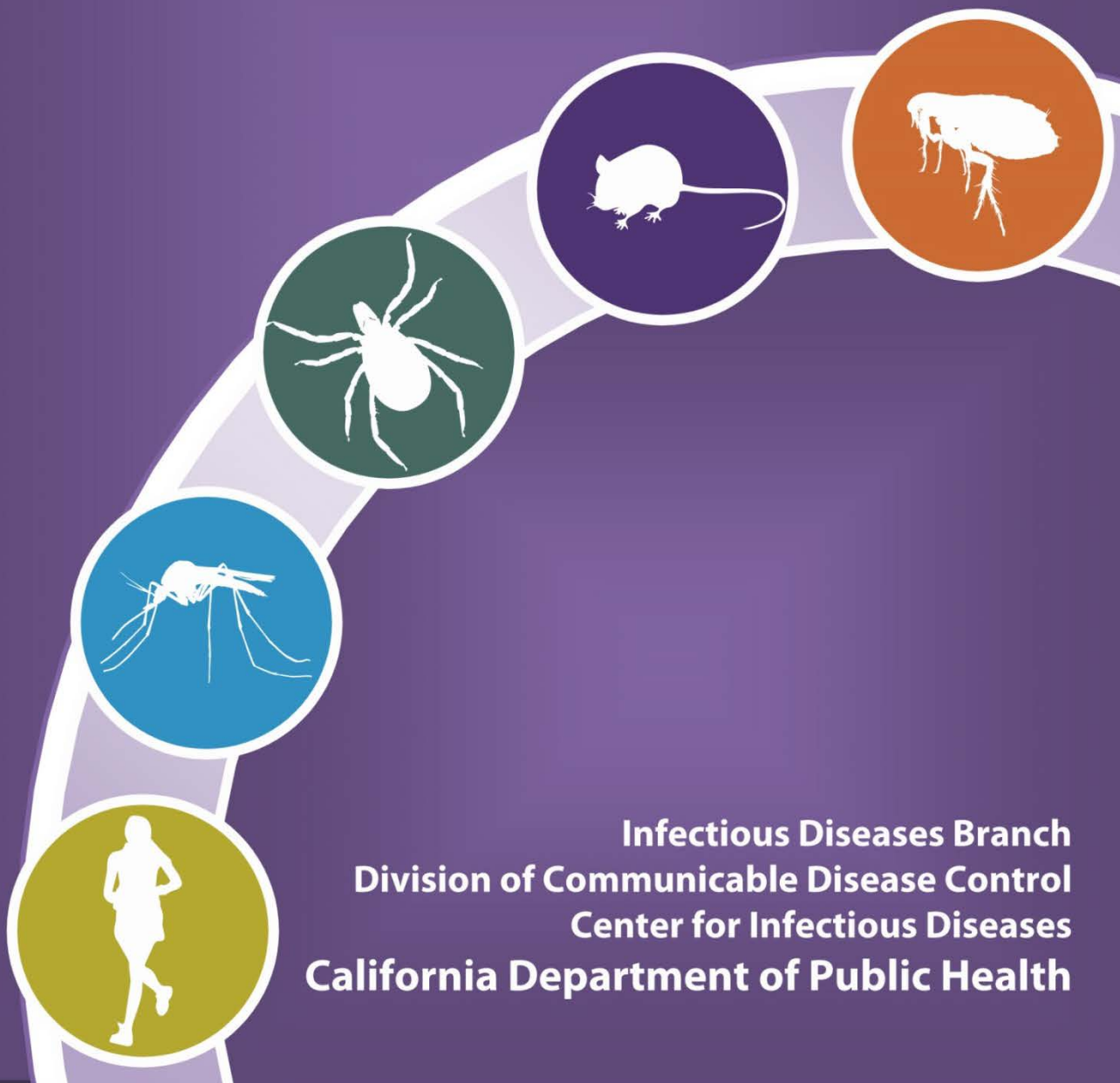


# Vector-Borne Disease Section Annual Report 2015



Infectious Diseases Branch  
Division of Communicable Disease Control  
Center for Infectious Diseases  
California Department of Public Health

2015

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

INFECTIOUS DISEASES BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CENTER FOR INFECTIOUS DISEASES

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH



Edmund G. Brown Jr.  
Governor  
State of California



Diana S. Dooley, Secretary  
Health and Human Services Agency



Karen Smith, MD, MPH, Director  
Department of Public Health

# Contents

Preface..... iii

Acknowledgements ..... iv

Program Overview ..... vi

## *Chapters*

<b>1</b>	Rodent-borne Diseases	<b>1</b>
<b>2</b>	Flea-borne Diseases	<b>4</b>
<b>3</b>	Tick-borne Diseases	<b>8</b>
<b>4</b>	Mosquito-borne Diseases	<b>14</b>
<b>5</b>	U.S. Forest Service Cost-Share Agreement	<b>21</b>
<b>6</b>	Vector Control Technician Certification Program	<b>29</b>
<b>7</b>	Public Information Materials and Publications	<b>31</b>

# Preface

I am pleased to present to you the 2015 Annual Report for the Vector-Borne Disease Section (VBDS) of the California Department of Public Health (CDPH). VBDS staff conducted prevention, surveillance, and control of existing and emerging vectors and vector-borne diseases throughout California in 2015.

As in 2014, California experienced widespread and elevated West Nile virus (WNV) activity in 2015. The number of human cases detected (783) was the third highest recorded since 2003 when WNV first invaded California, and the number of fatal cases (53) was the highest ever reported. The record hot temperatures statewide and extended drought may have contributed to the elevated activity. In addition to WNV activity, St. Louis encephalitis virus (SLEV) was detected in the Coachella Valley, Riverside County. This was the first detection of SLEV in California since 2003 and although no human cases were reported, evidence of virus activity was found in mosquitoes and sentinel chickens.

Invasive *Aedes* mosquitoes continued to expand their range in California in 2015. *Aedes aegypti* (yellow fever mosquito) infestations were found in five additional counties, with detections expanding from 14 cities in 2014 to 52 in 2015. The range of *Aedes albopictus* (Asian tiger mosquito) increased in Los Angeles County, and infestations were found in four additional counties. Both species are aggressive day-biters and vectors of Zika, dengue, and chikungunya viruses, which are currently not transmitted in California, although cases were identified in travelers returning to California in 2015 from regions where these viruses are circulating. VBDS worked closely with colleagues in counties bordering Mexico to enhance surveillance, preparedness, and response to emerging *Aedes*-borne diseases along the border.

Extensive plague activity was detected in California in 2015. Two human cases were identified with exposure to infected fleas in Yosemite National Park, and plague-positive animals and fleas were found in the South Lake Tahoe and eastern Sierra mountain regions. VBDS conducted extensive plague surveillance, risk assessment, and control, including the closure of recreation sites for flea treatment. Additionally, two cases of hantavirus pulmonary syndrome were identified in 2015; these cases represent the first cluster of patients from the same household.

Human cases of six tick-borne diseases were reported in California in 2015. VBDS activities in 2015 included enhancing nymphal tick surveillance and laboratory capacity, mapping of *Ixodes pacificus* distribution, and developing educational materials on preventing tick bites. VBDS continued to provide extensive consultation and training to United States Forest Service and National Park Service employees to reduce the risk of vector-borne disease exposure to park staff and visitors.

Many of you are our collaborators and colleagues and I hope that you find the information contained in this annual report to be of value as we collectively strive to optimize the health and well-being of all Californians.

Vicki L. Kramer, Ph.D., Chief  
Vector-Borne Disease Section

# Acknowledgements

**The California Department of Public Health, Vector-Borne Disease Section works with numerous local, state, and federal agencies, private and commercial organizations, and members of the medical community in its efforts to monitor, prevent, and control vector-borne diseases in California. Some of the Section's key collaborators in 2015 are listed here.**

## Rodent-borne Diseases

Alameda County Vector Control District (VCD); Inyo County Environmental Health Services (EHS); Mono County Health and Human Services (HHS); Mosquito and Vector Management District of Santa Barbara County; National Park Service (NPS); Riverside County Vector Control Program (VCP); San Bernardino County VCP; San Diego VCP; San Mateo Mosquito and Vector Control District (MVCD); United States Centers for Disease Control and Prevention (CDC); United States Forest Service (USFS); Ventura County Environmental Health Division (EHD).

## Flea-borne Diseases

California Land Management; CDC; County of El Dorado, Environmental Management Division; Fresno County Department of Agriculture; Los Angeles County Agricultural Commissioner; Los Angeles County Department of Health-Vector Management; Mariposa County EHS; Mono County HHS; NPS; Riverside County VCP; San Bernardino County VCP; San Mateo MVCD; School of Veterinary Medicine, University of California, Davis (UCD); United States Department of Agriculture Animal and Plant Health Inspection Service, Wildlife Services; USFS; West Valley MVCD; Riverside EHS; West Valley MVCD.

## Tick-borne Diseases

Butte County MVCD; University of California, Davis Arbovirus Research Training (DART) Laboratory; Marin County HHS; Marin-Sonoma MVCD; Napa County Mosquito Abatement District; NPS; Orange County MVCD; Placer County MVCD; Rickettsial Zoonoses Branch and Division of Vector-Borne Infectious Diseases, CDC; Sacramento-Yolo County MVCD; San Bernardino Environmental Health Department; San Mateo County MVCD; Santa Clara County VCD; Santa Cruz County MVCD; Shasta MVCD; Sutter-Yuba MVCD; Northern Arizona University; USFS; Ventura County EHD.

## Mosquito-borne Diseases

California Department of Fish and Wildlife; DART Laboratory; Mosquito and Vector Control Association of California; participating local health departments, physicians and veterinarians, and local mosquito and vector control agencies.

## California Department of Public Health Contributors

### Infectious Diseases Branch

Duc Vugia MD MPH; Janey Butner; Claudia Erickson MS CHES; Sarah Lewis MD MPH.

### Vector-Borne Disease Section

Sacramento: Vicki Kramer PhD; Anne Kjemtrup DVM MPVM PhD; Jesse Laxton; Charsey Porse PhD MPH; Lauren Salmo MPH CHES.

Northern Region: Mark Novak PhD; Mary Beth Danforth PhD; Ashley Freeman MSPH; Greg Hacker MS; Bryan Jackson PhD; Michael Niemela MS; James Tucker MS.

Southern Region: Renjie Hu PhD; Sarah Billeter PhD; Joseph Burns; Marco Metzger PhD.

Coastal Region: Kerry Padgett PhD; Ervic Aquino; Tina Feiszli MSPH; Leslie Foss MS; Gordon Lau; Kelly Liebman PhD; Mary-Joyce Pakingan; Robert Payne; Aidan Ward; Melissa Yoshimizu PhD.

Interns: Sonal Chand; Jennifer Johnson; Salyna Koeut.

### Veterinary Public Health Section

Curtis Fritz DVM MPVM PhD.

### Viral and Rickettsial Disease Laboratory

Dongxiang Xia MD PhD; Theresa Brown PHM; Robert Chiles; Giorgio Cosentino PHM; David Cottam PHM; Barryett Enge MS PHM; Alex Espinosa MS PHM; Ashraf Fadol PHM; Jill Hacker PhD MPH; Kim Hansard PHM; Carl Hanson PhD; Kristina Hsieh DrPH PHM; Maria Liu MPH PHM; Ruth Lopez; Sharon Messenger PhD; Mary Kate Morris PhD; Artem Muradyan PHM; Leo Ocegüera MPH PHM; Oliver Oyler; Chris Preas PHM; Maria Salas MPH; Diana Singh; Sarah Skallet; Pat Stoll MD MPH PHM; Maria Vu PHM; Shigeo Yagi PhD.

### Microbial Diseases Laboratory

Margot Graves; Robin Hogue CLS PHM.

### Annual Report Cover Art

Daniela Muhawi, Graphic Design.

# Program Overview

The mission of the California Department of Public Health Vector-Borne Disease Section (CDPH-VBDS) is to protect the health and well-being of Californians from arthropod- and vertebrate-transmitted diseases and injurious pests. [Authorizing statutes: Health and Safety Code Sections (HSC) 116108-116120, 116102, et. seq., and 116180; Government Code Section 12582]. CDPH-VBDS provides leadership, information, and consultation on vector-borne diseases and invasive vectors to the general public and agencies engaged in the prevention and control of vector-borne diseases. CDPH-VBDS staff, located in four regional offices and headquartered in Sacramento, provide the following services:

- Develop and implement statewide vector-borne disease prevention, surveillance, and control programs
- Design and conduct scientific investigations to further knowledge of vector-borne diseases in California
- Coordinate preparedness activities for detection and response to introduced vectors and vector-borne diseases, such as West Nile virus, Zika, chikungunya, dengue, and invasive *Aedes* mosquitoes
- Conduct emergency vector control when disease outbreaks occur
- Advise local agencies on public health issues related to vector-borne diseases
- Advise local agencies on regulatory issues pertaining to mosquito and vector control
- Oversee the Cooperative Agreement (HSC 116180) between CDPH and local vector control agencies
- Oversee the Vector Control Technician Certification and Continuing Education programs
- Provide information, training, and educational materials to governmental agencies, the medical community, and the public
- Provide consultation on issues related to the management of bed bugs, head lice, flies, and other arthropods of public health importance
- Maintain the San Francisco Bay Area U.S. Army Corps of Engineers general permit, which allows local vector control agencies to conduct abatement activities
- Oversee Special Local Need permits on restricted use of public health pesticides



## 1

## Rodent-borne Diseases



**Hantavirus infection is the most important rodent-borne disease in California. Since the disease was first identified in 1993, the California Department of Public Health, Vector-Borne Disease Section has collaborated with county, state, and federal public health agencies to identify and investigate human cases of disease, to survey and study Sin Nombre virus infection in wild rodents, and to prepare and promote preventive information for the general public.**

### Human disease surveillance

In 2015, hantavirus infection was diagnosed in two Mono County residents. The case-patients were an adult male and female who occupied the same residence. One required hospitalization; both case-patients survived. This is the first instance of concurrent hantavirus infections in the same household in California. California Department of Public Health, Vector-Borne Disease Section (CDPH-VBDS) investigators collected eight deer mice (*Peromyscus maniculatus*) from the case-patients' residence and four from the male's workplace. One deer mouse collected from the workplace tested positive for serum antibodies to Sin Nombre virus (SNV), the agent of hantavirus pulmonary syndrome.

### Rodent surveillance

In 2015, 839 rodents (Genera: *Neotoma*, *Microtus*, *Peromyscus*, and *Reithrodontomys*) were tested for antibodies to SNV (Table 1.1). Of 783 *Peromyscus* spp. sampled, 60 (7.7%) were positive for SNV antibodies. Seroprevalence in deer mice, the primary reservoir for SNV, was 14.1% (Table 1.1). At least one deer mouse was SNV antibody positive in 12 of 16 counties sampled in 2015 (Table 1.2). SNV antibody has been detected in deer mice from 27 of 39 counties sampled in the last ten years. Prevalence ranged from 2.2% to 38.5% (average 12.4%) over that time period (Table 1.2).

Additionally in 2015, 5 (10.2%) of 49 harvest mice (*Reithrodontomys megalotis*) demonstrated reactivity to SNV. None of five woodrats (*Neotoma* spp.) and neither of two voles (*Microtus* spp.) tested positive

for SNV antibody (Table 1.1). Seropositivity in these rodents may represent spillover of SNV from deer mice or infection with other hantaviruses (e.g. El Moro Canyon or Isla Vista), which cross react to the Sin Nombre virus assay. These other hantaviruses have not been shown to be pathogenic to humans.

#### Yosemite National Park hantavirus prevention

In May of 2013, Yosemite National Park (YOSE) and Public Health Foundation Enterprises (PHFE) entered into a five-year cooperative agreement to decrease the risk of contracting vector-borne diseases through increased health education, vector surveillance, and public health research. CDPH-VBDS worked closely with YOSE and PHFE staff in 2015, focusing efforts primarily on hantavirus prevention. Activities included facility evaluations, public education, and deer mouse trapping to estimate rodent abundance and SNV prevalence. Three (17.6%) of 17 deer mice trapped in Yosemite Valley were reactive to SNV antibody. In the Tuolumne Meadows area, 4 (13.8%) of 29 deer mice tested positive for SNV antibody, as did 9 (45.0%) of 20 deer mice collected from other locations in the park. PHFE staff provided recommendations to YOSE staff and associated partners based on rodent surveillance results and facility evaluations.

