

Spotted Fever  
Group  
*Rickettsia*  
including: Rocky  
Mountain  
spotted fever  
(*Rickettsia rickettsii*)



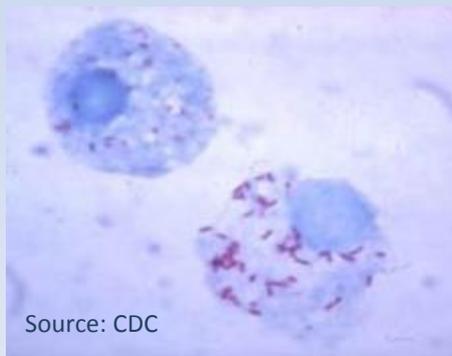
Source: CDC

American dog tick (*Dermacentor variabilis*)

# Spotted Fever Group Rickettsia:

## *Rickettsia rickettsii* and *Rickettsia* 364D

- Genus *Rickettsia* is in bacterial tribe *Rickettsieae*, family *Rickettsiaceae*, and order *Rickettsiales*
- Related to *Ehrlichia* and *Anaplasma*
- All intracellular pathogens
- Called “spotted fever group” due to the rashes typically seen with these infections



Source: CDC

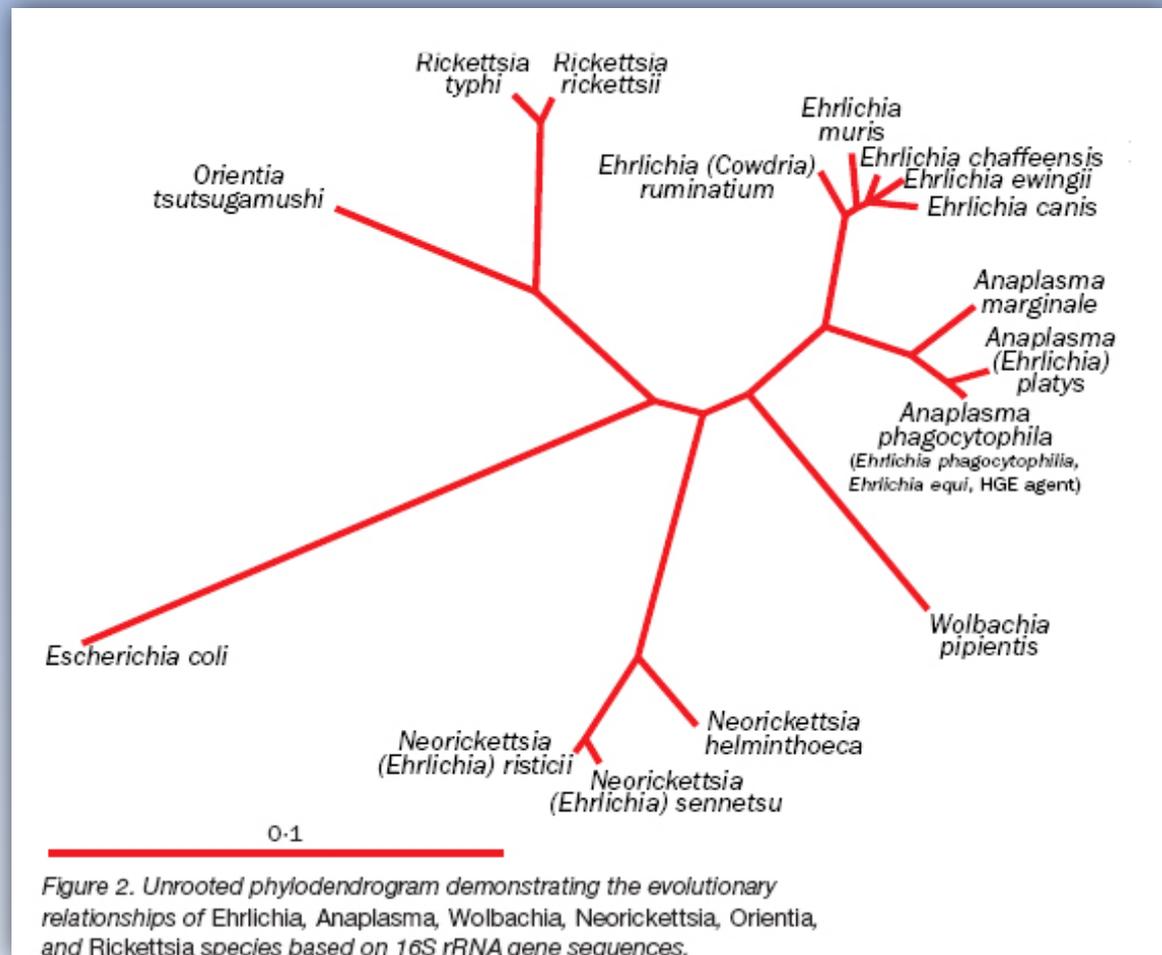
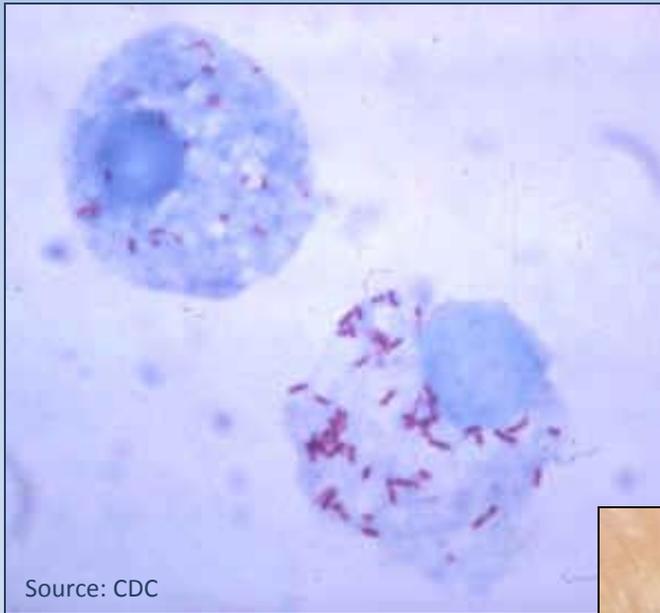
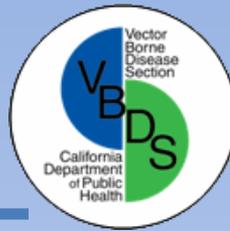


