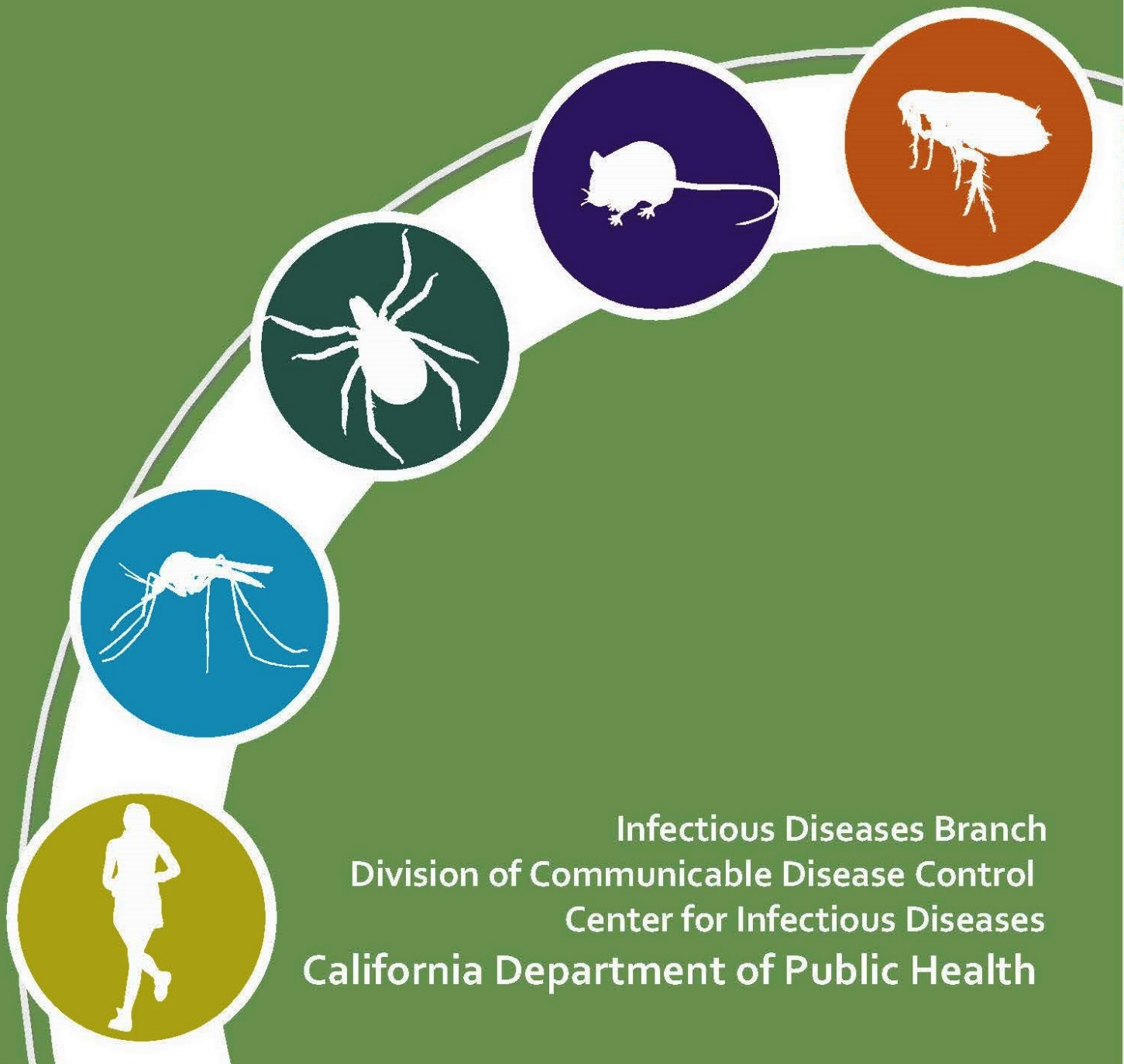
Vector-Borne Disease Section
Annual Report 2016



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

2016

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

INFECTIOUS DISEASES BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CENTER FOR INFECTIOUS DISEASES

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

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State of California

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California Health & Human Services Agency

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Health and Human Services Agency

California Department of PublicHealth

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

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Preface

I am pleased to present to you the 2016 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 2016.