#### Lassen Volcanic National Park hantavirus prevention

In May of 2014, the National Park Service, Pacific West Region and PHFE entered into a master agreement that allows other park units within California to obtain vector-borne disease related services from PHFE and CDPH. A task agreement with Lassen Volcanic National Park was initiated in August 2014



for services that included facility inspections for rodent-borne disease risk, technical assistance for rodent exclusion issues, and deer mouse trapping for SNV surveillance. In 2015, a total of 33 structures were evaluated for vector-borne disease and rodent exclusion issues. Fifteen (25.0%) of 60 deer mice tested were seropositive for SNV antibodies.

**Table 1.1 Serologic evidence of hantavirus (Sin Nombre) infection in California rodents, 2006 - 2015**

Species	Common name	2015			2006-2015		
		No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
<i>Peromyscus boylii</i>	brush mouse	16	0		1,459	35	2.4
<i>Peromyscus californicus</i>	parasitic mouse	94	0		1,258	16	1.3
<i>Peromyscus crinitus</i>	canyon mouse				65	1	1.5
<i>Peromyscus eremicus</i>	cactus mouse	3	0		2,087	79	3.8
<i>Peromyscus e. fraterculus</i>	northern Baja mouse	198	0		1,052	10	1.0
<i>Peromyscus maniculatus</i>	deer mouse	427	60	14.1	5,654	705	12.5
<i>Peromyscus truei</i>	piñon mouse	45	0		295	5	1.7
<i>Peromyscus sp.</i>	unspeciated <i>Peromyscus</i>				4	0	
<i>Peromyscus</i> spp. subtotal		783	60	7.7	11,874	851	7.2
<i>Reithrodontomys megalotis</i>	western harvest mouse	49	5	10.2	831	74	8.9
<i>Neotoma</i> spp.	woodrats	5	0		521	16	3.1
<i>Microtus</i> spp.	voles	2	0		163	30	18.4

**Table 1.2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus* in California, 2006-2015**

County	2015			2006-2015		
	No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
Alameda	3	0	0.0	104	0	
Alpine				7	1	14.3
Amador				4	0	
Butte				13	5	38.5
Colusa				2	0	
Contra Costa	12	0	0.0	16	0	
El Dorado	45	11	24.4	599	135	22.5
Glenn				5	0	
Inyo				14	3	21.4
Kern				6	1	16.6
Lassen				291	31	10.7
Los Angeles				8	0	
Madera				42	10	23.8
Marin				19	1	5.3
Mariposa	37	12	32.4	149	23	15.4
Modoc				23	7	30.4
Mono	12	1	8.3	689	197	28.6
Napa				13	2	15.4
Nevada	10	2	20.0	15	2	13.3
Orange				766	65	8.5
Placer	5	2	40.0	72	4	5.6
Plumas	11	2	18.2	38	9	23.7
Riverside	38	11	28.9	550	62	11.3
San Benito				5	0	
San Bernardino	54	0	0.0	414	9	2.2
San Diego	108	1	0.9	1,191	50	4.2
San Francisco				13	0	
San Mateo	11	1	9.1	37	9	24.3
Santa Barbara				54	11	20.4
Santa Clara				16	0	
Santa Cruz				14	0	
Shasta	28	7	25.0	86	18	20.9
Sierra				41	4	9.8
Siskiyou				58	9	15.5
Tehama	21	6	28.6	74	12	16.2
Trinity	3	0	0.0	3	0	
Tulare				8	0	
Tuolumne	29	4	13.8	219	26	11.9
Ventura				3	1	33.3
<b>Total</b>	<b>427</b>	<b>60</b>	<b>14.1</b>	<b>5,681</b>	<b>707</b>	<b>12.4</b>

## 2

## Flea-borne Diseases



**Plague and typhus are the principal flea-borne diseases under surveillance in California. The California Department of Public Health collaborates with local, state, and federal agencies to conduct a statewide plague surveillance program. The California Department of Public Health, Vector-Borne Disease Section collects, collates, and analyzes information on suspect and confirmed plague activity among humans, domestic pets, and wild animals throughout California to evaluate the potential risk of plague to the public and, where necessary, implement preventive and control actions.**

### Human disease surveillance

#### Typhus

Eighty cases of typhus fever were reported to the California Department of Public Health (CDPH) in 2015. Thirty-four of these were classified as confirmed cases according to CDPH working surveillance definition and 46 were probable. Seventy (87.5%) of the case-patients required hospitalization. Case-patients were residents of Los Angeles (63), Orange (15), San Diego (1), and Kern (1) counties. Typhus is considered endemic in parts of Orange and Los Angeles counties. The case-patient from Kern County reported travel outside the United States during the incubation period. The case-patient from San Diego County reported travel within the county to a rural area where the case-patient was exposed to fleas.

#### Plague

Two cases of plague in humans were reported in 2015. Both case-patients reported visiting or camping in Yosemite National Park (YOSE) prior to disease onset. The first case-patient was a pediatric California resident who survived after being hospitalized. The second case-patient was an adult out-of-state resident who also survived after hospitalization. The CDPH Vector-Borne Disease Section (VBDS) performed rodent and flea surveillance at locations in YOSE where the case-patients visited and where dead rodents were reported which included areas in Tuolumne and Mariposa counties.

### Animal disease surveillance

#### Domestic pets

No cases of plague in domestic pets were reported in 2015.

#### Wild animals

The CDPH-VBDS plague surveillance program received test results for 1,166 wild rodents and 134 carnivores from 25 California counties in 2015. Plague bacteria (*Yersinia pestis*) was detected in 14 rodents from four counties including El Dorado, Mono, Tulare, and Tuolumne (Figure 2.1, Table 2.1). Additionally, 50 rodents and 4 carnivores from eight counties tested positive for serum antibodies to *Yersinia pestis* (Table 2.2). San Diego County Department of Environmental Health, Vector Control Program tested an additional 350 rodents and Los Angeles County Environmental Health, Vector Control program tested 6 rodents; all of these tested negative (data not included in tables).

The rodent species tested for plague antibodies in 2015 included: 585 California ground squirrels (*Otospermophilus beecheyi*), 359 chipmunks (*Tamias* spp.), 93 mice (*Peromyscus* spp. and *Microtus* spp.), 83 golden-mantled ground squirrels (*Callospermophilus lateralis*), 27 Douglas squirrels (*Tamiasciurus douglasii*), 11 wood rats (*Neotoma* spp.), 7 Belding's ground squirrels (*Urocitellus beldingi*), and 1 western gray squirrel (*Sciurus griseus*).

Plague antibodies were detected in three California ground squirrels from Mariposa County, 23 lodgepole chipmunks (*Tamias speciosus*) from five counties including Madera, Mariposa, Mono, Tulare

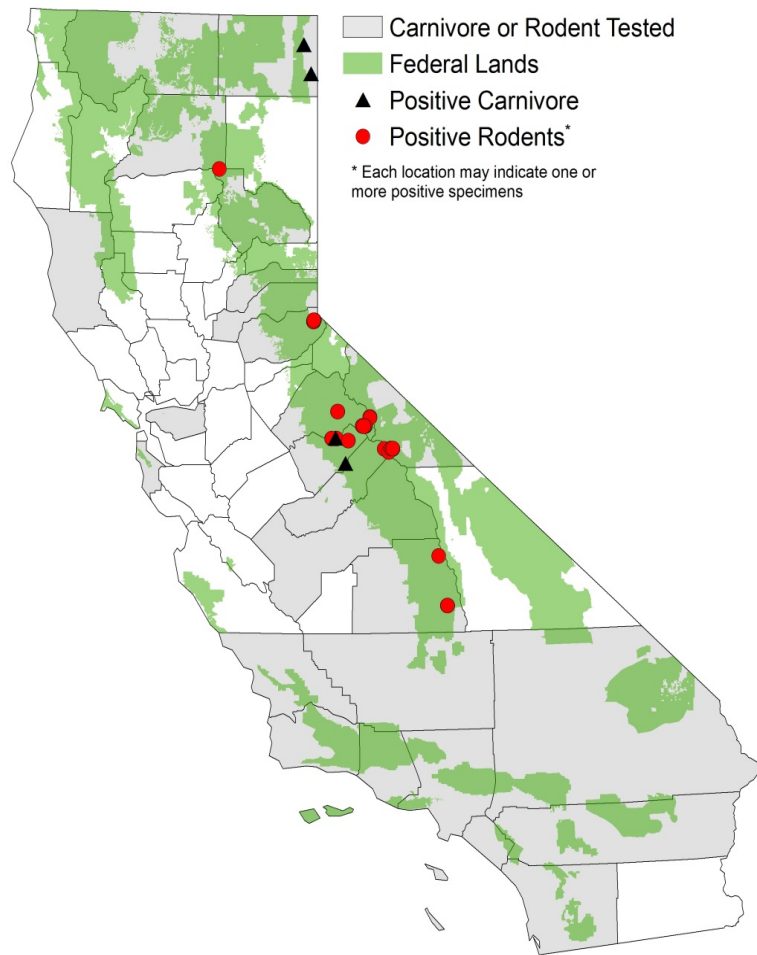


Figure 2.1. Approximate locations of carnivores or rodents on federal lands that tested positive for serum antibodies to *Yersinia pestis*, California 2015. Federal Lands include both National Forest and National Park Lands.

and Tuolumne, 13 yellow-pine chipmunks (*Tamias amoenus*) from El Dorado and Mono counties, 6 shadow chipmunks (*Tamias senex*) from El Dorado County, 3 least chipmunks (*Tamias minimus*) from Mono County, 1 Douglas squirrel from Plumas County, and 1 golden-mantled ground squirrel from Tulare County (Table 2.2).

A total of 134 wild carnivores were tested for plague antibodies including: 98 coyotes (*Canis latrans*) 20 black bears (*Ursus americanus*), 8 mountain lions (*Felis concolor*), 4 striped skunks (*Mephitis mephitis*), 2 red foxes (*Vulpes vulpes*), 1 gray fox (*Urocyon cinereoargenteus*), and 1 bobcat (*Lynx rufus*) (Table 2.1). Two positive black bears were detected in Mariposa and Tuolumne counties and two positive coyotes were detected in Modoc County.

#### Wild Rodent Flea Testing

A total of 999 fleas were identified to species, combined into 277 pools, and tested for the presence of *Yersinia pestis* bacteria by the U.S. Centers for Disease Control and Prevention (CDC) and CDPH. Ten flea pools tested positive, including five pools from the United States Forest Service, Tallac Historic Site and Taylor Creek Visitor Center areas near South Lake Tahoe in El Dorado County; four pools within Yosemite National Park, including three from Tuolumne County, and one from Mariposa County, and one pool from the Inyo National Forest, Mammoth Ranger Station in Mono County.

**Table 2.1 CDPH-VBDS plague bacteriological testing surveillance results in wild rodents and carnivores by location, California 2015**

County Location	No. rodents tested	No. carnivores tested	Positive Specimens		
			Species	Titer	Month
<b>El Dorado</b>	23	0			
LTBMU, Tallac Historical Site			CA G Sq	Pos	August
LTBMU, Tallac Historical Site			GM G Sq	Pos	September
<b>Mariposa</b>	9	0			
<b>Mono</b>	2	0			
Inyo NF, Mammoth Ranger Station			Chipmunk, LP	Pos	September
<b>Placer</b>	2	0			
<b>Plumas</b>	2	0			
<b>Tulare</b>	1	0			
Sequoia NP, Crabtree Ranger Station			GM G Sq	Pos	August
<b>Tuolumne</b>	15	0			
Yosemite NP, Tuolumne Meadows			GM G Sq	Pos	August
Yosemite NP, Tuolumne Meadows			Chipmunk	Pos	August
Yosemite NP, Tuolumne Meadows			Chipmunk	Pos	August
Yosemite NP, Tuolumne Meadows, Backpackers CG			GM G Sq	Pos	August
Yosemite NP, Tuolumne Meadows, Backpackers CG			GM G Sq	Pos	August
Yosemite NP, Tuolumne Meadows CG			Chipmunk, LP	Pos	August
Yosemite NP, Tuolumne Meadows CG			Chipmunk, LP	Pos	August
Yosemite NP, Tuolumne Meadows CG			Douglas Squirrel	Pos	August
Yosemite NP, Tuolumne Meadows			Chipmunk	Pos	September
Yosemite NP, Tuolumne Meadows Lodge			Chipmunk	Pos	September
<b>Total</b>	<b>54</b>	<b>0</b>			

**Abbreviations for Table 2.1, 2.2**

Chipmunk, S: Shadow chipmunk	LTBMU: Lake Tahoe Basin Management Unit
Chipmunk, LP: Lodge-pole chipmunk	NF: National Forest
Chipmunk, L: Least chipmunk	NP: National Park
Chipmunk, YP: Yellow-pine chipmunk	SP: State Park
GM G Sq: Golden-mantled ground squirrel	POS: Plague bacterium, <i>Yersinia pestis</i>
Ca G Sq: California ground squirrel	

**Table 2.2 CDPH-VBDS plague serological surveillance testing results in wild rodents and carnivores by location, California 2015**

County Location	No. rodents tested	No. carnivores tested	Positive Specimens		
			Species	Titer	Month
<b>Contra Costa</b>	0	1			
<b>El Dorado</b>	79	11			
LTBMU, Fallen Leaf CG			Chipmunk, YP	1:64	September
LTBMU, Tallac Historical Site			Chipmunk, YP	1:256	September
LTBMU, Tallac Historical Site			Chipmunk, YP	1:512	September
LTBMU, Tallac Historical Site			Chipmunk, YP	1:1024	September
LTBMU, Tallac Historical Site			Chipmunk, YP	1:512	September
LTBMU, Tallac Historical Site			Chipmunk, YP	1:256	September
LTBMU, Tallac Historical Site			Chipmunk, YP	1:128	September
LTBMU, Fallen Leaf CG			Chipmunk, S	1:512	September
LTBMU, Fallen Leaf CG			Chipmunk, S	1:128	September
LTBMU, Fallen Leaf CG			Chipmunk, S	1:64	September
LTBMU, Talyor Creek Visitor Center			Chipmunk, YP	1:64	September
LTBMU, Talyor Creek Visitor Center			Chipmunk, YP	1:64	September
LTBMU, Talyor Creek Visitor Center			Chipmunk, YP	1:512	September
LTBMU, Talyor Creek Visitor Center			Chipmunk, S	1:1024	September
LTBMU, Talyor Creek Visitor Center			Chipmunk, S	1:256	September
LTBMU, Talyor Creek Visitor Center			Chipmunk, S	1:128	September
<b>Fresno</b>	17	6			
<b>Kern</b>	0	19			
<b>Los Angeles</b>	55	9			
<b>Madera</b>	20	0			
Inyo NF, Pumice Flat Group CG			Chipmunk, LP	1:128	June
<b>Mariposa</b>	96	16			
Yosemite NP, Mariposa Grove			Black Bear	1:512	June
Yosemite NP, Glacier Point			Chipmunk, LP	1:128	August
Yosemite NP, Tamarack Flat CG			CA G Sq	1:128	August
Yosemite NP, Glacier Point			CA G Sq	1:64	August
Yosemite NP, Crane Flat CG			CA G Sq	1:64	August
Yosemite NP, Glacier Point			Chipmunk, LP	1:4,096	September
<b>Mendocino</b>	0	16			
<b>Modoc</b>	0	19			
Eagleville, 6 mi NE			Coyote	1:128	November
Lake City, 4 mi NE			Coyote	1:1,024	November
<b>Mono</b>	129	0			
Inyo NF, Upper Falls Tract			Chipmunk, LP	1:64	June
Inyo NF, Upper Falls Tract			Chipmunk, LP	1:512	June
Inyo NF, Saddlebag Lake CG			Chipmunk, LP	1:32	August
Inyo NF, Saddlebag Lake CG			Chipmunk, LP	1:256	August
Inyo NF, Pine Glen Group CG			Chipmunk, YP	1:256	September
Inyo NF, Pine Glen Group CG			Chipmunk, YP	1:64	September
Inyo NF, New Shady Rest CG			Chipmunk, YP	1:256	September
Mammoth Lakes RV Park			Chipmunk, L	1:256	September
Mammoth Lakes RV Park			Chipmunk, L	1:256	September
Mammoth Lakes RV Park			Chipmunk, L	1:1,024	September
<b>Nevada</b>	43	0			
<b>Orange</b>	7	0			
<b>Placer</b>	14	0			
<b>Plumas</b>	26	0			
Lassen Volcanic NP, Drakesbad Guest Ranch			Douglas Squirrel	1:128	September
<b>Riverside</b>	35	0			
<b>San Bernardino</b>	17	0			
<b>San Diego</b>	370	1			
<b>San Luis Obispo</b>	0	18			
<b>San Mateo</b>	14	0			
<b>Santa Barbara</b>	9	0			
<b>Shasta</b>	28	0			
<b>Siskiyou</b>	0	10			
<b>Tulare</b>	56	0			
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:128	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:128	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:128	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:256	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:64	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:64	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:256	May
Sequoia NF, Troy Meadow CG			GM G Sq	1:128	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:256	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:64	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:32	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:128	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:128	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:64	June
<b>Tuolumne</b>	69	4			
Yosemite NP, Tioga Rd.			Black Bear	1:256	July
Yosemite NP, Tuolumne Meadows Lodge			Chipmunk, LP	1:512	August
Yosemite NP, Tuolumne Meadows Lodge			Chipmunk, LP	1:128	August
Yosemite NP, Tuolumne Meadows Lodge			Chipmunk, LP	1:1024	August
<b>Ventura</b>	28	4			
<b>Total</b>	<b>1,112</b>	<b>134</b>			

## 3

## Tick-borne Diseases



At least seven tick-borne diseases have been documented in California. A goal of the California Department of Public Health, Vector-Borne Disease Section is to reduce human morbidity from tick-borne diseases in California through ongoing surveillance of the disease-causing agents and ticks, investigation of human cases, management of tick populations when appropriate, collation of state-wide tick data from participating agencies, and timely dissemination of findings and prevention messages to the public, medical and public health communities, and vector control agencies.