Figure 2. Unrooted phylogenetic tree demonstrating the evolutionary relationships of *Ehrlichia*, *Anaplasma*, *Wolbachia*, *Neorickettsia*, *Orientia*, and *Rickettsia* species based on 16S rRNA gene sequences.

# Rocky Mountain Spotted Fever



Source: CDC



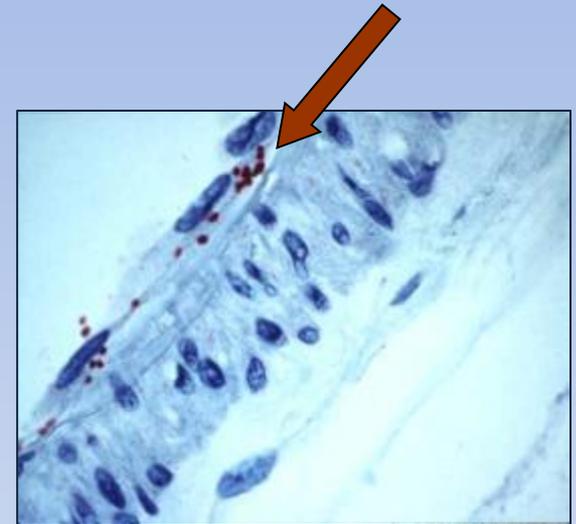
Source: CDC



# Rocky Mountain Spotted Fever (RMSF)



- Most severe tick-borne illness in the United States
  - 3-5% case fatality if treated
  - 20% case fatality if untreated\*
  - Recent studies suggest case fatality has decreased to as low as 0.5%
    - Higher risk of fatality in children 5-9 years\*\*
    - Most cases occur during summer months
- Primary California tick vectors
  - American dog tick (*Dermacentor variabilis*)
  - wood tick (*Dermacentor andersoni*)
- Family Rickettsiaceae
  - *Rickettsia rickettsii*
  - Small, intracellular bacteria



*Rickettsia rickettsii* in endothelial cells of a blood vessel from a patient with fatal RMSF