In 2016, Zika dominated the headlines. CDPH worked with local public health and vector control agencies extensively to respond to this emerging disease threat. Primarily transmitted by *Aedes aegypti* mosquitoes, Zika virus can also be transmitted sexually, via blood transfusion, and from mother to baby during pregnancy. Of particular concern, Zika infection during pregnancy can cause microcephaly and other severe birth defects. In California through the end of 2016, 486 travel-associated Zika cases were reported, most with prior travel to Latin America. No mosquito-borne transmission of Zika was detected in California, although the mosquito vectors of Zika virus, *Aedes aegypti* and *Aedes albopictus*, continued to expand their range, particularly in southern California and parts of the Central Valley. By the end of 2015, these species had been detected in 85 cities or census-designated places (CDPs), whereas through the end of 2016, they were found in 127 cities/CDPs. Fortunately neither *Aedes aegypti* nor *Aedes albopictus* were found in new counties in 2016.

For most Californians, West Nile virus poses the greatest mosquito-borne disease threat. In 2016, 442 cases were reported from 30 counties, including 19 fatalities. The number of cases was fewer than in the preceding two years, with case numbers peaking about five weeks earlier than average, perhaps due to cooler than usual fall temperatures. After a period of no detectable activity from 2004 through 2014, St. Louis encephalitis virus (SLEV) reemerged in 2015 in one county and in 2016 was detected in mosquitoes and/or sentinel chickens in eight counties. Three human cases of SLEV infection were reported from Fresno, Kern, and Sacramento counties: these were the first human SLEV cases detected in California since 1997.

Human cases of six tick-borne diseases were reported in California in 2016, including 13 cases of tick-borne relapsing fever (TBRF). Follow-up of several TBRF cases required an environmental investigation to reduce exposure risk to future occupants of these primarily rural, high-elevation cabins and facilities. Non-human plague and hantavirus activity was detected in rodents in many regions of California. One fatal human hantavirus case was reported in 2016 in a Los Angeles County resident. Elevated plague activity in campgrounds in two counties prompted VBDS to initiate flea control to mitigate plague transmission risk. VBDS continued to provide extensive consultation and training to United States Forest Service and National Park Service 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, PhD, 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, universities 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 2016 are listed here.

Rodent-borne Diseases

Alameda County Vector Control Services District; County of San Diego Vector Control Program (VCP); Los Angeles County Department of Public Health-Vector Management Program; National Park Service (NPS); Northwest Mosquito and Vector Control District (MVCD); Orange County MVCD; Riverside County Department of Environmental Health VCP; San Bernardino County VCP; San Mateo MVCD; United States Forest Service (USFS).

Flea-borne Diseases

Centers for Disease Control and Prevention (CDC); County of El Dorado, Environmental Management Division; Los Angeles County Agricultural Commissioner; Los Angeles County Department of Health-Vector Management Program; Nevada County Environmental Health Department (EHD); NPS; Riverside County VCP; San Diego VCP; San Mateo MVCD; United States Department of Agriculture Animal and Plant Health Inspection Service, Wildlife Services; USFS; University of California Berkeley.

Tick-borne Diseases

Butte County MVCD; University of California, Davis (UCD) Arbovirus Research Training (DART) Laboratory; Marin County Health and Human Services; Marin-Sonoma MVCD; Napa County Mosquito Abatement District; NPS; Northern Arizona University; 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; USFS; Ventura County EHD.

Mosquito-borne Diseases

California Department of Fish and Wildlife; UCD-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

Center for Infectious Diseases
Gil Chavez MD MPH.

Division of Communicable Disease Control
James Watt MD MPH; Todd Stolp MD.

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; Elizabeth Andrews PhD; Mary Beth Danforth PhD; 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; Jesse Erandio; Tina Feiszli MSPH; Leslie Foss MS; Margaret Kerrigan; Gordon Lau; Kelly Liebman PhD; Mary-Joyce Pakingan; Robert Payne; Skyler Valle; Aidan Ward; Melissa Yoshimizu PhD.
Interns: Rebecca Clason, Julia Jenssen, Nikki Johnson, Jenna Koontz, Heather Lockerbie, Elizabeth Mooney, Allyx Nicolici.