### Human disease surveillance

#### Anaplasmosis

In 2015, five cases of anaplasmosis caused by *Anaplasma phagocytophilum* were reported to the California Department of Public Health (CDPH): three met national surveillance criteria for a confirmed case; two met the criteria for a probable case. Case-patients were residents of Contra Costa, San Francisco (2), San Luis Obispo, and Santa Clara counties. Median age was 79 (range, 43 to 84 years) and all five were female. Two of the confirmed cases each reported a tick bite, one in Sonoma County and the other in New Jersey; the third confirmed case reported exposure in New York State, endemic for *A. phagocytophilum*; exposure information was not documented for the probable cases.

#### Babesiosis

Six cases of babesiosis caused by *Babesia microti* were reported to CDPH in 2015; all met national surveillance criteria for a confirmed case. The median age of case-patients was 59 years (range, 38 to 67) and all were male. Case-patients were residents of Alameda (2), Los Angeles (2), San Mateo, and Santa Clara counties. Four case-patients were hospitalized; all case-patients survived. All reported travel to the northeastern United States where *B. microti* is endemic and three recalled a tick bite while there.

#### Ehrlichiosis

One case of ehrlichiosis caused by *Ehrlichia chaffeensis* was reported to CDPH; the case met surveillance criteria for a probable case. The case-patient was a male with exposure reported in Arkansas, a state endemic for *E. chaffeensis*.

#### Lyme Disease

A total of 114 cases of Lyme disease caused by *Borrelia burgdorferi*, were reported in 2015; 98 of these met the surveillance case definition criteria for a confirmed case, and 16 were probable (Figure 3.1). Of the 98 confirmed cases, case-patients were residents of 28 counties, with Sonoma County reporting the highest number of cases (12), (Table 3.1). Of the 44 (45%) confirmed case-patients reporting travel history within the incubation period, 35 (80%) reported exposure outside of California, most commonly in the northeastern United States. The median age of confirmed Lyme disease case-patients was 35.5 (range, 1 to 73 years) and 60 (61%) were male. Of the 64 case-patients for whom race was reported, 60 self-identified as white, 3 as Asian and 1 as American Indian or Alaska native. Erythema migrans (EM) was identified in 59 (60%) case-patients, 40 (68%) of whom had onset of EM noted

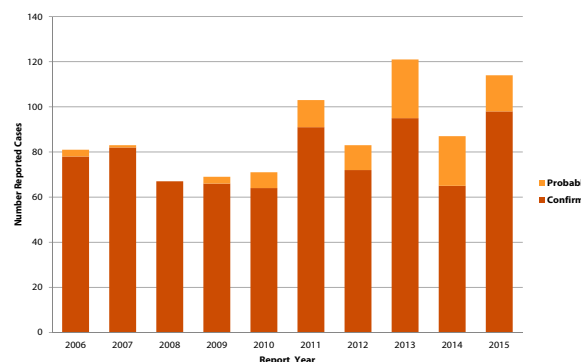


Figure 3.1. Confirmed and probable Lyme disease cases by report year 2006 - 2015

between May and September. Between 2006 and 2015, the highest incidence of Lyme disease was in the northwest and northern counties with western-facing Sierra slopes (Figure 3.2).



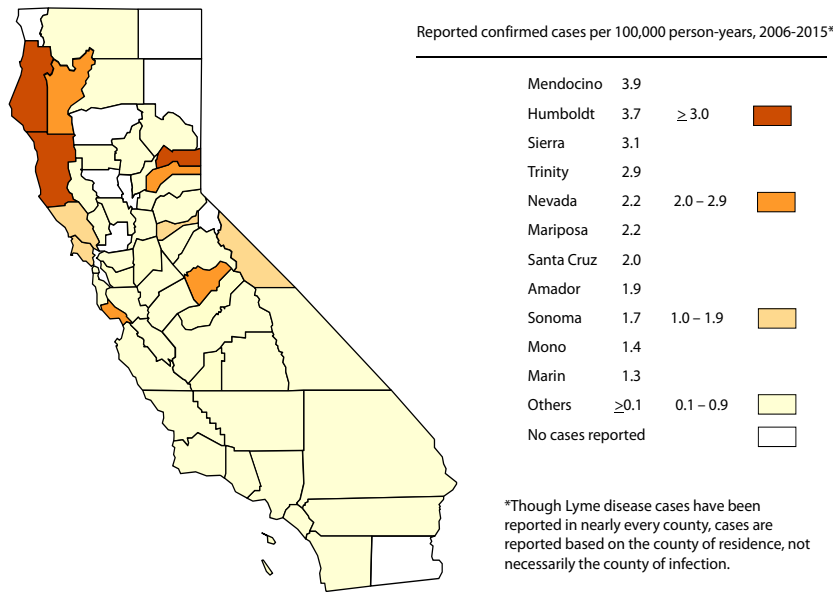


Figure 3.2. Incidence of confirmed Lyme disease, by county, California, 2006 - 2015

Spotted fever group rickettsiosis

Eight cases of Rocky Mountain spotted fever (RMSF), caused by *Rickettsia rickettsii*, were reported to CDPH in 2015; one met the national surveillance case definition for confirmed, and seven met the surveillance criteria for probable. The case-patients were residents of Alameda, Kern, Madera, Orange (2), San Bernardino, and San Diego (2) counties. Four (50%) case-patients were female, and median age was 28.5 years (range, 18 to 61 years). The confirmed case-patient survived and did not report travel outside Madera County. Of the probable cases, four reported possible exposure outside their county of residence including Los Angeles and San Mateo counties, Maryland, and Oklahoma.

Tick-borne relapsing fever

Eight cases of tick-borne relapsing fever (TBRF), caused by *Borrelia hermsii*, were reported to CDPH in 2015: six of these met CDPH working surveillance case definition criteria for a confirmed case, two were probable. Median age of confirmed case-patients was 30 years (range, 16 to 60 years) and three (50%) were male. Confirmed case-patients were residents of four counties: Alameda, Mono, Santa Clara (2), and Tulare (2). States or California counties where case-patients (confirmed and probable) were likely exposed in the three weeks prior to illness onset included Arizona, El Dorado, and Fresno (4). Two

cases had multiple exposure potential in Mono, Nevada, Placer, or Tuolumne counties.

**Tick surveillance**

*Anaplasma phagocytophilum*

In 2015, CDPH Vector-Borne Disease Section (CDPH-VBDS), in collaboration with Marin-Sonoma Mosquito and Vector Control District (MVCD) and Napa County Mosquito Abatement District (MAD), tested 220 adult, 75 nymphal, and 2 larval western blacklegged ticks (*Ixodes pacificus*) from Marin, Sonoma, Napa, Santa Cruz, and San Luis Obispo counties for the presence of *Anaplasma phagocytophilum*. Two (2.7%) nymphal western blacklegged ticks collected from China Camp State Park, Marin County, tested positive by real-time polymerase chain reaction (RT-PCR) at the CDPH Viral and Rickettsial Disease Laboratory (CDPH-VRDL).

***Borrelia spirochetes***

*Borrelia burgdorferi sensu lato*

In 2015, local, state, and federal agencies in collaboration with CDPH-VBDS collected 14,220 adult, 674 nymphal, and 244 larval western blacklegged ticks from 32 counties to test for *Borrelia burgdorferi*, the agent of Lyme disease. Collection and testing data for western blacklegged ticks

**Table 3.1: Reported confirmed Lyme disease cases by county of residence , California, 2006-2015**

County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL	Incidence per 100,000 person-years
Alameda	4	2	6	2	3	1	4	0	5	8	35	0.22
Alpine	0	0	0	0	0	0	0	0	0	0	0	0.00
Amador	1	2	1	0	0	0	0	1	0	2	7	1.85
Butte	1	0	2	2	0	0	0	0	1	0	6	0.27
Calaveras	0	0	0	0	0	0	0	0	0	1	1	0.22
Colusa	0	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	0	0	1	1	0	2	3	4	2	4	17	0.16
Del Norte	0	0	0	0	0	0	0	0	0	0	0	0.00
El Dorado	4	2	1	2	1	0	1	1	1	2	15	0.83
Fresno	1	0	2	0	1	1	4	1	0	1	11	0.11
Glenn	0	0	0	0	0	0	0	0	1	0	1	0.35
Humboldt	4	7	5	4	9	6	2	4	3	6	50	3.70
Imperial	0	0	0	0	0	0	0	0	0	0	0	0.00
Inyo	1	0	0	0	0	0	0	0	0	0	1	0.54
Kern	1	5	2	1	2	0	0	0	0	1	12	0.14
Kings	0	0	0	1	0	0	0	1	0	0	2	0.13
Lake	0	1	0	0	0	0	0	0	0	1	2	0.31
Lassen	0	0	0	0	0	0	0	0	0	0	0	0.00
Los Angeles	12	10	6	3	6	8	1	17	6	7	76	0.08
Madera	0	0	0	0	0	1	0	0	0	0	1	0.07
Marin	8	1	2	2	2	1	3	7	3	5	34	1.32
Mariposa	0	0	0	0	0	0	1	1	1	1	4	2.20
Mendocino	2	7	8	7	3	3	3	0	1	0	34	3.86
Merced	0	0	0	0	0	1	0	0	0	0	1	0.04
Modoc	0	0	0	0	0	0	0	0	0	0	0	0.00
Mono	0	0	0	0	1	0	0	1	0	0	2	1.43
Monterey	0	1	0	0	0	1	1	1	0	0	4	0.09
Napa	0	2	0	1	0	1	1	0	2	2	9	0.65
Nevada	2	4	1	3	1	6	3	1	0	1	22	2.24
Orange	2	1	1	0	5	6	0	0	0	0	15	0.05
Placer	0	1	1	1	0	1	2	1	0	0	7	0.19
Plumas	0	0	0	0	0	0	0	0	1	0	1	0.50
Riverside	0	0	1	4	0	4	0	2	1	1	13	0.06
Sacramento	2	2	0	1	1	1	0	0	0	0	7	0.05
San Benito	0	0	0	0	0	0	0	0	0	1	1	0.18
San Bernardino	0	0	1	0	0	2	1	0	0	1	5	0.02
San Diego	10	5	3	11	4	9	7	6	7	9	71	0.22
San Francisco	3	5	3	1	2	1	3	4	0	0	22	0.26
San Joaquin	0	0	0	0	0	0	1	0	1	0	2	0.03
San Luis Obispo	0	0	2	0	0	1	0	3	3	2	11	0.40
San Mateo	2	1	2	1	2	1	1	3	5	6	24	0.32
Santa Barbara	0	2	1	0	2	3	0	6	0	3	17	0.39
Santa Clara	8	2	2	2	6	10	4	12	4	9	59	0.32
Santa Cruz	6	4	1	7	6	9	4	7	4	8	56	2.08
Shasta	0	0	0	0	1	1	1	0	0	0	3	0.17
Sierra	0	0	0	0	0	0	1	0	0	0	1	3.11
Siskiyou	0	0	0	0	0	1	0	1	0	1	3	0.67
Solano	0	0	0	0	0	0	0	0	0	0	0	0.00
Sonoma	2	10	9	7	5	7	13	7	10	12	82	1.67
Stanislaus	0	0	1	1	0	0	0	0	1	0	3	0.06
Sutter	0	0	0	0	0	0	0	0	0	0	0	0.00
Tehama	0	0	0	0	0	0	0	0	0	0	0	0.00
Trinity	0	0	0	0	0	2	1	0	1	0	4	2.91
Tulare	0	1	0	0	0	0	1	0	0	1	3	0.07
Tuolumne	0	0	0	0	0	0	0	0	0	1	1	0.18
Ventura	0	4	2	0	1	0	2	2	0	0	11	0.13
Yolo	2	0	0	0	0	0	1	1	0	1	5	0.24
Yuba	0	0	0	1	0	0	2	0	1	0	4	0.55
<b>TOTAL</b>	<b>78</b>	<b>82</b>	<b>67</b>	<b>66</b>	<b>64</b>	<b>91</b>	<b>72</b>	<b>95</b>	<b>65</b>	<b>98</b>	<b>778</b>	<b>0.20</b>

were collated by CDPH-VBDS. Ticks were tested individually either by RT-PCR only or by direct fluorescent antibody (DFA) followed by RT-PCR (Table 3.2). From the 31 counties where ticks were tested individually, the overall prevalence of *B. burgdorferi* was 0.5% in adult ticks and 5.0% in nymphal ticks (Table 3.2). Ticks tested by local vector control agencies in pools were tested by RT-PCR (Table 3.3). In the five counties where adult ticks were tested in pools, the minimum infection prevalence (MIP = number of positive pools divided by total ticks tested multiplied by 100) was 0.6% (Table 3.3).

#### *Borrelia miyamotoi*

In 2015, of the western blacklegged ticks collected, 12,717 adult and 674 nymphal ticks were tested for *Borrelia miyamotoi*, a relapsing fever-type spirochete implicated in human disease in the eastern United States and Europe. Of the 3,496 individually tested ticks, 15 (0.4%) of the adults tested positive and 9 (1.3%) of the nymphs tested positive (Table 3.2). Of the 9,221 adult ticks tested in pools, 81 (0.9% MIP) tested positive (Table 3.3).

#### *Rickettsia philipii*

In 2015, CDPH-VBDS collected 949 adult, 3 nymphal, and 22 larval Pacific Coast ticks (*Dermacentor occidentalis*) from Butte, Calaveras, Contra Costa, El Dorado, Inyo, Kern, Los Angeles, Mendocino, Monterey, Napa, Nevada, Orange, Placer, Riverside, Sacramento, San Bernardino, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Tuolumne, Ventura, and Yuba counties for *Rickettsia philipii* testing. Tick collections were often conducted in collaboration with the local vector control agency. All ticks were tested by RT-PCR at CDPH-VRDL. Positive ticks were detected in six counties: Los Angeles (1/70 or 1.4%), Orange (12/281 or 4.3%), Riverside (1/46 or 2.2%), San Bernardino (1/280 or 0.4%), Santa Barbara (5/48 or 10.4%), and Santa Clara (3/48 or 6.3%) counties. CDPH-VBDS conducted tick surveillance in response to a previous human suspect case from Orange County.

#### *Francisella tularensis*

In 2015, CDPH-VBDS, in collaboration with Napa County MAD, conducted tick surveillance for *Francisella tularensis*, the agent of tularemia. Ticks collected from Napa County were from areas where potential tick exposure and previous human cases had been reported. Ticks were tested at the San Diego County Department of Environmental Health, Vector Control Laboratory by RT-PCR. Tested ticks included: 436 adult American dog ticks (*Dermacentor variabilis*) and 1 adult Pacific Coast tick. Four male and seven female American dog ticks (2.5% of all adult ticks) tested positive for *F. tularensis*.