Source: CDC

\* Chapman et al., MMWR Recomm Rep 55: 1 – 27

\*\* Openshaw et al., Am. J. Trop. Med. Hyg., 83(1), 2010, pp. 174–182

# Clinical Features of RMSF



- Sudden fever, myalgia, nausea, headache
  - 2 to 14 days after tick bite
- Rash (81%-91% of patients\*)
  - Usually 3 to 5 days after tick bite
  - Starts as blanching macular rash
    - Eventually become papular\*\*
  - Often on palms and soles (36-82% cases)\*
  - Often spreads to entire body
  - The later the rash appears, the higher the mortality\*
- Thrombocytopenia
  - Leads to severe complications
    - Acute respiratory distress syndrome (ARDS), abdominal pain, neurologic or bleeding disorders, loss of circulation (gangrene)



Source: CDC



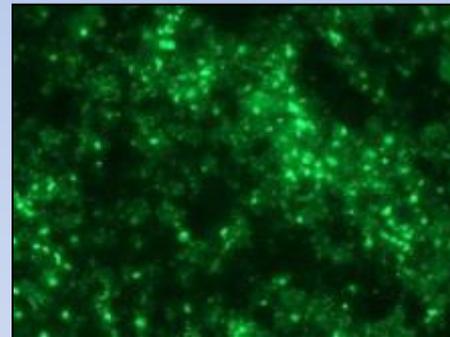
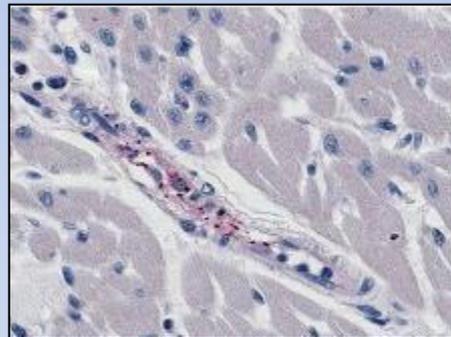
\* Mandell et al, Principles and Practices of Infectious Diseases, 2005 pp 2288-2293

\*\*CDC Rocky Mountain Spotted Fever: <http://www.cdc.gov/ncidod/dvrd/rmsf/Signs.htm>

# Diagnosis and Treatment



- Diagnosis
  - Serology
    - Rising antibody titers (four-fold change in acute and convalescent samples)
    - IFA or ELISA tests
  - PCR, immunohistochemical staining of tissue (difficult to obtain), culture



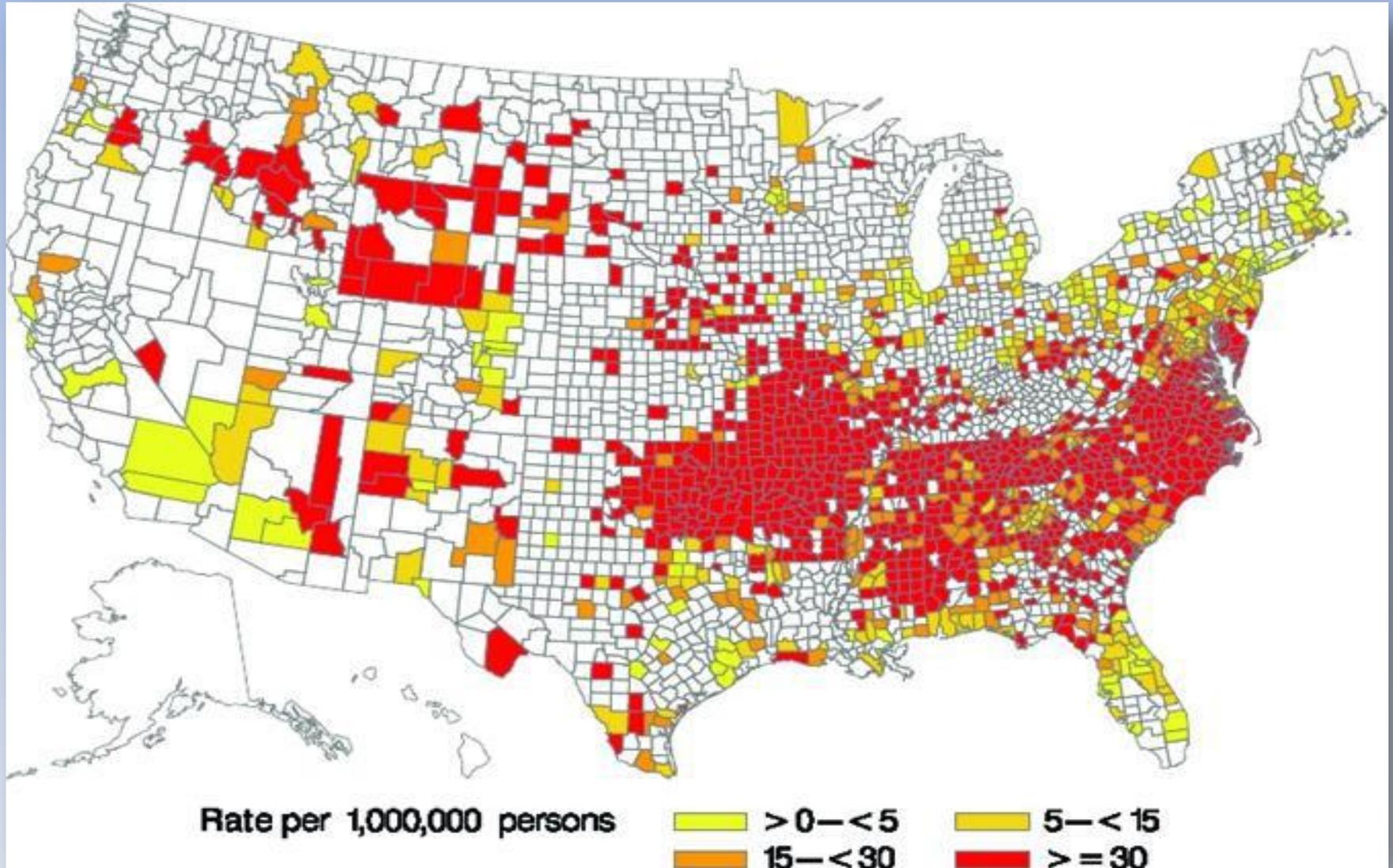
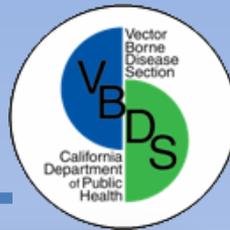
Source: Centers for Disease Control and Prevention