Veterinary Public Health Section
Curtis Fritz DVM MPVM PhD; Rebecca Campagna DVM MPH.

Viral and Rickettsial Disease Laboratory
Dongxiang Xia MD PhD; Sharon Messenger 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; Mary Kate Morris PhD; Artem Muradyan PHM; Leo Oceguera 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
Heike Quinn; John Crandall; Yismashoa Gebremichael; Chau-Linda Truong.

Center for Family Health
Connie Mitchell MD MPH; Karen Ramstrom DO MSPH; Olga Barer BS; Monica Lehman RN MSN MPH; Richard Olney MD MPH; Similoluwa Sowunmi MPH; Barbara Warmerdam.

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Chapters

Many staff from the Vector-Borne Disease Section contribute to each chapter of the Annual Report; however, only the lead author(s) for each chapter is listed below.

1 Rodent-borne Diseases
Jackson B. Chapter 1: Rodent-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2016. California Department of Public Health, Sacramento, California, 2017. Pp 1-3.

2 Flea-borne Diseases
Tucker J and Porse C. Chapter 2: Flea-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2016. California Department of Public Health, Sacramento, California, 2017. Pp 4-7.

3 Tick-borne Diseases
Yoshimizu M; Kjemtrup A and Porse C. Chapter 3: Tick-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2016. California Department of Public Health, Sacramento, California, 2017. Pp 8-13.

4 Mosquito-Borne Diseases
Feiszli T; Wong J; Porse C and Metzger, M. Chapter 4: Mosquito-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2016. California Department of Public Health, Sacramento, California, 2017. Pp 14-21.

5 U.S. Forest Service Cost-Share Agreement
Burns J. Chapter 5: U.S. Forest Service Cost-Share Agreement. In: Vector-Borne Disease Section Annual Report, 2016. California Department of Public Health, Sacramento, California, 2017. Pp 22-29.

6 Vector Control Technician Certification Program
Niemela M. Chapter 6: Vector Control Technician Certification Program In: Vector-Borne Disease Section Annual Report, 2016. California Department of Public Health, Sacramento, California, 2017. Pp 30-31.

7 Public Information Materials, Publications
Erickson C and Kjemtrup A. Chapter 7: Public Information Materials, Publications. In: Vector-Borne Disease Section Annual Report, 2016. California Department of Public Health, Sacramento, California, 2017. Pp 30-31.

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) 116100-116108; 116110-116112; 116120; 116180; and 116130]. 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 vector-borne diseases and vectors, such as West Nile virus, Zika, chikungunya, dengue, and invasive *Aedes* mosquitoes
- Provide laboratory and proficiency testing for vector-borne disease agents in arthropods and vertebrates and testing for pesticide resistance in 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 2016, hantavirus pulmonary syndrome (HPS) was diagnosed in one Los Angeles County resident. The case-patient was an adult male who did not survive the infection. The case-patient had not traveled outside his county of residence during the six weeks prior to onset of illness. California Department of Public Health, Vector-Borne Disease Section (CDPH-VBDS) and Los Angeles County Department of Public Health-Vector Management Program (LACDPH-VMP) investigators collected 16 deer mice (*Peromyscus maniculatus*) from the case-patient's residence; none had serum antibodies to Sin Nombre virus (SNV). Since 1980, HPS has been diagnosed in 72 California residents, with SNV exposure of most case-patients identified from the interior mountain ranges of the state or eastern Sierra (Figure 1.1).