Table 3.2. Infection prevalence of *Borrelia burgdorferi sensu lato* and *Borrelia miyamotoi* spirochetes in *Ixodes pacificus* ticks, California 2015

County Location	No. Ticks Tested		Positive <i>B. burgdorferi</i>		Positive <i>B. miyamotoi</i>		Collected by	Laboratory
	Adults	Nymphs	Adults (IP) <sup>a</sup>	Nymphs (IP)	Adults (IP)	Nymphs (IP)		
<b>Alameda</b>								
Redwood RP	28	26					CDPH, VBDS	CDPH, VBDS
Piedmont Pines		3					CDPH, VBDS	CDPH, VBDS
<b>Amador</b>								
Indian Grinding Rock SP	84	67	1 (1.2)	6 (9.0)		1 (1.5)	CDPH, VBDS	CDPH, VBDS
Tiger Creek Afterbay	1						CDPH, VBDS	CDPH, VBDS
<b>Butte</b>								
Loafer Creek SRA	121						CDPH, VBDS	CDPH, VBDS
<b>Calaveras</b>								
Calaveras Big Trees SP		1					CDPH, VBDS	CDPH, VBDS
Mokelumne Coast	152	4	1 (0.7)				CDPH, VBDS	CDPH, VBDS
Natural Bridge Park Trail	38	1	3 (7.9)				CDPH, VBDS	CDPH, VBDS
<b>Colusa</b>								
East Park Reservoir	3						CDPH, VBDS	CDPH, VBDS
Mendocino NF	5						CDPH, VBDS	CDPH, VBDS
<b>Contra Costa</b>								
Briones RP	3	15		1 (6.7)			CDPH, VBDS	CDPH, VBDS
Tilden RP	57	5					CDPH, VBDS	CDPH, VBDS
<b>El Dorado</b>								
Folsom SRA	380	121		13 (10.7)		1 (0.8)	CDPH, VBDS	CDPH, VBDS
<b>Inyo</b>								
Inyo NF	2						CDPH, VBDS	CDPH, VBDS
<b>Kern</b>								
Fort Tejon SP	57						CDPH, VBDS	CDPH, VBDS
<b>Los Angeles</b>								
Griffith Park	16	1					CDPH, VBDS	CDPH, VBDS
Monrovia Canyon Park	37						CDPH, VBDS	CDPH, VBDS
San Diamas Community RP	1						CDPH, VBDS	CDPH, VBDS
<b>Mariposa</b>								
Midpines	4	3					CDPH, VBDS	CDPH, VBDS
Yosemite NP	40	1					CDPH, VBDS	CDPH, VBDS
<b>Mendocino</b>								
Angelo Coast Range, UC Reserve	7	2					CDPH, VBDS	CDPH, VBDS
<b>Monterey</b>								
Garrapata SP	20						CDPH, VBDS	CDPH, VBDS
Pfeiffer Big Sur SP	48	1					CDPH, VBDS	CDPH, VBDS
<b>Napa</b>								
Angwin	69				3 (4.3)		Napa MAD; CDPH, VBDS	CDPH, VBDS
Bothe-Napa Valley SP	62	246	2 (3.2)	3 (1.2)		5 (2.0)	Napa MAD; CDPH, VBDS	CDPH, VBDS
Robert Louis Stevenson SP	54				1 (1.9)		Napa MAD; CDPH, VBDS	CDPH, VBDS
<b>Nevada</b>								
Empire Mines SP	17						CDPH, VBDS	CDPH, VBDS
Englebright Lake	50	53		2 (3.8)		2 (3.8)	CDPH, VBDS	CDPH, VBDS
<b>Orange</b>								
Cleveland NF	12						CDPH, VBDS	CDPH, VBDS
Crystal Cove SP	271		2 (0.7)				CDPH, VBDS	CDPH, VBDS
<b>Placer</b>								
Auburn SRA	76	1					CDPH, VBDS	CDPH, VBDS
<b>Riverside</b>								
Santa Rosa Plateau Ecol Reserve	99						CDPH, VBDS	CDPH, VBDS
<b>Sacramento</b>								
Folsom SRA	1						CDPH, VBDS	CDPH, VBDS
Mississippi Bar SRA	81	61	3 (3.7)	9 (14.8)			CDPH, VBDS	CDPH, VBDS
<b>San Bernardino</b>								
Devils Canyon Dam	4						CDPH, VBDS	CDPH, VBDS
Mentone	55						CDPH, VBDS	CDPH, VBDS
Penstock	39						CDPH, VBDS	CDPH, VBDS
San Bernardino NF	544	1	3 (0.6)				CDPH, VBDS	CDPH, VBDS
Wrightwood	1						CDPH, VBDS	CDPH, VBDS
<b>San Luis Obispo</b>								
Los Padres NF	243		1 (0.4)			9 (3.7)	CDPH, VBDS	CDPH, VBDS
Montana de Oro SP	55						CDPH, VBDS	CDPH, VBDS
<b>San Mateo</b>								
Huddart Park	22						SMCMVCD; CDPH, VBDS	CDPH, VBDS
<b>Santa Barbara</b>								
Los Padres NF	187						CDPH, VBDS	CDPH, VBDS
<b>Santa Clara</b>								
Ed Levin County Park	119						SCCVCD; CDPH, VBDS	CDPH, VBDS
Stevens Creek County Park	72	13					SCCVCD; CDPH, VBDS	CDPH, VBDS
<b>Santa Cruz</b>								
Capitola	38	3					Santa Cruz MVCD	CDPH, VBDS
Felton	24						Santa Cruz MVCD	CDPH, VBDS
Nisene Marks SP	28						Santa Cruz MVCD	CDPH, VBDS
<b>Shasta</b>								
Shasta-Trinity NF		26					CDPH, VBDS	CDPH, VBDS
Whiskeytown NRA		15					CDPH, VBDS	CDPH, VBDS
<b>Sierra</b>								
Tahoe NF	16						CDPH, VBDS	CDPH, VBDS
<b>Stanislaus</b>								
Del Puerto Canyon	24						CDPH, VBDS	CDPH, VBDS
<b>Tuolumne</b>								
Columbia SP	25	2					CDPH, VBDS	CDPH, VBDS
Yosemite NP	4						CDPH, VBDS	CDPH, VBDS
<b>Ventura</b>								
Los Padres NF	68						CDPH, VBDS	CDPH, VBDS
<b>Yuba</b>								
Sutter Buttes SP	6						CDPH, VBDS	CDPH, VBDS
Tahoe NF	26	2	1 (3.9)		2 (7.7)		CDPH, VBDS	CDPH, VBDS
<b>Total</b>	<b>3,496</b>	<b>674</b>	<b>17 (0.5)</b>	<b>34 (5.0)</b>	<b>15 (0.4)</b>	<b>9 (1.3)</b>		

**Table Legend**

All ticks are tested in a two-step process, unless otherwise noted. Step 1 is a direct fluorescent antibody test (DFA) for the genus *Borrelia*; if DFA is positive, then it is followed by step 2, a multiplex Real-Time Polymerase Chain Reaction (RT-PCR) for *Borrelia burgdorferi sensu lato* and *Borrelia miyamotoi*.

**Footnotes:**

<sup>a</sup>IP - Infection Prevalence = number of positive ticks divided by ticks tested multiplied by 100.  
<sup>b</sup>Tested by RT-PCR specific for *Borrelia burgdorferi sensu stricto*

**Abbreviations:**

Location:  
 NF, National Forest  
 NP, National Park  
 NRA, National Recreation Area  
 SRA, State Recreation Area  
 SP, State Park  
 RP, Regional Park  
 OSP, Open Space Preserve

Laboratory:

CDPH, VBDS, California Department of Public Health, Vector-Borne Disease Section  
 MAD, Mosquito Abatement District  
 M/S MVCD, Marin/Sonoma Mosquito and Vector Control District  
 MVCD, Mosquito & Vector Control District  
 SMCMVCD, San Mateo County Mosquito and Vector Control District  
 SCCVCD, Santa Clara County Vector Control District

**Table 3.3. Minimum infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* in *Ixodes pacificus* ticks, California 2015**

County		Positive <i>B. burgdorferi</i> Pools (MIP) <sup>b</sup>	Positive <i>B. miyamotoi</i> Pools (MIP) <sup>b</sup>	Collected by	Laboratory
Location	Adults (pools)				
<b>Placer</b>					
Auburn SRA	315 (72)	2 (0.6)	3 (1.0)	Placer MVCD	Placer MVCD
Folsom SRA	94 (21)	1 (1.1)		Placer MVCD	Placer MVCD
Hidden Falls RP	94 (20)			Placer MVCD	Placer MVCD
Placer Nature Center	24 (5)	2 (8.3)		Placer MVCD	Placer MVCD
Tahoe NF	167 (34)	7 (4.2)	3 (1.8)	Placer MVCD	Placer MVCD
<b>Sacramento<sup>a</sup></b>					
Ancil Hoffman Park	13 (7)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
East Lake Natoma Trail	288 (59)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
Folsom	16 (8)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
Gold Lake Drive	14 (9)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
Mississippi Bar	210 (46)	7 (3.3)		Sac/Yolo MVCD	Sac/Yolo MVCD
Negro Bar SP	242 (48)	8 (3.3)		Sac/Yolo MVCD	Sac/Yolo MVCD
Nimbus Dam Overlook	86 (20)	3 (3.4)		Sac/Yolo MVCD	Sac/Yolo MVCD
Snipes Pershing Park	187 (40)	5 (2.7)		Sac/Yolo MVCD	Sac/Yolo MVCD
Willow Creek	100 (23)	2 (2.0)		Sac/Yolo MVCD	Sac/Yolo MVCD
<b>Santa Clara</b>					
Alma Bridge	17 (4)	0	0	Santa Clara MVCD	Santa Clara MVCD
Almaden Quicksilver County Park	168 (36)	0	4 (2.4)	Santa Clara MVCD	Santa Clara MVCD
Alum Rock Park	191 (42)	0	1 (0.5)	Santa Clara MVCD	Santa Clara MVCD
Arastradero Preserve	241 (51)	1 (0.4)	2 (0.8)	Santa Clara MVCD	Santa Clara MVCD
Calero County Park	336 (69)	1 (0.3)	4 (1.2)	Santa Clara MVCD	Santa Clara MVCD
Ed Levin County Park	213 (47)	0	0	Santa Clara MVCD	Santa Clara MVCD
Foothills Park	314 (65)	2 (0.6)	1 (0.3)	Santa Clara MVCD	Santa Clara MVCD
Fremont Older OSP	214 (49)	0	0	Santa Clara MVCD	Santa Clara MVCD
Grant Ranch County Park	366 (77)	1 (0.3)	5 (1.4)	Santa Clara MVCD	Santa Clara MVCD
Heintz	390 (83)	0	1 (0.3)	Santa Clara MVCD	Santa Clara MVCD
Henry W. Coe SP	280 (59)	3 (1.1)	3 (1.1)	Santa Clara MVCD	Santa Clara MVCD
Lexington Dam	236 (53)	0	2 (0.9)	Santa Clara MVCD	Santa Clara MVCD
Monte Bello OSP	379 (80)	2 (0.5)	2 (0.5)	Santa Clara MVCD	Santa Clara MVCD
Mount Madonna County Park	160 (35)	1 (0.6)	2 (1.3)	Santa Clara MVCD	Santa Clara MVCD
Pichetti Ranch OSP	399 (81)	0	3 (0.8)	Santa Clara MVCD	Santa Clara MVCD
Rancho Canada del Oro OSP	173 (38)	1 (0.6)	3 (1.7)	Santa Clara MVCD	Santa Clara MVCD
Rancho San Antonio County Park and OSP	178 (41)	1 (0.6)	3 (1.7)	Santa Clara MVCD	Santa Clara MVCD
Saint Joseph's Hill OSP	56 (12)	0	1 (1.8)	Santa Clara MVCD	Santa Clara MVCD
Santa Teresa County Park	392 (85)	0	3 (0.8)	Santa Clara MVCD	Santa Clara MVCD
Sierra Azul OSP	220 (47)	0	2 (0.9)	Santa Clara MVCD	Santa Clara MVCD
Steven Creek County Park	280 (61)	0	3 (1.1)	Santa Clara MVCD	Santa Clara MVCD
Uvas Canyon County Park	160 (34)	0	0	Santa Clara MVCD	Santa Clara MVCD
<b>San Mateo</b>					
Año Nuevo SP	215 (44)	1 (0.5)	2 (0.9)	San Mateo MVCD	San Mateo MVCD
Big Canyon Park	188 (37)	0	2 (1.1)	San Mateo MVCD	San Mateo MVCD
Butano SP	30 (6)	0	0	San Mateo MVCD	San Mateo MVCD
Crystal Springs Regional Trail	180 (36)	0	1 (0.6)	San Mateo MVCD	San Mateo MVCD
Edgewood Park	174 (34)	0	2 (1.2)	San Mateo MVCD	San Mateo MVCD
Huddart Park	243 (53)	2 (0.8)	3 (1.2)	San Mateo MVCD	San Mateo MVCD
Laurelwood Park	279 (56)	1 (0.4)	3 (1.1)	San Mateo MVCD	San Mateo MVCD
Los Trancos OSP	193 (40)	1 (0.5)	4 (2.1)	San Mateo MVCD	San Mateo MVCD
Pulgas Ridge OSP	337 (68)	0	8 (2.4)	San Mateo MVCD	San Mateo MVCD
San Pedro Valley County Park	173 (45)	0	1 (0.6)	San Mateo MVCD	San Mateo MVCD
Sweeny Ridge	153 (33)	1 (0.7)	1 (0.7)	San Mateo MVCD	San Mateo MVCD
Thornewood OSP	359 (72)	3 (0.8)	7 (2.0)	San Mateo MVCD	San Mateo MVCD
Waterdog Lake Park	229 (46)	0	0	San Mateo MVCD	San Mateo MVCD
Windy Hill OSP	184 (37)	1 (0.5)	0	San Mateo MVCD	San Mateo MVCD
Wunderlich County Park	227 (45)	0	3 (1.3)	San Mateo MVCD	San Mateo MVCD
<b>Yolo<sup>a</sup></b>					
Cache Creek CG	161 (36)	1 (0.6)		Sac/Yolo MVCD	Sac/Yolo MVCD
Cache Creek, Blue Ridge Trail	186 (40)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
<b>Total</b>	<b>10,724 (2,289)</b>	<b>61 (0.6)</b>	<b>81 (0.9)</b>		

<sup>a</sup> Tested by polymerase chain reaction (PCR) specific for *Borrelia burgdorferi* sensu stricto only.

<sup>b</sup> MIP - Measure of prevalence. MIP (minimum infection prevalence) is equal to the number of positive pools divided by the number of ticks pooled multiplied by 100.

<sup>c</sup> 9,221 adult ticks tested for *Borrelia miyamotoi*

**Abbreviations:**

Location: CG, Campground NF, National Forest SP, State Park SRA, State Recreation Area RP, Regional Park OSP, Open Space Preserve  
 Laboratory: MVCD, Mosquito and Vector Control District

# 4

## Mosquito-borne Diseases



Mosquito-borne diseases under surveillance in California include the endemic arboviral diseases caused by West Nile virus, western equine encephalitis virus, and St. Louis encephalitis virus, as well as the travel-associated diseases caused by *Plasmodium* spp. (malaria), dengue, chikungunya, and Zika viruses. The California Department of Public Health, Vector-Borne Disease Section monitors and consults with local agencies regarding invasive mosquito species including *Aedes aegypti* (yellow fever mosquito) and *Aedes albopictus* (Asian tiger mosquito). Endemic arbovirus surveillance is performed under the California Arbovirus Surveillance program, a cooperative effort of multiple state and local entities.

### Human disease surveillance

#### West Nile virus

Serological diagnosis of human infection with West Nile virus (WNV) and other arboviruses was performed at the California Department of Public Health Viral and Rickettsial Disease Laboratory (CDPH-VRDL), ten local county public health laboratories, and multiple commercial laboratories. Local county laboratories tested for WNV using an IgM or IgG immunofluorescent assay (IFA) and/or an IgM enzyme immunoassay (EIA). Specimens with inconclusive results were forwarded to the CDPH-VRDL for further testing with a plaque reduction neutralization test (PRNT) or reverse transcriptase-polymerase chain reaction (RT-PCR). Additional WNV infections were identified through nucleic acid test screening performed by blood donation centers.

In 2015, a total of 783 symptomatic and 77 asymptomatic infections with WNV were identified, a 3.6% decrease in infections compared to 2014 (Table 4.1).

Of the 783 clinical cases, 198 (25%) were classified as West Nile fever and 585 (75%)

were classified as West Nile neuroinvasive disease (i.e. encephalitis, meningitis, or acute flaccid paralysis). Case-patients were residents of 31 counties and 482 (62%) were male. Incidence was highest (66.1 cases per 100,000 persons) in Glenn County (Table 4.1, Figure 4.1). The median age for West Nile fever cases was 58 years (range, 9 to 94 years), and for neuroinvasive cases was 61 years (range, 5 to 98 years). The median age of the 53 WNV-associated fatalities was 75 years (range, 44 to 98 years). Dates of symptom onset ranged from March 19 to December 4.