- Treatment
  - Doxycycline
    - Adults and children (not pregnant women)\*

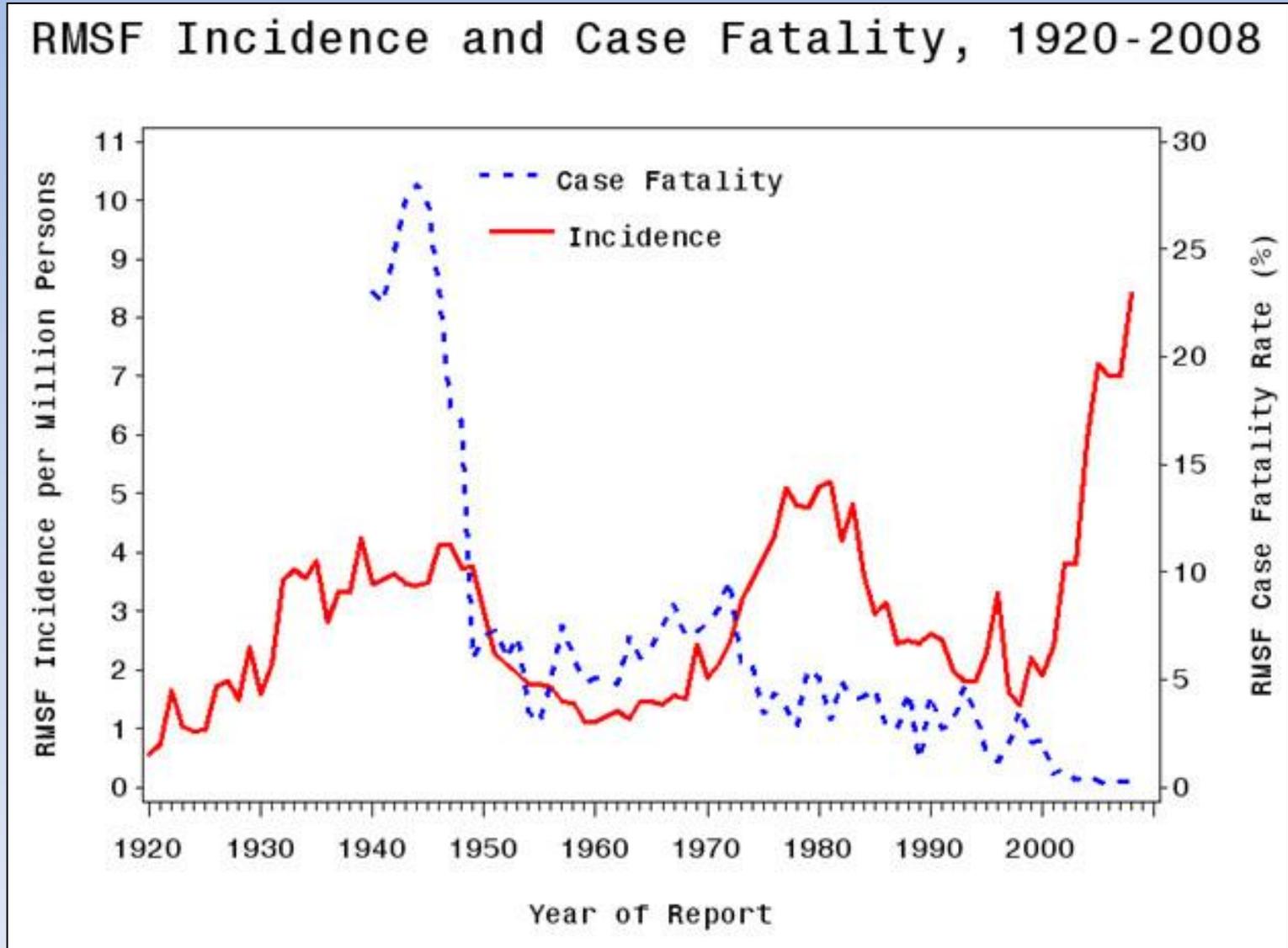
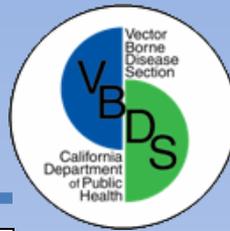
***Do not wait for diagnosis – must treat on suspicion!***