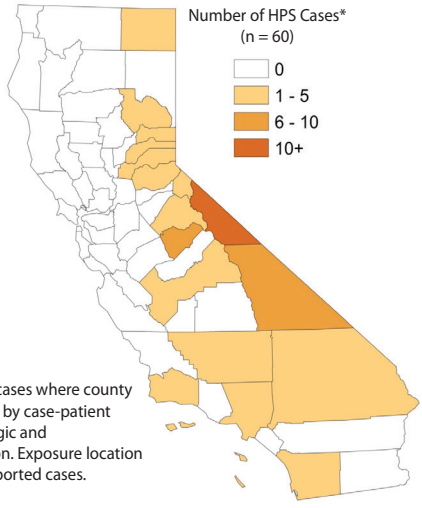
Rodent surveillance

In 2016, 968 rodents (Genera: *Neotoma*, *Microtus*, *Peromyscus*, and *Reithrodontomys*) were tested for antibodies to SNV (Table 1.1). Of 844 *Peromyscus* spp. sampled, 29 (3.4%) were positive for SNV antibodies. Seroprevalence in deer mice, the primary reservoir for SNV, was 7.4% (Table 1.1). At least one deer mouse was SNV antibody-positive in 7 of 14 counties sampled in 2016 (Table 1.2). SNV antibody has been detected in deer mice from 25 of 37 counties sampled in the last 10 years; prevalence ranged from 1.8% to 38.5% (average 11.3%) over that time period (Table 1.2).

Additionally, 5 (10.9%) of 46 harvest mice (*Reithrodontomys megalotis*) and 1of 6 *Microtus* spp. demonstrated reactivity to SNV. None of 72 woodrats (*Neotoma* spp.) demonstrated reactivity to SNV (Table 1.1). Seropositivity in non-*Peromyscus* spp. 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 assay. In California, no hantaviruses other than SNV have been shown to be pathogenic to humans.

Yosemite National Park hantavirus prevention

In May 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



*Represents only those cases where county of exposure determined by case-patient history, and epidemiologic and environmental evaluation. Exposure location not obtainable for all reported cases.

Figure 1.1. Likely County of Exposure for Reported Hantavirus Pulmonary (HPS) Case-Patients (1980 – 2016)

with YOSE and PHFE staff in 2016 on hantavirus prevention. Activities included facility evaluations, public education, and deer mouse surveillance to estimate rodent abundance and SNV prevalence. In 2016, 89 buildings in YOSE were evaluated for rodent-borne disease risks. Deer mouse surveillance was conducted in five areas of the park. One (2.9%) of 35 deer mice trapped in Yosemite Valley was reactive to SNV antibodies. In the Tuolumne Meadows area, 2 (14.3%) of 14 deer mice tested positive for SNV antibodies, as did 1 (8.3%) of 12 deer mice collected from other locations in the park. PHFE staff provided recommendations to YOSE staff and associated partners based on surveillance results and facility evaluations.

Lassen Volcanic National Park hantavirus prevention

The National Park Service and PHFE entered into a master agreement in May 2014 that allows park units within California to obtain vector-borne disease related services from PHFE and CDPH. Lassen Volcanic National Park (LAVO) initiated a task agreement in August 2014 for services that included hantavirus risk reduction, including facility inspections for rodent-borne disease risk and deer mouse trapping for SNV surveillance. In 2016, 12 buildings in LAVO were evaluated for vector-borne disease risks, and deer mouse trapping was conducted at the Kohm Yah-mah-nee Visitor Center and nearby Southwest Campground. Four of seven deer mice sampled were positive for SNV antibodies.

Table 1.1 Serologic evidence of hantavirus (Sin Nombre) infection in California rodents, 2007 - 2016

		2016			2007-2016		
Species	Common name	No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
Peromyscus boylii	brush mouse	46	0		1,060	12	1.1
Peromyscus californicus	parasitic mouse	130	3	2.3	1,312	21	1.6
Peromyscus crinitus	canyon mouse	7	0		79	0	
Peromyscus eremicus	cactus mouse	79	0		1,861	49	2.6
Peromyscus e. fraterculus	northern Baja mouse	177	0		1,179	10	0.8
Peromyscus maniculatus	deer mouse	350	26	7.4	5,172	583	11.3
Peromyscus truei	piñon mouse	54	0		324	6	1.9
Peromyscus sp.	unspeciated *Peromyscus*	1	0		1	0	
Peromyscus spp. subtotal		844	29	3.4	10,988	681	6.2
Reithrodontomys megalotis	western harvest mouse	46	5	10.9	972	99	10.2
Neotoma spp.	woodrats	72	0		354	2	0.6
Microtus spp.	voles	6	1	16.7	148	25	16.9

Table 1.2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus* in California, 2007-2016