The number of reported human West Nile virus fatalities was higher in 2015 than in any other year since WNV was first detected in California in 2003.

No cases of western equine encephalomyelitis (WEEV) or St. Louis encephalitis (SLEV) were identified in California residents in 2015.

#### Malaria

One hundred three confirmed cases of malaria were reported to CDPH in 2015. Case-patients were residents of 20 California counties and 59 (57.8%) were male. The median age was 36 years (range, 4 to 79 years). Of the 87 cases for which the *Plasmodium* species was determined, 52 were *P. falciparum*,

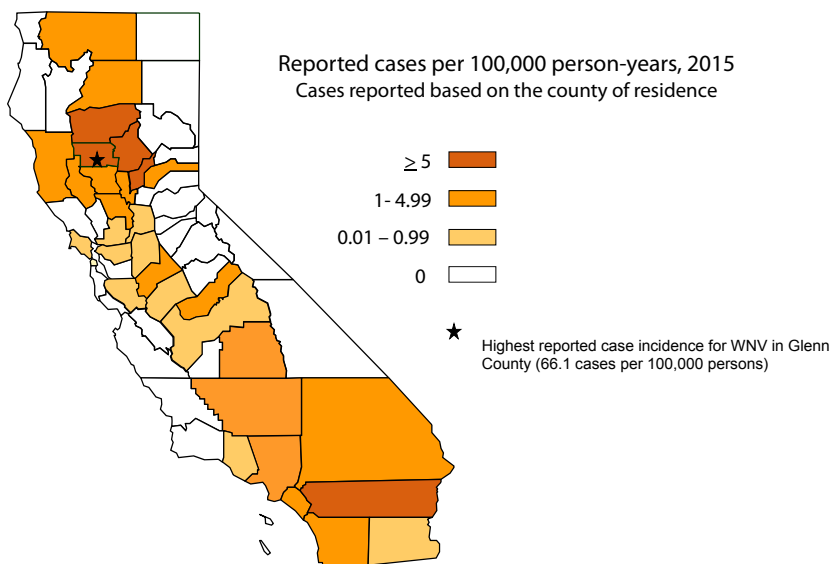


Figure 4.1. Incidence of reported human cases of West Nile virus, by county, California 2015



Table 4.1. Reported WNV human cases by county of residence, California, 2006-2015

County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2015 incidence per 100,000 person-years	10 year incidence per 100,000 person-years
Alameda	1	0	1	0	1	0	2	0	1	0	0.00	0.04
Alpine	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Amador	0	0	0	0	0	1	0	0	0	0	0.00	0.28
Butte	31	16	6	2	1	3	10	24	24	53	23.63	7.58
Calaveras	0	0	1	0	0	0	0	0	0	0	0.00	0.22
Colusa	4	2	1	0	0	0	3	2	3	1	4.61	7.37
Contra Costa	8	3	4	5	4	3	4	5	5	1	0.09	0.38
Del Norte	0	0	0	0	0	0	0	0	0	0	0.00	0.00
El Dorado	2	0	1	1	0	1	0	1	0	0	0.00	0.32
Fresno	11	17	3	13	23	9	24	8	43	8	0.82	1.64
Glenn	12	7	1	0	2	1	7	9	10	19	66.14	23.67
Humboldt	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Imperial	1	3	0	0	0	0	1	0	1	1	0.55	0.38
Inyo	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Kern	49	140	2	18	15	18	25	25	11	11	1.26	3.59
Kings	1	7	2	3	1	1	3	1	4	0	0.00	1.54
Lake	2	0	0	0	0	0	1	0	1	2	3.08	0.92
Lassen	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Los Angeles	13	36	156	20	4	58	163	151	253	286	2.82	1.12
Madera	0	2	0	1	7	2	3	3	3	4	2.57	1.60
Marin	1	0	0	0	0	0	0	2	0	1	0.39	0.15
Mariposa	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Mendocino	0	2	0	0	0	0	0	0	1	2	2.25	0.56
Merced	4	4	1	4	1	1	13	0	1	1	0.38	1.13
Modoc	2	0	0	0	0	0	0	0	0	0	0.00	2.13
Mono	1	0	0	0	0	0	0	0	0	0	0.00	0.68
Monterey	0	0	0	1	0	0	1	0	0	0	0.00	0.05
Napa	1	1	0	0	0	0	0	1	0	0	0.00	0.21
Nevada	1	0	0	0	0	0	0	0	0	2	2.04	0.31
Orange	6	9	71	4	1	10	42	10	263	92	2.92	1.61
Placer	8	4	6	0	3	1	12	6	7	0	0.00	1.27
Plumas	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Riverside	4	17	62	3	0	7	19	35	14	127	5.50	1.25
Sacramento	15	25	13	0	12	4	29	11	10	4	0.27	0.84
San Benito	0	0	0	0	0	0	0	0	0	0	0.00	0.00
San Bernardino	3	4	36	2	5	4	33	13	21	54	2.57	0.83
San Diego	1	15	35	4	0	0	1	0	11	42	1.30	0.34
San Francisco	0	0	0	0	1	0	1	1	0	0	0.00	0.04
San Joaquin	8	10	12	10	6	5	13	8	9	2	0.28	1.15
San Luis Obispo	1	0	0	0	0	0	0	0	0	0	0.00	0.04
San Mateo	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Santa Barbara	0	0	1	0	0	1	0	1	0	0	0.00	0.07
Santa Clara	5	4	1	0	0	1	0	2	10	8	0.42	0.16
Santa Cruz	0	0	0	0	0	1	0	0	0	0	0.00	0.04
Shasta	4	9	1	0	0	0	1	1	2	3	1.68	1.18
Sierra	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Siskiyou	0	0	0	0	0	0	0	0	0	1	2.22	0.22
Solano	8	1	1	0	0	0	2	1	5	1	0.23	0.44
Sonoma	0	1	0	0	0	0	0	0	0	0	0.00	0.02
Stanislaus	11	21	17	14	12	11	26	17	33	13	2.44	3.29
Sutter	12	3	0	0	0	0	8	10	8	2	2.08	4.48
Tehama	6	4	4	0	0	1	4	5	4	5	7.77	5.13
Trinity	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Tulare	6	10	5	4	12	11	7	5	21	13	2.81	2.03
Tuolumne	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Ventura	3	1	0	0	0	0	7	2	1	6	0.71	0.24
Yolo	27	2	1	2	0	0	10	6	15	8	3.82	3.39
Yuba	5	0	0	1	0	3	4	13	6	10	13.50	5.67
<b>Total WNV disease</b>	<b>278</b>	<b>380</b>	<b>445</b>	<b>112</b>	<b>111</b>	<b>158</b>	<b>479</b>	<b>379</b>	<b>801</b>	<b>783</b>	<b>2.02</b>	<b>1.01</b>
Asymptomatic Infections <sup>a</sup>	14	29	53	17	20	18	48	54	91	77		
<b>Total WNV infections</b>	<b>292</b>	<b>409</b>	<b>498</b>	<b>129</b>	<b>131</b>	<b>176</b>	<b>527</b>	<b>433</b>	<b>892</b>	<b>860</b>	<b>2.22</b>	<b>1.12</b>

<sup>a</sup> WNV infections detected through blood bank screening; no associated illness reported



28 *P. vivax*, 5 *P. malariae*, and 2 *P. ovale*. Ninety-two case-patients reported compatible travel history to malaria-endemic areas including Africa (63), Asia (12), India (10), Central America (6), and South America (1). Exposure information for 11 case-patients was not available.

### Dengue

One hundred twenty-five cases of dengue were reported to CDPH in 2015; 28 of these met the criteria for a confirmed case, and 97 were probable. Case-patients were residents of 23 California counties, 68 (54%) were female, and the median age was 37 (range 6 to 87 years). No locally acquired cases were reported. Travel region history included South East Asia (3), North America [includes Hawaii (5) and Mexico (22)], Central America (26), India (13), Caribbean (8), South America (7), Asia (2), and South Pacific (1). Exposure region was not available for two travel-associated case-patients.

### Chikungunya

Two hundred seventy-one cases of chikungunya were reported to CDPH in 2015; 65 of these met the criteria for a confirmed case and 206 were probable. Case-patients were residents of 29 California counties, 187 (69%) were female and the median age was 47 (range 1 to 87 years). No locally acquired cases were reported. All case-patients reported travel to chikungunya-endemic or outbreak areas including Latin America (249), India (12), Caribbean (3), Africa (2), and South America (1). Exposure region was not available for four travel-associated case-patients.

### Zika

Eleven cases that fit the working surveillance definition for confirmed Zika cases were identified with onset in 2015; nine (82%) were female, median age was 29 years (range 16 to 56 years). Case-

**Zika is an arboviral disease first described from east Africa in the 1950s. Transmitted by *Aedes aegypti* and *Aedes albopictus* Zika virus spread eastward in 2013-2015 to French Polynesia and to Brazil. By 2015, Zika virus had spread through South and Central America and parts of Mexico.**

patients were residents of Alameda, Los Angeles, Napa, San Diego, San Francisco, San Mateo, Santa Clara, and Sonoma counties. Areas

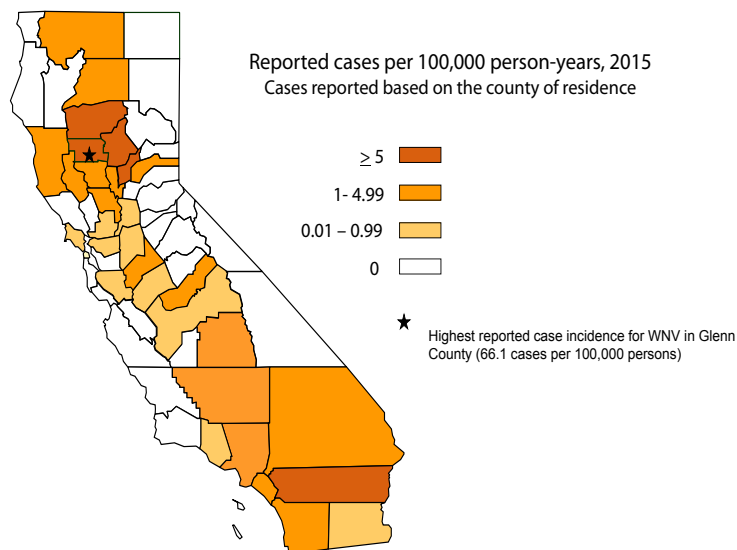


Figure 4.1. Incidence of reported human cases of West Nile virus, by county, California 2015

of travel were Brazil (2), Kiribati (1), Costa Rica (2), El Salvador (5), and Haiti (1).

### Mosquito surveillance

A total of 1,051,371 mosquitoes (38,680 pools) collected in 35 counties were tested at the University of California, Davis Arbovirus Research Training (DART) Laboratory or at one of 11 local agencies by a real-time (TaqMan) reverse transcriptase-polymerase chain reaction (qRT-PCR) for SLEV, WEEV, and/or WNV viral RNA. Three local agencies also tested an additional 23,378 mosquitoes (1,031 pools) for WNV using a commercial rapid assay-RAMP® (Rapid Analyte Measurement Platform, Response Biomedical Corp) (Table 4.2).

West Nile virus was detected in 3,329 mosquito pools from 29 counties; 3,302 were positive by qRT-PCR and 27 were positive by RAMP® only (Tables 4.2, 4.6). In addition, 38 mosquito pools from the Coachella Valley in Riverside County tested positive for SLEV. Statewide, the minimum infection rate (MIR) of WNV in all mosquitoes tested, defined as the number of infected mosquito pools divided by the total number of mosquitoes tested and multiplied by 1,000, was 3.1; the MIR was highest (9.2) in Tulare County (Table 4.2, Figure 4.2). Since 2003, the annual statewide MIR of WNV in California has ranged from a low of 0.08 in 2003 to a high of 3.9 in 2014. West Nile virus was identified from six *Culex* species (*Cx. erythrothorax*,

**Table 4.2. West Nile Virus (WNV) positive mosquito pools and minimum infection rate, by county, California 2015**

County	No. mosquitoes tested <sup>a</sup>	No. mosquito pools tested	WNV positive pools <sup>a</sup>	WNV Minimum Infection Rate <sup>b</sup>
Alameda	4,824	388	16	3.3
Alpine	0			
Amador	0			
Butte	18,604	392	94	5.1
Calaveras	0			
Colusa	0			
Contra Costa	20,942	603	8	0.4
Del Norte	0			
El Dorado	0			
Fresno	38,564	928	108	2.8
Glenn	3,143	63	21	6.7
Humboldt	0			
Imperial	0			
Inyo	0			
Kern	22,038	584	135	6.1
Kings	19,825	549	144	7.3
Lake	17,100	660	31	1.8
Lassen	0			
Los Angeles	87,141	2,566	294	3.4
Madera	8,782	349	21	2.4
Marin	1,800	105	0	0.0
Mariposa	0			
Mendocino	0			
Merced	8,723	374	8	0.9
Modoc	0			
Mono	0			
Monterey	0			
Napa	4,516	214	0	0.0
Nevada	0			
Orange	159,997	5,179	576	3.6
Placer	32,618	2,103	52	1.6
Plumas	0			
Riverside	145,746	4,720	158	1.1
Sacramento	70,098	4,568	164	2.3
San Benito	0			
San Bernardino	51,882	2,277	291	5.6
San Diego	5,256	352	46	8.8
San Francisco	75	7	0	0.0
San Joaquin	77,933	3,147	208	2.7
San Luis Obispo	192	5	0	0.0
San Mateo	1,125	204	5	4.4
Santa Barbara	8,885	222	1	0.1
Santa Clara	8,429	620	20	2.4
Santa Cruz	3,284	186	0	0.0
Shasta	16,522	551	48	2.9
Sierra	0			
Siskiyou	0			
Solano	6,935	207	6	0.9
Sonoma	15,205	595	12	0.8
Stanislaus	83,830	2,285	84	1.0
Sutter	9,503	249	54	5.7
Tehama	0			
Trinity	0			
Tulare	57,449	1,853	528	9.2
Tuolumne	0			
Ventura	1,327	32	0	0.0
Yolo	57,602	2,437	173	3.0
Yuba	4,854	137	23	4.7
<b>Total</b>	<b>1,074,749</b>	<b>39,711</b>	<b>3,329</b>	<b>3.1</b>

<sup>a</sup>Tested by University of California at Davis Center for Vectorborne Diseases or local mosquito/vector control agency.

<sup>b</sup>Minimum Infection Rate = (No. pools positive/No. mosquitoes tested) X 1,000

**Table 4.3. West Nile virus (WNV) positive mosquito pools and minimum infection rate, by mosquito species, California 2015**

Mosquito Species	No. Pools Tested	No. Mosquitoes	WNV +	Minimum Infection Rate <sup>a</sup>
<b>Culex species</b>				
<i>Cx. erraticus</i>	1	39	0	0.0
<i>Cx. erythrothorax</i>	1,490	56,224	17	0.3
<i>Cx. pipiens</i>	9,755	204,556	470	2.3
<i>Cx. quinquefasciatus</i>	14,267	427,866	1,988	4.6
<i>Cx. restuans</i>	1	18	0	0.0
<i>Cx. stigmatosoma</i>	835	12,331	43	3.5
<i>Cx. tarsalis</i>	12,542	353,833	805	2.3
<i>Cx. territans</i>	1	9	0	0.0
<i>Cx. thriambus</i>	115	427	4	9.4
unknown	3	51	0	0.0
<b>All Culex</b>	<b>39,010</b>	<b>1,055,354</b>	<b>3,327</b>	<b>3.2</b>
<b>Anopheles species</b>				
<i>An. franciscanus</i>	8	47	0	0.0
<i>An. freeborni</i>	218	5,880	0	0.0
<i>An. hermsi</i>	11	255	0	0.0
<i>An. punctipennis</i>	4	11	0	0.0
<b>All Anopheles</b>	<b>241</b>	<b>6,193</b>	<b>0</b>	<b>0.0</b>
<b>Aedes species</b>				
<i>Ae. aegypti</i>	4	48	0	0.0
<i>Ae. dorsalis</i>	9	65	0	0.0
<i>Ae. melanimom</i>	1	10	0	0.0
<i>Ae. squamiger</i>	8	59	0	0.0
<i>Ae. taeniorhynchus</i>	11	486	0	0.0
<i>Ae. vexans</i>	17	599	0	0.0
<i>Ae. washinoi</i>	16	677	0	0.0
<b>All Aedes</b>	<b>66</b>	<b>1,944</b>	<b>0</b>	<b>0.0</b>
<b>Other species</b>				
<i>Culiseta incidens</i>	267	6,362	2	0.3
<i>Culiseta inornata</i>	24	254	0	0.0
<i>Culiseta particeps</i>	20	546	0	0.0
<i>Psorophora columbiae</i>	1	11	0	0.0
Unknown	82	4,085	0	0.0
<b>All other</b>	<b>394</b>	<b>11,258</b>	<b>2</b>	<b>0.2</b>

<sup>a</sup> Minimum Infection Rate = (No. pools positive/No. mosquitoes tested) X 1,000

**St. Louis encephalitis virus re-emerged in California in 2015, with the detection of positive mosquito and sentinel chicken samples near the Salton Sea in Riverside County. This was the first detection of SLEV activity in California since 2003.**

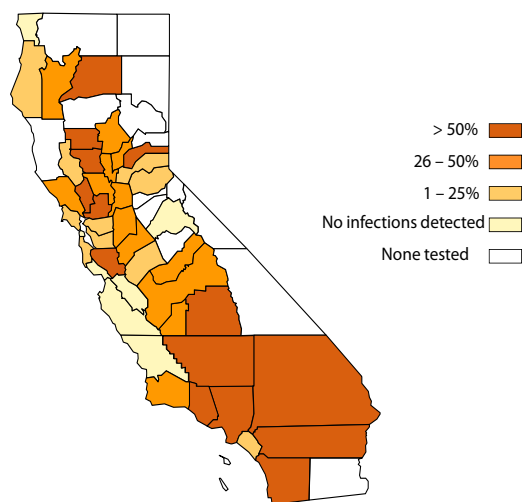
*Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. stigmatosoma*, *Cx. tarsalis*, *Cx. thriambus*), and *Culiseta incidens* (Table 4.3). St. Louis encephalitis virus was identified only in *Cx. tarsalis*. In 2015, the first detection of WNV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in Los Angeles County on March 18. The last detection of WNV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in Orange County on December 10. The first and last SLEV positive mosquitoes were collected in Riverside County on July 8 and October 6, respectively.

