseases in California

- Anaplasmosis
- Babesiosis

Seasonal Risk of Exposure to Infected Western Blacklegged Ticks in California

Conclusions

- **California home to many tick-borne diseases**
  - Fairly well described (Anaplasmosis, Lyme, Relapsing Fever, etc.)
  - Emerging and (re) emerging disease agents (*Rickettsia spp*, *B. miyamotoi*)
- **Though prevalence of agents in ticks may be low locally, other risks for exposure to tick-borne infections**
  - **Travel associated**
  - Blood-transfusion associated
- **Knowing when, how, and where people are exposed to tick-borne disease helpful in differentials, diagnostic test interpretation, and prevention**
- **Prevention of tick-bites is key to prevention of disease!**

Vector-Borne Disease Section Team

Thanks for you attention and Questions

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