\* Mandell et al, Principals and Practices of Infectious Diseases, 2005 pp 2288-2293

# Annual Reported Incidence for Rocky Spotted Mountain Fever in the United States, 2000-2007



# Reported Incidence and Case Fatality of Rocky Mountain Spotted Fever in the United States, 1920-2008

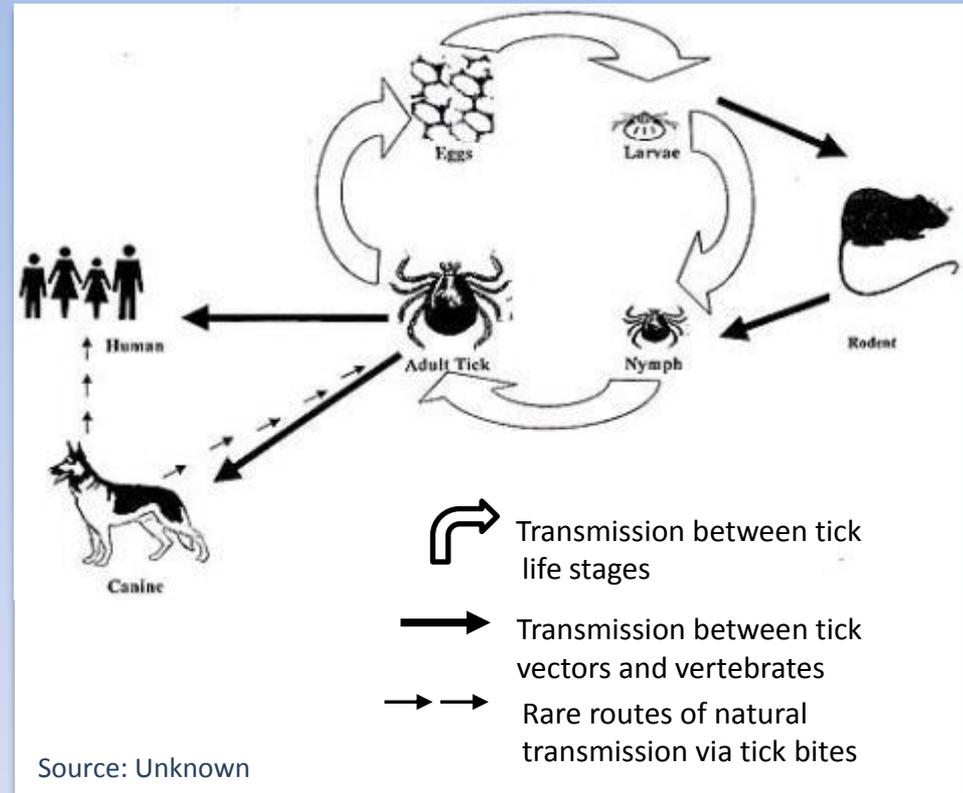




# Tick-Pathogen Cycle



- Ticks acquire infection by feeding on infected mammal (such as chipmunk, squirrel, dog)
- Ticks maintain and pass on infection between life stages (transstadial) and through eggs to larvae (transovarial)
- Ticks function as both reservoir and vector
- Ticks require 6-20 hours of feeding to transmit Rickettsiae
  - Shorter transmission time than for other tick-borne diseases