	2016			2007-2016		
County	No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
Alameda	27	0	0.0	116	0	
Amador				4	0	
Butte				13	5	38.5
Colusa				2	0	
Contra Costa				15	0	
El Dorado	20	1	5.0	556	130	23.4
Glenn				5	0	
Inyo				14	3	21.4
Kern				6	1	16.7
Lassen				169	15	8.9
Los Angeles				8	0	
Madera				42	10	23.8
Mariposa	43	1	2.3	192	24	12.5
Modoc	12	1	8.3	35	8	22.9
Mono				367	93	25.3
Napa				13	2	15.4
Nevada				15	2	13.3
Orange				660	85	12.9
Placer				72	4	5.6
Plumas	2	0	0.0	40	9	22.5
Riverside	50	9	18.0	412	35	8.5
San Benito				5	0	
San Bernardino	13	0	0.0	285	5	1.8
San Diego	98	0	0.0	1,432	51	3.6
San Francisco				13	0	
San Mateo	36	7	19.4	73	16	21.9
Santa Barbara				54	11	20.4
Santa Clara				15	0	
Santa Cruz				14	0	
Shasta	5	0	0.0	91	18	19.8
Sierra	11	0	0.0	36	1	2.8
Siskiyou	8	0	0.0	66	9	13.6
Tehama	7	4	57.1	81	16	19.8
Trinity				3	0	
Tulare				8	0	
Tuolumne	18	3	16.7	237	29	12.2
Ventura				3	1	33.3
Total	**350**	**26**	**7.4**	**5,172**	**583**	**11.3**

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, implements preventive and control actions.

Human disease surveillance

Typhus

Eighty-three cases of typhus fever were reported to the California Department of Public Health (CDPH) in 2016. Thirty-seven of these were classified as confirmed cases according to CDPH working surveillance definition and 46 were probable. Sixty-seven (81%) of the case-patients required hospitalization. Case-patients were residents of Los Angeles (64), Orange (17), Riverside (1), and San Bernardino (1) counties. Typhus is considered endemic in parts of Orange and Los Angeles counties. The case-patient from Riverside County reported travel outside the United States during the incubation period. No travel or flea exposure could be ascertained from the San Bernardino County case-patient.

Plague

No cases of plague in humans were reported in 2016.

Animal disease surveillance

Wild animals

The CDPH-VBDS plague surveillance program tested 869 wild rodents and 121 carnivores from 32 California counties in 2016 (Tables 2.1 - 2.3). Plague bacteria (*Yersinia pestis*) were detected in four rodents from Siskiyou and Tuolumne counties (Figure 2.1, Table 2.1). Additionally, 59 rodents and 4 carnivores from 11 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 299 rodents and Los Angeles County Environmental Health, Vector Control program tested 65 rodents; all of these tested negative (data from these programs are not included in tables).

The rodent species tested for plague antibodies in 2016 included: 218 California ground squirrels (*Otospermophilus beecheyi*), 259 chipmunks (*Tamias* spp.), 211 mice and voles (*Peromyscus* spp., *Zapus* spp., and *Microtus* spp.), 127 golden-mantled ground squirrels (*Callospermophilus lateralis*), 13 Belding's ground squirrels (*Urocitellus beldingi*), 7 Douglas squirrels (*Tamiasciurus douglasii*), and 7 wood rats (*Neotoma* spp.).

Plague antibodies were detected in 7 California ground squirrels from El Dorado, Fresno, Mariposa, and Riverside counties, 30 lodgepole chipmunks (*Tamias speciosus*) from Mono, Tulare, and Tuolumne counties, 13 yellow-pine chipmunks (*Tamias amoenus*) from El Dorado, Modoc, Mono, Nevada, and Sierra counties, 5 shadow chipmunks (*Tamias senex*) and 1 long-eared chipmunk (*Tamias quadrimaculatus*) from El Dorado County, and 3 deer mice (*Peromyscus maniculatus*) from Modoc, Mono, and Tuolumne counties (Table 2.2).