### Animal Surveillance

#### Chicken serosurveillance

In 2015, 35 local mosquito and vector control agencies in 31 counties maintained 164 sentinel chicken flocks (Table 4.4). Blood samples were collected from chickens every other week and tested for antibodies to SLEV, WNV, and WEEV by an EIA at the CDPH Vector-Borne Disease Section (VBDS) laboratory. Positive samples were confirmed at the CDPH-VBDS laboratory by IFA or western blot. Samples with inconclusive results were tested by PRNT at the CDPH-VRDL.

Of 13,603 chicken blood samples tested, 449 seroconversions to WNV were detected among 96 flocks in 22 counties (Tables 4.4, 4.6), and nine SLEV



**Table 4.4. Results of testing sentinel chickens for West Nile (WNV) virus, by county, California 2015**

County	No. flocks	No. chickens <sup>a</sup>	No. WNV positive flocks	WNV positive sera
Alameda	2	10	0	0
Alpine	0			
Amador	0			
Butte	7	46	7	37
Calaveras	1	10	0	0
Colusa	1	10	1	10
Contra Costa	5	50	3	18
Del Norte	0			
El Dorado	0			
Fresno	0			
Glenn	1	10	1	10
Humboldt	0			
Imperial	0			
Inyo	0			
Kern	0			
Kings	0			
Lake	2	12	2	4
Lassen	0			
Los Angeles	48	311	27	138
Madera	0			
Marin	1	6	0	0
Mariposa	0			
Mendocino	0			
Merced	8	48	8	23
Modoc	0			
Mono	0			
Monterey	2	22	0	0
Napa	0			
Nevada	4	21	2	4
Orange	0			
Placer	2	11	2	8
Plumas	0			
Riverside	15	130	6	22
Sacramento	2	10	2	2
San Benito	1	10	0	0
San Bernardino	9	72	7	36
San Diego	3	21	2	12
San Francisco	0			
San Joaquin	0			
San Luis Obispo	0			
San Mateo	3	30	0	0
Santa Barbara	5	50	0	0
Santa Clara	8	56	2	5
Santa Cruz	2	20	0	0
Shasta	7	52	4	22
Sierra	0			
Siskiyou	0			
Solano	3	36	3	7
Sonoma	2	12	0	0
Stanislaus	2	16	2	9
Sutter	6	42	6	36
Tehama	3	30	3	18
Trinity	0			
Tulare	0			
Tuolumne	0			
Ventura	5	38	2	11
Yolo	2	10	2	6
Yuba	2	14	2	11
<b>Total</b>	<b>164</b>	<b>1,216</b>	<b>96</b>	<b>449</b>

<sup>a</sup> Reflects planned standard number of chickens per flock. Actual number may vary due to mortality or replacement of seroconverted chickens.

seroconversions were detected among two flocks in Riverside County. Statewide, 37% of sentinel chickens seroconverted to WNV. Since 2003, the statewide percentage of WNV seroconversions in chickens has ranged from a low of 3.2% in 2003 to a high of 37% in 2015. In 2015, the first WNV seroconversion was detected in Placer County on June 4 and the last seroconversion was detected in Los Angeles County on November 18. The first and last SLEV seroconversions were detected on August 17 and November 9, respectively.

#### Dead bird surveillance for West Nile virus

In 2015, the WNV hotline and website received 10,850 dead bird reports from the public in 56 counties (Table 4.5). Oral swabs from dead bird carcasses were tested either at DART by qRT-PCR or at one of 15 local agencies by qRT-PCR or RAMP®. Of the 3,244 carcasses deemed suitable for testing, WNV was detected in 1,349 (42%) carcasses from 37 counties; 1,297 by qRT-PCR and 52 by RAMP® (Tables 4.5, 4.6, Figure 4.3). Since 2003, the prevalence of WNV positive dead birds has ranged from a low of 5% in 2003 to a high of 60% in 2014. In 2015, the first WNV positive dead bird was an American crow reported from Alameda County on February 3, and the last WNV positive dead bird was a red-shouldered hawk reported from San Diego County on December 29.

#### **Invasive mosquito surveillance**

*Aedes aegypti*, also known as the yellow fever mosquito, was first detected in 2013 in Madera, Fresno, and San Mateo counties with additional detections made in 2014 in Tulare, Kern, Los Angeles, and San Diego counties. In 2015, *Ae. aegypti* was discovered in Alameda, San Diego, Imperial, San Bernardino, and Orange counties and the number of cities and census-designated places quadrupled from 13 in 2014 to 52 by the end of December. *Aedes albopictus*, also known as the Asian tiger mosquito, continued to be detected in Los Angeles County since its discovery in 2011. In 2015, the number of cities and census-designated places in Los Angeles County infested with *Ae. albopictus* grew from 14 in 2014 to 24 by the end of December. *Ae. albopictus* was detected in six additional cities in Kern, San Diego, San Bernardino, and Orange

**Table 4.5. Dead birds reported, tested<sup>a</sup>, and positive for West Nile virus, by county, California 2015**

County	Reported	Tested	Positive (%)
Alameda	494	82	19 (23.2)
Alpine	0		
Amador	14	0	
Butte	322	82	38 (46.3)
Calaveras	18	0	
Colusa	8	4	3 (75.0)
Contra Costa	914	49	11 (22.5)
Del Norte	3	1	0 (0)
El Dorado	136	26	4 (15.4)
Fresno	186	10	3 (30.0)
Glenn	16	5	4 (80.0)
Humboldt	33	9	2 (22.2)
Imperial	3	0	
Inyo	3	0	
Kern	58	1	1 (100)
Kings	20	7	3 (42.9)
Lake	54	21	5 (23.8)
Lassen	6	0	
Los Angeles	1,096	164	103 (63.8)
Madera	14	3	1 (33.3)
Marin	170	14	3 (21.4)
Mariposa	9	0	
Mendocino	20	0	
Merced	114	13	3 (23.1)
Modoc	7	0	
Mono	9	0	
Monterey	37	5	0
Napa	77	11	7 (63.6)
Nevada	55	17	10 (58.8)
Orange	217	422	83 (19.8)
Placer	205	191	21 (11.0)
Plumas	4	0	
Riverside	358	110	82 (74.6)
Sacramento	1,045	363	103 (28.4)
San Benito	15	2	0
San Bernardino	264	41	25 (61.0)
San Diego	438	550	355 (64.6)
San Francisco	109	15	0
San Joaquin	279	68	18 (26.5)
San Luis Obispo	41	1	0
San Mateo	626	158	23 (14.6)
Santa Barbara	71	8	3 (37.5)
Santa Clara	1,390	357	231 (64.7)
Santa Cruz	125	43	0
Shasta	99	26	16 (61.6)
Sierra	0		
Siskiyou	5	0	
Solano	177	14	10 (71.4)
Sonoma	281	36	11 (30.6)
Stanislaus	318	44	14 (31.8)
Sutter	102	43	16 (37.2)
Tehama	27	0	
Trinity	10	6	2 (33.3)
Tulare	119	44	23 (52.3)
Tuolumne	11	2	0
Ventura	254	36	26 (72.2)
Yolo	310	124	61 (49.2)
Yuba	54	16	6 (37.5)
<b>Totals</b>	<b>10,850</b>	<b>3,244</b>	<b>1,349 (41.6)</b>

<sup>a</sup> Tested by the University of California Davis Arboviral Research and Training or local mosquito/vector control agency

counties. *Aedes notoscriptus*, a mosquito native to Australia and the southwest Pacific, was first discovered in 2014 in two Los Angeles County cities. In 2015, only one adult specimen was collected in the state.

All three invasive mosquito species are container breeders. *Aedes aegypti* and *Ae. albopictus* are the primary worldwide vectors of dengue, chikungunya, Zika, and other arboviruses. A total of 48 *Ae. aegypti* were tested for dengue, chikungunya, and West Nile viruses (Table 4.3); none were positive. Target-specific surveillance tools used for detecting presence (eggs) and capturing adult *Aedes* mosquitoes included the use of ovicups, Biogents Sentinel traps, and autocidal gravid ovitraps developed by the United States Centers for Disease Control and Prevention, Dengue Branch. Enhanced surveillance also included door-to-door property inspections. Local community education and outreach were used to mobilize residents and business owners to protect themselves against mosquito bites, report mosquitoes suspected of being invasive species, and help eliminate potential invasive mosquito larval sources on their properties.

**Table 4.6. Infections with West Nile virus in humans, dead birds, mosquito pools, and sentinel chickens, by county, California, 2015**

County	Humans <sup>a</sup>	Dead Birds	Mosquito Pools	Sentinel Chickens
Alameda	0	19	16	0
Alpine	0	NT	NT	NT
Amador	0	NT	NT	NT
Butte	58	38	94	37
Calaveras	0	NT	NT	0
Colusa	1	3	NT	10
Contra Costa	1	11	8	18
Del Norte	0	0	NT	NT
El Dorado	0	4	NT	NT
Fresno	13	3	108	NT
Glenn	21	4	21	10
Humboldt	0	2	NT	NT
Imperial	1	NT	NT	NT
Inyo	0	NT	NT	NT
Kern	12	1	135	NT
Kings	0	3	144	NT
Lake	2	5	31	4
Lassen	0	NT	NT	NT
Los Angeles	313	103	294	138
Madera	4	1	21	NT
Marin	1	3	0	0
Mariposa	0	NT	NT	NT
Mendocino	2	NT	NT	NT
Merced	2	3	8	23
Modoc	0	NT	NT	NT
Mono	0	NT	NT	NT
Monterey	0	0	NT	0
Napa	1	7	0	NT
Nevada	2	10	NT	4
Orange	97	83	576	NT
Placer	1	21	52	8
Plumas	0	NT	NT	NT
Riverside	141	82	158	22
Sacramento	6	103	164	2
San Benito	0	0	NT	0
San Bernardino	60	25	291	36
San Diego	44	355	46	12
San Francisco	0	0	0	NT
San Joaquin	2	18	208	NT
San Luis Obispo	0	0	0	NT
San Mateo	0	23	5	0
Santa Barbara	0	3	1	0
Santa Clara	8	231	20	5
Santa Cruz	0	0	0	0
Shasta	3	16	48	22
Sierra	0	NT	NT	NT
Siskiyou	1	NT	NT	NT
Solano	1	10	6	7
Sonoma	0	11	12	0
Stanislaus	13	14	84	9
Sutter	2	16	54	36
Tehama	7	NT	NT	18
Trinity	0	2	NT	NT
Tulare	15	23	528	NT
Tuolumne	0	0	NT	NT
Ventura	6	26	0	11
Yolo	9	61	173	6
Yuba	10	6	23	11
<b>State Totals</b>	<b>860</b>	<b>1,349</b>	<b>3,329</b>	<b>449</b>

<sup>a</sup>Includes asymptomatic infections detected through blood bank screening

NT= no samples tested



## 5

## U.S. Forest Service Cost-Share Agreement



**In 1992, the Vector-Borne Disease Section, California Department of Public Health, entered into a Challenge Cost-Share Agreement with the Pacific Southwest Region (Region 5) of the United States Department of Agriculture Forest Service (USFS). The agreement maintains cooperative surveillance and control of vector-borne diseases within the National Forests.**

This report highlights some of the vector-borne disease monitoring, risk assessment and reduction, and education of personnel, concessionaires, and the public that the California Department of Public Health, Vector-Borne Disease Section (CDPH-VBDS) and local collaborators conducted in the 18 National Forests in California in 2015. Surveillance results are summarized in Table 5.1.

### Angeles National Forest

Biologists from CDPH-VBDS collaborated with the Los Angeles County Vector Management Program to conduct plague surveillance at sites throughout the Forest. None of the 104 California ground squirrels (*Otospermophilus becheeyi*) sampled and tested were positive for antibodies to *Yersinia pestis*, the causative agent for plague. None of the seven carnivores tested from lands adjacent to the Forest were positive for serum antibodies to *Y. pestis*. District and Forest leadership were notified of CDPH-VBDS rodent testing results.

The Forest Safety Officer (FSO), Forest leadership, and District Rangers were reminded that CDPH-VBDS provides employees, concessionaires, and volunteers with disease prevention materials and safety education upon request. In addition, CDPH-VBDS provides disease surveillance and facility evaluations for the Forest. The FSO was reminded of and given an electronic copy of a USFS Facilitated Learning Analysis (FLA) and Job Hazard Analysis (JHA) in response to a fatal hantavirus case involving a USFS employee in Colorado. The JHA provides beneficial information and safety recommendations concerning hantavirus similar to recommendations put forth by CDPH-VBDS.

### Cleveland National Forest

Adult tick surveillance was conducted by CDPH-VBDS biologists in Holy Jim Canyon where 120 adult western blacklegged (*Ixodes pacificus*) ticks tested negative for *Borrelia burgdorferi*, the causative agent of Lyme disease. Twenty-four (18%) of 131 Pacific Coast ticks (*Dermacentor occidentalis*) from the San Juan Trail near Blue Jay campground tested positive for spotted fever group *Rickettsia* (SFGR). Of the positive ticks, three (12.5%) were characterized as infected with *Rickettsia philipii*, the causative agent of Pacific Coast tick fever. The FSO and Trabuco Ranger District staff were notified of the test results. Testing by San Diego County Vector Control Program (SDCVCP) found none of the 104 collected western blacklegged ticks positive for *B. burgdorferi* from several sites on the Forest. Plague surveillance conducted by CDPH-VBDS biologists at Blue Jay and Observatory campgrounds found all 27 California ground squirrels negative for antibodies to *Y. pestis*. In addition, 38 California ground squirrels tested by SDCVCP from other Forest locations were also negative for serum antibodies to *Y. pestis* as was the lone carnivore tested by CDPH-VBDS from lands adjacent to the Forest.

Upon request, tick-borne disease educational materials and wallet tick ID cards were provided to the FSO for redistribution to Forest and Ranger District staff. A CDPH-VBDS biologist also fulfilled a request for District volunteer safety training. The FSO, Forest leadership, and District Rangers were reminded that CDPH-VBDS provides employees, concessionaires, and volunteers with disease prevention materials and safety education upon request. In addition, CDPH-VBDS provided disease surveillance and facility evaluations for the Forest.