# Ticks Associated with RMSF Transmission and Distribution in California



Source: CDC

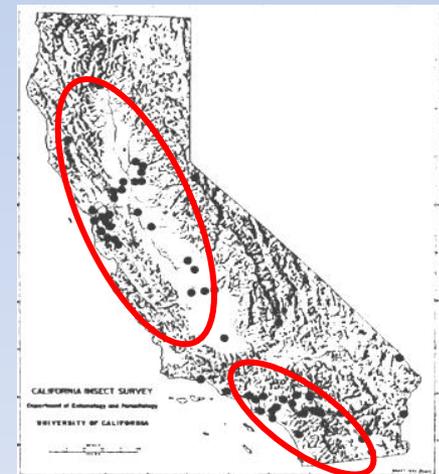
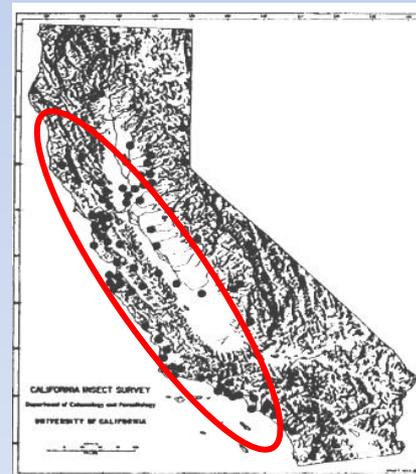
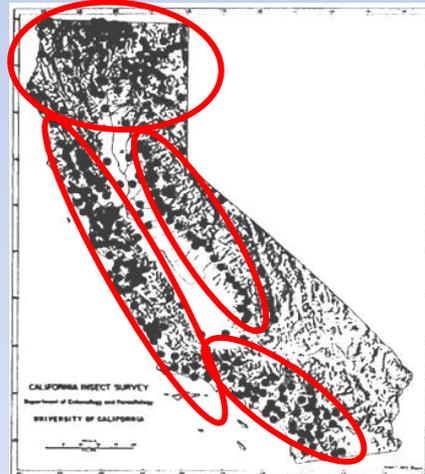
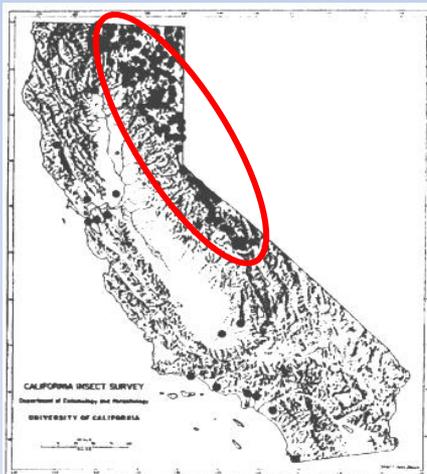


**Wood tick**  
*Dermacentor andersoni*

**Pacific Coast tick**  
*Dermacentor occidentalis*

**American dog tick**  
*Dermacentor variabilis*

**Brown dog tick**  
*Rhipicephalus sanguineus*



**Red circles generalize tick species distribution**  
**The Ticks of California, by D. Furman and E. Loomis, 1984**



Source: CDC

# American Dog Tick (*Dermacentor variabilis*)

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- Primary vector of RMSF in southeastern states
- Common tick in California
- Adult tick preferred host
  - large and medium-sized mammals including domestic dog
  - Often bites humans
- Immature stages preferred host
  - small rodents



Source: CDC

**Range of *D. variabilis* in the US**



# Rocky Mountain Wood Tick (*Dermacentor andersoni*)

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Source: CDC

- Vector for RMSF in Rocky Mountain region
- Adult tick feeds on large domestic and wild mammals and also bites humans
- Immature stages feed on rodents



Source: CDC

**Range of *D. andersoni* in the US**



# Brown Dog Tick

## (*Rhipicephalus sanguineus*)

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Source: CDC

- Historical and known vector in South America
- Recently implicated in the U.S. as primary vector in two recent RMSF outbreaks
  - Eastern Arizona 2003 - current
  - Mexicali outbreak 2008 - current
- *R. sanguineus* appears to be predominant vector of RMSF in the southwest U.S.
- Continued environmental and dog-targeted tick control necessary to prevent continued transmission



Source: CDC

**Range of *R. sanguineus* in the U.S.**

# Other Spotted Fever Rickettsiae

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# Tick-Borne Spotted Fever Rickettsiae in the United States



- In addition to *Rickettsia rickettsii* (RMSF), several other tick-borne species of Rickettsiae, “spotted fever group *Rickettsia*” have been shown to cause human infections
- Spotted fever group *Rickettsia* are transmitted to humans by the bite of an infected tick
  - May cause similar signs and symptoms to those observed for RMSF
- Pathogens in the U.S. include several species of *Rickettsia*
  - *Rickettsia parkeri*
    - Transmitted by *Amblyomma maculatum* (Gulf Coast tick)
    - Eastern and southern U.S., particularly along the coast
  - *Rickettsia* species 364D (*Rickettsia philipii*)
    - Transmitted by *Dermacentor occidentalis* (Pacific Coast tick)

# *Rickettsia philipii*



- Originally described as “*Rickettsia* 364D”
- First detected in ticks in 1966 in California
- To date, detected in Pacific Coast ticks (*Dermacentor occidentalis*) ticks only
- First human case from Lake County, California July 2008
- Common sign includes a local cutaneous eschar (dark crusted ulcer)
- Treated with doxycycline



Eschar on forearm



Eschar on arm



# *Rickettsia philipii*

## Clinical Case Summary 2008 - 2013 (n=12)

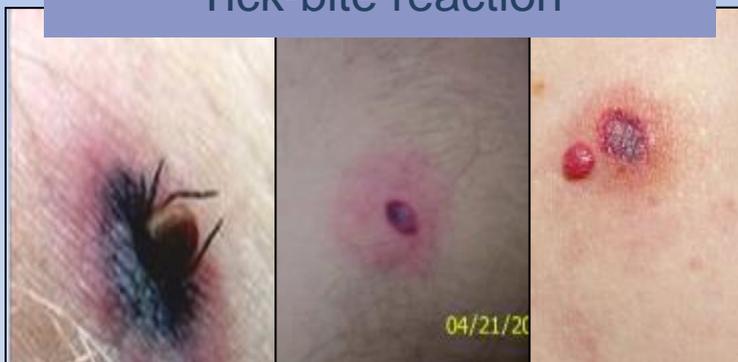
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- Proposed clinical name: Pacific Coast Tick Fever
- Clinical
  - Fever 92%
  - Headache 90%
  - Lymphadenopathy 46%
  - Eschar 100%
    - some multiple, at least one with petechial rash
  - Only 3 with recalled tick bite
- Lab
  - Often low white blood cell count
  - Thrombocytopenia
  - Liver function transaminases (LFTs) sometimes mild abnormal

# Challenges for Diagnosing

– Many “look-alikes”