**Table 5.1. Testing results for selected vector-borne disease agents in U.S. National Forests, California, 2015**

National Forest	Hantavirus		<i>Yersinia pestis</i>						<i>Borrelia</i> spp. <sup>b</sup>		<i>Rickettsia</i> spp. <sup>c</sup>	
	(Peromyscus mice)		Rodents		Fleas		(carnivores) <sup>a</sup>		(Ixodes ticks)		(Dermacentor ticks)	
	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested
Angeles			0	104			0	7				
Cleveland			0	65			0	1	0	224	24	131
Eldorado	11	45	0	3								
Inyo	1	12	9	136	2	38	1	2	0	2	1	12
Klamath							0	10				
Lake Tahoe BMU			18	80	3	64						
Lassen							0	2				
Los Padres			0	37			0	17	10	200	11	76
Mendocino									3	160	1	5
Modoc							2	15				
Plumas			0	1								
San Bernardino	0	31	0	29					2	328	25	291
Sequoia			14	56	0	4						
Shasta-Trinity									0	26	0	6
Sierra			0	17			1	6				
Six Rivers	0	4										
Stanislaus							0	2				
Tahoe	4	15	0	26					3	44	0	1
<b>Total, all forests</b>	<b>16</b>	<b>107</b>	<b>41</b>	<b>554</b>	<b>5</b>	<b>106</b>	<b>4</b>	<b>62</b>	<b>18</b>	<b>984</b>	<b>62</b>	<b>522</b>

<sup>a</sup> Carnivore specimens taken directly from or adjacent to USFS lands. Because of the broad home range of some carnivores, results obtained can be inferred to a large area, including both USFS and adjacent lands.

<sup>b</sup> *Borrelia* spp. results listed here do not differentiate *Borrelia burgdorferi*, causative agent for Lyme disease, and *Borrelia miyamotoi*, a relapsing fever-type spirochete.

<sup>c</sup> *Rickettsia* spp results listed here do not differentiate between *R. philipii*, causative agent for Pacific Coast Tick Fever, and *R. rickettsii*, causative agent for Rocky Mountain spotted fever.

The FSO was reminded of and given an electronic copy of a USFS FLA and JHA as described under the Angeles National Forest.

Eldorado National Forest

Hantavirus surveillance was conducted upon request at Lumberyard Fire Station where a facility evaluation was conducted in 2014. Eight (32%) of 25 deer mice (*Peromyscus maniculatus*) were positive for serum antibodies to Sin Nombre virus (SNV), the causative agent of hantavirus pulmonary syndrome. Hantavirus and plague surveillance were conducted concurrently at Leek Springs Fire Lookout. Three (15%) of 20 deer mice were positive for serum antibodies to SNV. None of three sciurid rodents sampled were positive for serum antibodies to *Y. pestis*. Test results and protective measures to reduce hantavirus risk to personnel were communicated to

District and Forest staff. Plague Caution signs were posted at recreation sites and vector-borne disease prevention brochures and rodent carcass submission information were given to concessionaires on the Pacific and Placerville Ranger Districts. The FSO, Forest leadership, and District Rangers were reminded that CDPH-VBDS provides employees, concessionaires, and volunteers with disease prevention materials and safety education upon request, as well as providing disease surveillance and facility evaluations for the Forest. Requested safety presentations were given to Lumberyard Fire Station and Pacific Ranger District firefighting personnel. Lastly, a CDPH-VBDS biologist discussed occupational risk for Lyme disease at the Amador Ranger District.



### Inyo National Forest

The first documented evidence of western blacklegged ticks (two adults) from an Inyo National Forest (INF) campground was found at Upper Grays Meadow during routine adult tick surveillance. Neither tested positive for *Borrelia* organisms. One (8%) of 12 Pacific Coast ticks collected from the campground was positive for SFGR. Soft tick collection was conducted in collaboration with University of California, Irvine researchers at a long-term lease recreation facility with a history of repeated tick-borne relapsing fever exposures. No ticks were collected in four hours of searching. Recommendations for reducing soft tick exposure were given to the facility owner and staff. A soft tick collected by an INF employee was identified as *Ornithodoros coriaceus* by a CDPH-VBDS biologist.

CDPH-VBDS biologists conducted an environmental investigation to evaluate potential hantavirus exposure at an employee residence and work station in response to two confirmed hantavirus pulmonary syndrome cases. Eight deer mice collected adjacent to the residence were negative for serum antibodies to SNV. One (25%) of four deer mice from a case-patient's work site was positive for serum antibodies to SNV. Surveillance results and a report of findings were communicated to the District Ranger and FSO. Opportunistic plague surveillance conducted in conjunction with the hantavirus investigation found no evidence of serum antibodies to *Y. pestis* in the rodents tested from both sites. Requested hantavirus surveillance was conducted at Lee Vining Ranger Station. No mice were captured in the 50 Sherman live traps set in and around compound structures. Rodent control conducted by a private pest control operator appeared to be effective against deer mice although evidence of current woodrat infestations was noted in two structures. A hantavirus facility risk assessment was conducted at the Mono Basin Scenic Area Visitor Center with a final report of findings sent to the FSO, District leadership, Region 5 Liaison and Region Safety Officer.

Numerous plague surveillance events including visual inspections and/or rodent trapping were conducted routinely and in response to plague positive carcasses, reports of dead rodents, and anecdotal evidence of suspected plague epizootics in the eastern Sierra. Routine surveillance at Pumice Flat Group and Red's Meadow campgrounds,

Woods Lodge, and Upper Falls Tract yielded two serologically plague positive rodents, one (20%) of five rodents from Pumice Flat Group and one (17%) of six from Upper Falls Tract. One (20%) of five flea pools from Upper Falls Tract was positive by PCR for *Y. pestis*. None of the 15 rodents from Red's Meadow nor the 12 rodents from Woods Lodge were serologically positive *Y. pestis*. Collectively, 22 flea pools tested by PCR from Pumice Flat Group Campground, Red's Meadow Campground, and Woods Lodge were negative for evidence of plague bacteria. A visual inspection for plague activity at Sawmill Walk-In Campground was conducted in response to a presumptive plague positive Douglas tree squirrel (*Tamiasciurus douglasii*) carcass. Although the Douglas tree squirrel tested negative upon confirmatory testing, abandoned rodent burrows and a lack of diurnal rodents common to the region indicated a rodent die-off in the area. Plague Warning signs were posted and plague brochures were made available to campers. Visual inspections for plague activity were conducted at Saddlebag Lake and Aspen campgrounds. Normal rodent activity was noted with no reports of dead or dying rodents by the campground hosts. Follow-up plague surveillance was conducted at Saddlebag Lake and Sawmill Walk-In campgrounds. Two (13%) of 15 rodents from Saddlebag Lake were positive for serum antibodies to *Y. pestis*. None of four rodents from Sawmill Walk-in was positive. The ten flea pools tested from both locations were negative by PCR for evidence of plague bacteria. A noticeable lack of golden-mantled ground squirrels (*Callospermophilus lateralis*) and lodgepole chipmunks (*Tamias speciosus*) and abandoned rodent burrows in conjunction with reports of numerous rodents present prior to the surveillance event indicated a probable rodent die-off. Results were communicated to the District Ranger and FSO. CDPH-VBDS conducted a visual re-inspection of Saddlebag Lake Campground in response to plague positive serological test results and a campground host report of chipmunk absence noted by University of California, Davis researchers. No rodents were seen during the visit. A Plague Warning sign was posted at the campground. Due to scheduled campground seasonal closure within two weeks, no additional action was deemed necessary. Findings and recommendations were communicated to the FSO. CDPH-VBDS biologists conducted plague surveillance at New Shady Rest and Pine Glen Group campgrounds, as well as a privately

owned recreational vehicle campground on long-term leased lands, in response to a plague positive chipmunk carcass and flea pool recovered from the area. Six (14%) of 43 rodents tested were positive for serum antibodies to *Y. pestis*. Plague Warning signs were posted and plague prevention brochures were made available to recreational users in the area. The District Ranger and FSO were informed of the test results and recommendations were made for heightened awareness by Forest staff.

Additional visual inspections and plague surveillance were conducted at campgrounds in the Mono Lake Ranger District. None of 20 rodents tested at Oh! Ridge campground nor the 4 rodents sampled from Junction Campground was positive for serum antibodies to *Y. pestis*. A single rodent from Tioga Lake Campground was trapped and tested negative for serum antibodies to *Y. pestis*. A noticeable absence of rodents at Ellery Lake Campground, in conjunction with reports of numerous rodents in the area in the months preceding the surveillance event, indicated a potential rodent die-off. Results were communicated to the Ranger District and FSO. One of two carnivores tested from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*.

A CDPH-VBDS biologist contacted Forest and District leadership regarding disease prevention materials and training opportunities for staff, volunteers, and concessionaires, and presented a safety talk to employees and volunteers at the Annual All-Forest Safety Meeting in Bishop. The biologist also collaborated with the Region Safety Officer and Public Information Officer on a press release concerning plague activity in the Sierra region and responded to employee emails regarding hantavirus and rodent concerns at a private residence and staff housing.

#### Klamath National Forest

None of 10 carnivores tested from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*. A CDPH-VBDS biologist spoke with the FSO about CDPH-VBDS services provided under the Cost-Share Agreement and the variety of vector-borne disease issues potentially affecting Forest staff and visitors. The biologist sent information on training opportunities for staff and concessionaires, the availability of facility evaluations, and vector-borne disease prevention brochures and materials.

CDPH-VBDS also provided the FSO with a flash drive containing occupational safety information and safety materials on hantavirus and tick-borne diseases.

#### Lake Tahoe Basin Management Unit

A plague-positive California ground squirrel carcass from Kiva Picnic area prompted a series of responses by CDPH-VBDS biologists and collaborating agencies. CDPH-VBDS conducted an initial visual inspection of the Kiva Picnic Area, Taylor Creek Visitor Center, Fallen Leaf, and Camp Richardson campgrounds. No visual evidence of a rodent die-off was noted. Seven flea pools tested from rodent burrows swabbed at Kiva Picnic Area were negative for plague bacteria by culture. Plague Warning signs for posting and plague prevention brochures for distribution to staff and visitors were given to Lake Tahoe Basin Management Unit (LTBMU) staff. Subsequently, a golden-mantled ground squirrel carcass and one (50%) of two flea pools from Tallac Historical Site was also submitted for testing and found positive for *Y. pestis* by PCR and culture. Results were communicated to LTBMU leadership. Plague surveillance at Tallac Historical Site and Taylor Creek Visitor Center found 6 (27%) of 22 and 6 (38%) of 16 rodents, respectively, positive for serum antibodies to *Y. pestis*. None of 13 and one (5%) of 20 flea pools were positive respectively for plague bacteria by culture. Additionally, one California ground squirrel carcass from Tallac Historical Site and its associated flea pool were positive by culture for plague bacteria. Four additional rodent carcasses and two associated flea pools were negative for plague by culture. Due to the presence of plague-positive rodent carcasses and flea pools, high serological prevalence in rodents, and high flea index in live rodent captures, CDPH-VBDS recommended LTBMU leadership conduct area closures, treatment for fleas, and post visitor advisories. CDPH-VBDS biologists assisted with disease risk messaging for Unit employees. With assistance from El Dorado County Vector Control and LTBMU staff, insecticide treatment for fleas was conducted at Taylor Creek Visitor Center and surrounding affected areas. Additional plague surveillance was conducted at Fallen Leaf Campground where 4 (12%) of 33 rodents sampled were positive for serum antibodies to *Y. pestis*. None of 19 flea pools tested were culture positive for bacteria. CDPH-VBDS biologists conducted post-flea treatment assessment plague surveillance at

Tallac Historical site. Test results, field observations, and recommendations for public safety at all sites, including Fallen Leaf and Camp Richardson campgrounds, were emailed to LTBMU leadership. Final post-treatment plague surveillance was conducted at Tallac Historical Site and Taylor Creek Visitor Center. None of three rodent samples was positive for serum antibodies to *Y. pestis*. Rodent bait stations were removed and 600 plague prevention brochures were given to staff for distribution to the public. A CDPH-VBDS biologist sent reports summarizing rodent trapping, plague testing results, and flea treatment at Taylor Creek Visitor Center, Tallac Historic Site, and Fallen Leaf Campground to the Management Unit Supervisor, FSO, Recreation Staff Officer, Recreation Specialist, Region Safety Officer, and Pesticide Use Specialist.

The Supervisor's Office was reminded that under the Cost-Share Agreement, CDPH-VBDS provides employees, concessionaires, and volunteers with disease prevention materials and safety education upon request, as well as disease surveillance and facility evaluations. A biologist contacted the Recreation Supervisor via email to offer assistance with pre-season training and mailed 50 laminated Plague Caution signs upon request. The biologist presented a safety talk to California Land Management employees and scheduled direct surveillance for hantavirus risk assessment with the Recreation Officer.

#### Lassen National Forest

Neither of the two carnivores tested from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*. Visual plague assessments were conducted on the Almanor and Hat Creek Ranger Districts. Plague Caution signs were posted throughout Battle Creek Campground and a CDPH-VBDS biologist discussed plague and hantavirus risks with the campground concessionaires. None of the areas visited showed evidence of plague activity. A CDPH-VBDS biologist spoke with the Almanor District Ranger regarding ongoing rodent and bat issues at District facilities, and contacted the FSO to inform Forest leadership about disease prevention training opportunities for staff and concessionaires, facility evaluations, and availability of vector-borne disease prevention brochures and materials. CDPH-VBDS also provided the FSO with a flash drive containing occupational safety information and safety materials

on hantavirus and tick-borne diseases.

#### Los Padres National Forest

CDPH-VBDS biologists and collaborators from the Mosquito and Vector Management District of Santa Barbara County and Ventura County Environmental Health Department conducted adult tick surveillance on the Santa Barbara, Santa Lucia, and Ojai Ranger Districts and collected 200 western blacklegged ticks. One (0.5%) western blacklegged tick was positive for *B. burgdorferi* and 9 (5%) were positive for *B. miyamotoi*. Three (10%) of 31 Pacific Coast ticks from Romero Canyon and 2 (29%) of 7 Pacific Coast ticks from Snyder Trails were positive for *R. philipii*. One (20%) of 5, 1 (50%) of 2, and 3 (10%) of 31 Pacific Coast ticks from Cerro Alto, Rinconada, and Romero Canyon Trails, respectively, were positive for SFGR. Testing results were reported to the FSO and responsible District staff.

In collaboration with the Ventura County Environmental Health Department, plague surveillance was conducted at campgrounds on the Mt. Pinos and Santa Lucia Ranger Districts. None of the 37 sciurid rodents tested were positive for serum antibodies to *Y. pestis*. Test results were communicated to responsible parties at the Forest and District levels. None of the 17 carnivores tested from lands adjacent to the Forest were positive for serum antibodies to *Y. pestis*.

A CDPH-VBDS biologist requested the FSO inform Forest leadership of disease prevention training opportunities for staff and concessionaires, facility evaluations, and availability of vector-borne disease prevention brochures and materials. The biologist provided the Mt. Pinos Ranger District with disease prevention brochures and spoke with the Resource Officer regarding any issues or questions concerning vector-borne diseases in the District.

#### Mendocino National Forest

CDPH-VBDS biologists conducted adult tick surveillance along Ivory Mill Road. One hundred-sixty western blacklegged ticks and five Pacific Coast ticks were collected. Of the western blacklegged ticks, two (1%) tested positive for *B. burgdorferi* and one (0.6%) tested positive for *B. miyamotoi*. Visual plague assessments were conducted and Plague Caution signs were posted at several campgrounds on the Grindstone Ranger District. CDPH-VBDS

visited the Grindstone Ranger District Office and Stoneyford Work Center to discuss vector-borne disease issues with staff and deliver vector-borne disease prevention brochures and tick identification (ID) cards. A biologist asked the FSO to inform Forest leadership that the Cost-Share Agreement provides disease prevention training opportunities for staff and concessionaires, facility evaluations, and vector-borne disease prevention brochures and materials. A biologist sent the FSO a breakdown of the vector-borne disease safety information contained on a flash drive provided to the Forest.

#### Modoc National Forest

Two (13%) of 15 carnivores from lands adjacent to the Forest tested positive for serum antibodies to *Y. pestis*. CDPH-VBDS provided the Supervisor's Office and Big Valley Ranger District with vector-borne disease prevention brochures and tick ID wallet cards for distribution to USFS personnel and visitors. The FSO was informed of disease prevention training opportunities for staff and concessionaires, facility evaluations, and availability of vector-borne disease prevention brochures and materials.

#### Plumas National Forest

A woodrat carcass from Forest lands tested negative by culture for *Y. pestis*. A CDPH-VBDS biologist conducted visual plague assessments and posted Plague Caution signs at recreation sites, and spoke with the campground host at Gold Lake Campground about vector-borne diseases. The biologist contacted and/or visited the Supervisor and District Ranger offices to provide information about plague activity and rodent carcass submission instructions as well as provide vector-borne disease prevention brochures and training materials.