Tick-bite reaction



Source: Mariposa  
Environmental Health

Cutaneous anthrax



Source: CDC.gov

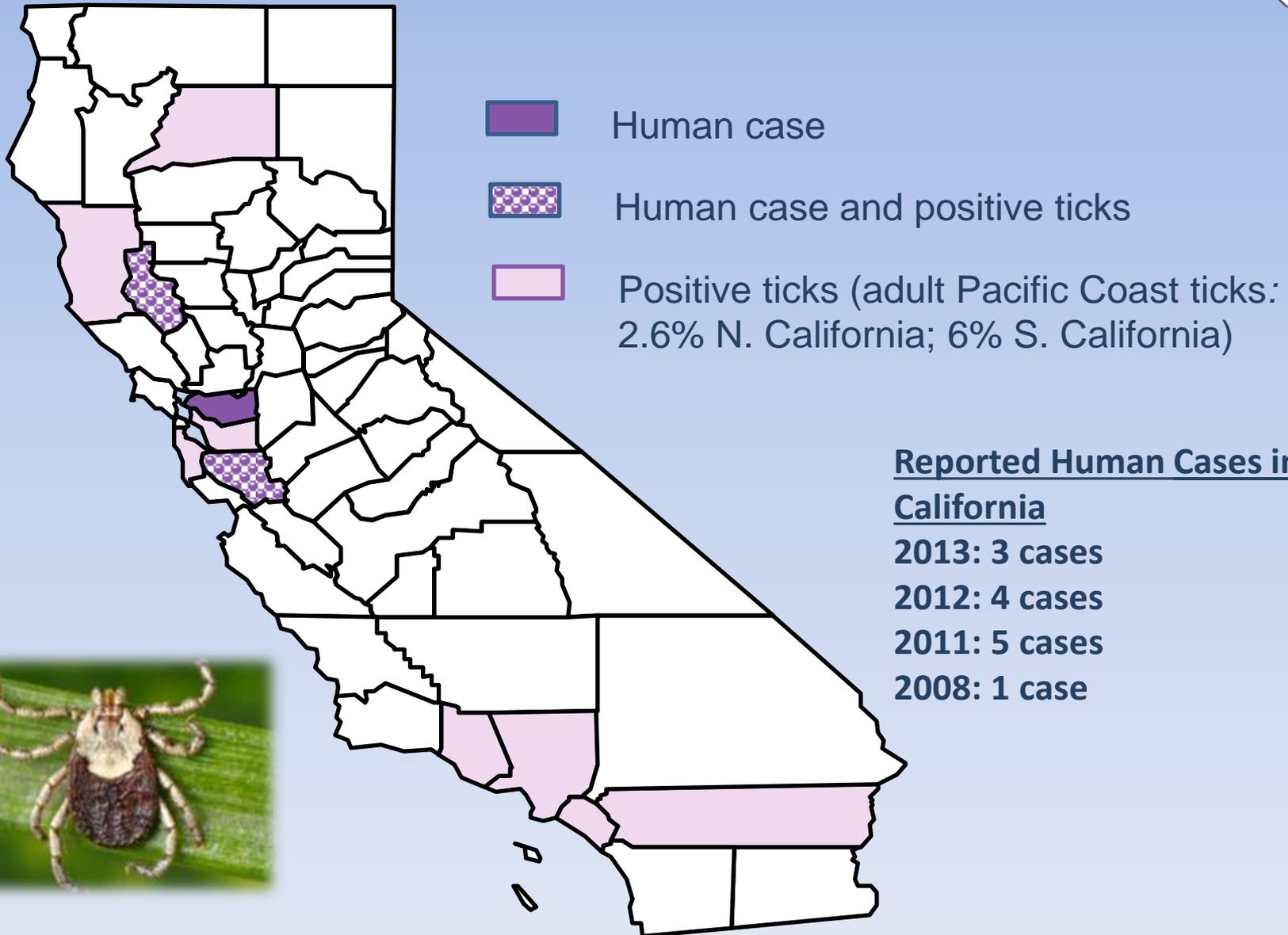
Source:  
<http://www.textbookofbacteriology.net/Anthraxlesion.gif>

Parapox virus



Source: [Colorado State University Extension](http://www.colostate.edu/~extension/)

# Distribution of *Rickettsia philipii* Cases and Infected Ticks in California





# If You Identify A Suspect *Dermacentor* Tick-Bite Associated Eschar:

- Submit whole blood sample for Spotted Fever Group *Rickettsia* testing to CDPH, Viral and Rickettsial Disease Laboratory (VRDL; add details/contact) at time of identification and convalescent sample 3-4 weeks later
- Collect two samples from wound under eschar with dry cotton swabs, store in vials, send to VRDL for PCR

California Department of Public Health – July 2012

**Laboratory Testing for Spotted Fever Rickettsiosis**

A newly described eschar-associated illness has been identified in California caused by Spotted Fever Group (SFG) *Rickettsia* 364D and transmitted with tick bite. The most prominent clinical feature of *Rickettsia* 364D infection is the development of an isolated ulcer with raised erythematous margins and core black eschar, usually with surrounding generalized edema and erythema, which develops 3-14 days at the site

**Specimen collection:**

**Minimum specimen requirement:** Paired serum specimens. Sera (5-10 cc) should be collected in a red top or tiger top tube.

- Acute serum should be taken in the 1st week of illness (or within ~7-10 days post onset)
- Convalescent serum should be taken at least

<http://www.cdph.ca.gov/programs/vrdl/Pages/WhatsNew.aspx>



To find out more about spotted fever group  
Rickettsiae in California,  
visit the CDPH website at:

<http://www.cdph.ca.gov/HealthInfo/discond/Pages/TickBorneDiseases.aspx>



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