#### San Bernardino National Forest

Tick collection was conducted at recreation locations throughout the Forest by a CDPH-VBDS biologist and staff from the San Bernardino County Mosquito and Vector Control Program (SBCVCP). Two (0.6%) of 328 western blacklegged ticks tested positive for *B. burgdorferi*. One (0.3%) of 291 Pacific Coast ticks was positive for *R. philipii* and 24 (8%) of 291 Pacific Coast ticks were positive for SFGR. Thirty-one and 29 rodents tested negative for serum antibodies to SNV or *Y. pestis*, respectively, in collaboration with SBCMVC and Riverside County Environmental

Health Vector Control Program.

A CDPH-VBDS biologist assisted the Front Country Ranger District wildlife biologist with small rodent trapping in a survey for the white-eared pocket mouse (*Perognathus alticolus*). Rodent identification and safe handling techniques focusing on hantavirus risk minimization were emphasized. A requested facility walk-through was conducted to assess risk for hantavirus. The FSO, Front Country, and San Jacinto Ranger Districts were informed of the vector-borne disease surveillance, education, and risk evaluation services provided under the Cost-Share Agreement and encouraged to contact CDPH-VBDS with any questions, concerns, or requests for service. Upon request, a wildlife biologist with the Front Country Ranger District was given information on various filtering mask efficiencies.

#### Sequoia National Forest

CDPH-VBDS biologists visited Frog Meadow Guard Station where a cabin was associated with several cases of tick-borne relapsing fever in 2014. CO<sub>2</sub> traps were set in an unsuccessful attempt to capture soft ticks. The responsible Recreation Supervisor was reminded of the continuing risk for tick-borne relapsing fever at the location. The Western Divide and Kern River Ranger Districts were informed of plague surveillance conducted at several campgrounds on the Forest. Fourteen (47%) of 29 rodents from two surveillance events at Troy Meadow Campground were positive for serum antibodies to *Y. pestis*. Four flea pools were negative by PCR for plague bacteria. Results were communicated to the District Ranger, FSO, and Blackrock Information Station, and the campground was posted with Plague Warning signs and provided educational brochures. At Fairview and Fish Creek campgrounds, none of 22 and none of five rodents tested respectively, were positive for serum antibodies to *Y. pestis*. Campgrounds along the Western Divide Highway, Highway 190, and along the Kern River were posted with Plague Caution signs.

The FSO and District Rangers were informed of the vector-borne disease surveillance, education, and risk evaluation services for employees and concessionaires provided under the Cost-Share Agreement, and were encouraged to contact CDPH-



VBDS with any questions, concerns, or requests for service. Staff at the Johnsondale and Peppermint Work Stations were provided with vector-borne disease safety and disease prevention brochures and materials. The Hume Lake District Ranger was given vector-borne disease safety and disease prevention brochures and materials upon request.

#### Shasta-Trinity National Forest

Twenty-six nymphal western blacklegged ticks collected and tested from the McCloud Bridge and Hirz Bay campgrounds were negative for *Borrelia* organisms. Six Pacific Coast ticks collected from Hirz Bay Campground were negative for *Rickettsia* spp. A CDPH-VBDS biologist conducted a hantavirus facility assessment upon request at the District office with a final report to be sent to the FSO and District leadership. The biologist also met with the FSO to discuss vector-borne disease issues on the Forest and services provided under the Cost-Share Agreement, and gave a breakdown of the vector-borne disease safety information contained on a flash drive provided to the Forest. The Hat Creek Ranger District staff was provided vector-borne disease prevention and safety brochures and tick wallet cards for distribution to USFS personnel and visitors.

#### Sierra National Forest

CDPH-VBDS biologists conducted plague surveillance at College and Rancheria campgrounds on the High Sierra Ranger District. None of the 17 sciurid rodents tested was positive for serum antibodies to *Y. pestis*. Results were communicated to the District and FSO. One (17%) of 6 carnivores from lands adjacent to the Forest was positive for plague antibodies. A biologist notified Forest leadership regarding the travel history of a human plague case with low potential of exposure on the Forest. The High Sierra District wildlife biologist was notified of the intent to conduct plague surveillance and a CDPH-VBDS biologist visited the District office and provided contact information and vector-borne disease prevention brochures.

#### Six Rivers National Forest

Hantavirus surveillance and facility assessments were conducted at the Mad River District Fire Cache and Hot Shot crew barracks. None of the four deer mice sampled was positive for serum antibodies to

SNV. Results were communicated to the District. A CDPH-VBDS biologist visited the Supervisor's Office, Orleans Ranger District, and Gasquet Ranger Station where contact information, vector-borne disease prevention brochures, tick ID cards, and occupational health posters for tick-borne diseases and hantavirus were provided to staff. The FSO was contacted to inform Forest leadership of disease prevention training opportunities for staff and concessionaires, facility evaluations, and availability of vector-borne disease prevention brochures and materials. The FSO was also given a flash drive containing occupational safety information on hantavirus and tick-borne disease prevention.

#### Stanislaus National Forest

Neither of the two carnivores tested from lands adjacent to the Forest was positive for antibodies to *Y. pestis*. The Summit Ranger District and FSO were provided information on a human plague case with travel history and low exposure potential on the District. A visual plague assessment was subsequently conducted at Rainbow Pool. Plague Caution signs were posted at recreation sites throughout the Calaveras, Mi-Wok, and Summit Ranger Districts, concessionaires, when present, were supplied with vector-borne disease prevention brochures, rodent carcass submission protocol for plague testing, and CDPH-VBDS biologist contact information.

Upon request, safety presentations covering vector-borne disease awareness and prevention were given to staff on the Calaveras, Groveland, and Mi-Wok Ranger Districts. Leadership at the Supervisor's Office and Ranger Districts were contacted to remind staff of disease prevention training opportunities for employees and concessionaires, facility evaluations, and the availability of vector-borne disease prevention brochures and materials. The Supervisor's Office, Groveland and Mi-Wok, Ranger Districts, and Pinecrest Ranger Station were visited to ensure sufficient supplies of vector-borne disease prevention brochures and materials for staff and visitors.

#### Tahoe National Forest

CDPH-VBDS biologists conducted tick surveillance on the American River and Yuba River Ranger Districts. Forty-four western blacklegged ticks from the Yuba River Ranger District were tested for *Borrelia*

organisms. One (2%) was positive for *B. burgdorferi* and two (5%) were positive *B. miyamotoi* organisms. The single Pacific Coast tick collected and tested was negative for *Rickettsia* spp. Combined hantavirus and plague surveillance was conducted at Boca Reservoir, Granite Flat, and Silver Creek campgrounds. Two (20%) of 10, two (100%) of two and none of three *Peromyscus* mice from the campgrounds, respectively, were positive for serum antibodies to SNV. None of the 26 sciurid rodents tested were positive for serum antibodies to *Y. pestis*. Test results were submitted to the Truckee Ranger District leadership and the FSO. Requested hantavirus facility risk assessments were conducted at French Meadows and Sugar Pine Reservoirs with reports and findings submitted to District, Forest and Region leadership. Visual plague assessments were conducted and Plague Caution signs were posted at recreation areas on the Downieville Ranger District.

Vector-borne disease awareness and prevention presentations were given to American River, Sierraville, Truckee, and Yuba River Ranger District staff. The FSO and District Ranger staff were reminded of disease prevention training opportunities, facility evaluations, and availability of vector-borne disease prevention brochures and materials available under the Cost-Share Agreement. The Truckee Ranger District was provided vector-borne disease prevention brochures, tick ID cards, and the rodent carcass submission protocol for plague testing. Upon request, a CDPH-VBDS biologist attended the Yuba River Ranger District safety committee meeting to plan occupational safety day activities.

#### Other R5 Activities

CDPH-VBDS responded to an R5 Occupational Health and Safety Officer report of nuisance day-biting mosquitoes at Mare Island with information and follow-up with Solano County Mosquito Abatement District. A Travel Alert/Health Advisory concerning chikungunya and dengue cases in Mexico was relayed to Region leadership safety staff. The R5 Safety Officer requested comments and edits to a safety article regarding tick bites. Completed hantavirus facility assessments were sent to the R5 Safety Officer and contract liaison. A pre-season safety letter emphasizing tick-borne relapsing fever and plague awareness and protocols for submitting dead rodents for plague testing was sent to the R5

liaison and the R5 Safety Officer for distribution throughout the Region. Region leadership was kept informed of the increased plague risk and activity in the Sierra region forests.

CDPH-VBDS staff met with the R5 Cost-Share Agreement liaison and R5 Safety Officer to review past activities and plan future activities beneficial to both parties in accordance with the Cost-Share Agreement. The 2014 Annual and 2015 Quarterly Reports of Activities and Annual Pesticide Use report were provided to the Region along with updated contact lists for CDPH-VBDS biologists. The Region Headquarters and FSOs were provided with flash drives developed specifically for R5, containing vector-borne disease prevention, occupational health and safety training information, and tutorials for hantavirus and tick-borne diseases.

**2015 saw a surge in plague-positive rodents and associated flea pools. The number of serologically positive rodents and carnivores and bacteriologically positive flea pools and rodent carcasses was the highest since the implementation of the Cost-Share Agreement in 1992. Reasons for these major and minor plague epizootics in the Sierra Nevada at numerous locations along a 220 mile transect, from Troy Meadow Campground in the south, to the Lake Tahoe Basin Management Unit in the north, are unknown.**

## 6

## Vector Control Technician Certification Program



**The California Health and Safety Code, § 106925, requires every government agency employee who handles, applies, or supervises the use of any pesticide for public health purposes to be certified by the California Department of Public Health. The Vector-Borne Disease Section administers the Public Health Vector Control Technician certification examination twice each year (May and November) to certify the competence of government agency personnel to control vectors for the health and safety of the public.**

To become certified in a control category, applicants must pass the Core section and at least one Specialty section of the examination. Each applicant to the examination pays a fee for each section requested on the application. The Core section consists of questions about the safe and effective use of pesticides. Specialty sections of the examination include the Biology and Control of Mosquitoes in California, Arthropods of Public Health Significance in California, and Vertebrates of Public Health Importance in California (Table 6.1). Successful examinees are issued a gold certification card that is valid for up to two years in the qualified categories specified on the card. To maintain full certification status in subsequent two-year cycles, Certified Technician employees must pay annual renewal fees and fulfill minimum continuing education requirements. The California Department of Public Health (CDPH), Vector-Borne Disease Section approved 142 continuing education events in 2015. Successful examinees that elect not to participate in continuing education are issued parchment certificates in the categories in which they qualified. These Certified Technicians (Limited) employees may use pesticides only under the direct supervision of a Certified Technician.

Through 2015, 1,263 Vector Control Technicians employed at 112 local public health agencies and the CDPH held 2,981 certificates (Table 6.2). The agencies include special districts, departments of county government, departments of city government, the University of California, and CDPH. Of these agencies, 76 are signatory to a cooperative agreement with CDPH.

In 2015, 874 individuals employed at 76 agencies held full certification status. In addition, 390 employees from 55 agencies held limited status. Many agencies employ technicians with both full and limited status.

Vector Control Technicians can view their certification records and the approved Vector Control continuing education courses at: <http://ce.calsurv.org>. All training manuals, as well as practice questions and the Continuing Education Guide, are posted on the website dedicated to the Vector Control Technician Program: <http://www.cdph.ca.gov/certlic/occupations/Pages/VectorControlTechnicianProgram.aspx>.



**Table 6.1. Results of certification examinations administered in 2015.**

<b>Exam section</b>	<b>No. Exams Given</b>	<b>No. Passed (%)</b>
Core	134	102 (76)
Mosquito Control	140	84 (60)
Terrestrial Invertebrate Control	88	53 (60)
Vertebrate Vector Control	88	64 (73)
<b>Totals</b>	<b>450</b>	<b>303 (67)</b>

**Table 6.2. Vector Control Technician certificates in effect as of December 2015**

<b>Certification Category</b>	<b>No. Certificates</b>		
	<b>Full Status</b>	<b>Limited Status</b>	<b>Total</b>
Mosquito Control	862	243	1,105
Terrestrial Invertebrate Vector Control	667	214	881
Vertebrate Vector Control	683	312	995
<b>Totals</b>	<b>2,212</b>	<b>769</b>	<b>2,981</b>

## 7

# Public Information Materials, Publications



**A goal of the California Department of Public Health Vector-Borne Disease Section is to provide clear and effective information on disease prevention. This goal is pursued through a variety of approaches including giving presentations, developing and distributing printed and electronic materials, and maintaining websites with up-to-date information. Research projects in which the California Department of Public Health Vector-borne Disease Section was a principal or collaborating investigator are published in peer-reviewed scientific literature.**

## Public Information Materials

In 2015, new public education materials as listed below were created and distributed. To find information on a specific vector or disease, go to <http://www.cdph.ca.gov> and enter a term in the "search" box. All public education materials are available from the California Department of Public Health, Vector-Borne Disease Section webpage:

- *Interactive Map of Rodent Plague Surveillance in California* (May 2015, map)
- *Distribution Map of 54 Reported Cases of HPS in California Residents by Most Likely County of Exposure, Through December 2014* (June 2015, map)
- Toolkit: Hantavirus - Reducing Your Risk of Exposure (June 2015, toolkit webpage)
- Tick-Borne Diseases: Occupational Health Toolkit (June 2015, toolkit webpage)
- "Don't Let the Ticks Bite" Toolkit (June 2015, toolkit webpage)
- *Quick Guide to Ticks and Diseases They Transmit* (July 2015, flier)
- *Prevenga las Picaduras de Garrapatas - Prevenga Enfermedades* (August 2015, brochure)
- *Prevent Tick Bites - Prevent Disease* (August 2015, brochure)
- Occupational Health Vector-Borne Disease Prevention Flashdrives for Region 5 - United States Forest Service (R5-USFS.)

**Vector-Borne Disease Section flash drives were created for R5-USFS Safety Officers. These contain occupational safety information and safety materials on hantavirus and tick-borne diseases including videos and allow for use in areas with no internet access.**

## Publications\*

**Feiszli, T; Padgett, K;** Simpson, J; Barker, CM; Fang, Y; Reisen, WK; Salas M; **Foss, L;** Messenger S; and **Kramer, V.** Surveillance for Mosquito-borne Encephalitis Virus Activity in California, 2014. Proceedings and Papers of the 83st Annual Conference of the Mosquito and Vector Control Association of California, 2015 83: 98-104.

**Foss L, Padgett K,** Reisen WK, **Kjemtrup A,** Ogawa J, **Kramer V.** West Nile Virus-Related Trends In Avian Mortality In California, USA. 2003-2012. J Wildl Dis. 2015; 51 (3):576-588.

Forrester JD, **Kjemtrup AM,** Fritz CL, Marsden-Haug N, Nichols JB, Tengelsen LA, Sowadsky R, DeBess E, Cieslak PR, Weiss J, Evert N, Ettestad P, Smelser C, Iralu J, Nett RJ, Mosher E, Baker JS, Van Houten C, Thorp E, Geissler AL, Kugeler K, Mead P. Centers for Disease Control and Prevention (CDC). Tickborne relapsing fever - United States, 1990-2011. MMWR Morb Mortal Wkly Rep. 2015 Jan 30;64(3):58-60.

Healy JM, Reisen W, **Kramer VL,** Fischer M, Lindsey NP, Nasci RS, Macedo PA, White G, Takahashi R, Khang L, Barker CM. Comparison of the efficiency and cost of West Nile virus surveillance methods in California. Vectorborne Zoonotic Dis. 2015; (15)2:147-155.

Kwit N, Nelson C, Kugeler K, Petersen J, Plante L, Yaglom H, **Kramer V,** Schwartz B, House J, Colton L, Feldpausch A, Drenzek C, Baumbach J, DiMenna M, Fisher E, Debess E, Buttke D, Weinburke M, Percy C, Schriefer M, Gage K, Mead P. Human Plague - United States, 2015. MMWR Morb Mortal Wkly Rep. 2015 Aug 28; 64(33):918-9.

**Porse CC, Kramer V, Yoshimizu MH, Metzger M, Hu R, Padgett K,** Vugia DJ. Public Health Response to *Aedes aegypti* and *Ae. albopictus* Mosquitoes Invading California, USA. Emerg Infect Dis. 2015 Oct; 21(10):1827-9.

Salkeld D, **Padgett KA,** Jones, JH, Antolin, MF. A Public Health Perspective on Patterns of Biodiversity and Zoonotic Disease [Letter]. Proc Nat Acad Sci. 2015 Oct; 112 (146).

\*Bolded names are members of VBDS staff









California Department of Public Health, Vector-Borne Disease Section, 1616 Capitol Avenue, MS 7307, P.O. Box 997377, Sacramento, CA 95899-7377  
VBDS@cdph.ca.gov, 916-552-9730, www.cdph.ca.gov/programs/vbds

---