A total of 121 wild carnivores were tested for plague antibodies including: 77 coyotes (*Canis latrans*), 23 black bears (*Ursus americanus*), 5 mountain lions (*Felis concolor*), 1 skunk (unidentified species), 4 red foxes (*Vulpes vulpes*), 6 raccoons (*Procyon lotor*), and 5 bobcats (*Lynx rufus*). One seropositive black bear was detected in Mariposa County and three positive coyotes were detected in Kern County (Table 2.2).

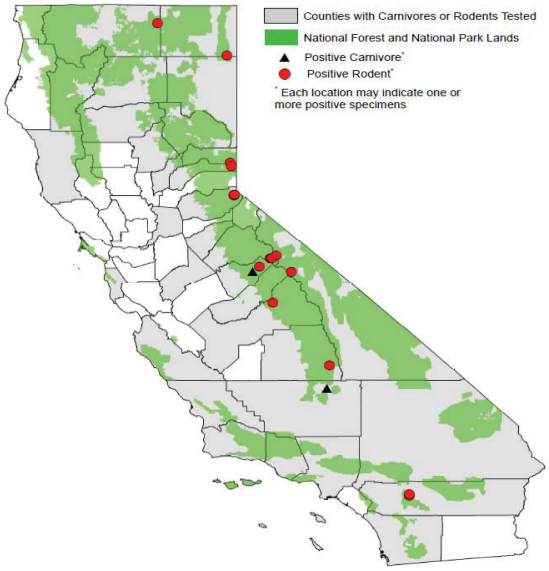


Figure 2.1. Approximate locations of carnivores or rodents on federal lands that tested positive for serum antibodies to *Yersinia pestis*, California 2016

Rodent Flea Testing

A total of 847 fleas collected from sylvatic rodents or their burrows were identified to species, combined into 301 pools, and tested for the presence of *Yersinia pestis* bacteria. One flea pool (*Eumolpianus eumolpi*) collected from a yellow-pine chipmunk at the U.S Forest Service's Fallen Leaf campground, El Dorado County, tested positive.

Table 2.1 CDPH-VBDS Plague bacteriological testing in wild rodents by location, California 2016

County Location	No. rodents tested	Positive Specimens Species	Result	Month
El Dorado	9			
Mariposa	4			
Nevada	3			
Shasta	1			
Siskiyou	1			
Lava Beds NM, Labyrinth Cave		Woodrat, BT	Pos	December
Tuolumne	9			
Yosemite NP, Tuolumne Meadows Lodge		GM G Sq	Pos	June
Yosemite NP, Tuolumne Meadows Ranger Camp		Chipmunk, LP	Pos	June
Yosemite NP, Tuolumne Meadows CG		GM G Sq	Pos	August
Total	**27**			

Abbreviations for Table 2.1, 2.2

Chipmunk, S: Shadow chipmunk
Chipmunk, LP: Lodgepole chipmunk
Chipmunk, LE: Long-eared chipmunk
Chipmunk, YP: Yellow-pine chipmunk
CaGSq: California ground squirrel
GM G Sq: Golden-mantled ground squirrel
Woodrat, BT: Bushy-tailed woodrat
LTBMU: Lake Tahoe Basin Management Unit
NF: National Forest
NP: National Park
NM: National Monument
CG: Campground
Pos: Plague bacterium, *Yersinia pestis*

Table 2.2 CDPH-VBDS positive plague serological surveillance results in wild rodents and carnivores by location, California 2016

County Location	No. rodents tested	No. carnivores tested	Antibody positive specimens Species	Titer	Month
El Dorado	70	3			
LTBMU, Tallac Historical Site			Chipmunk, LE	1:128	May
LTBMU, Tallac Historical Site			Chipmunk, S	1:256	May
LTBMU, Taylor Creek Visitor Center			Chipmunk, S	1:256	May
LTBMU, Tallac Historical Site			Chipmunk, S	1:512	May
LTBMU, Tallac Historical Site			Chipmunk, YP	1:128	May
LTBMU, Taylor Creek Visitor Center			Chipmunk, YP	1:128	May
LTBMU, Taylor Creek Visitor Center			Chipmunk, YP	1:256	May
LTBMU, Taylor Creek Visitor Center			Chipmunk, YP	1:64	May
LTBMU, Fallen Leaf CG			CA G Sq	1:512	June
LTBMU, Fallen Leaf CG			CA G Sq	1:64	June
LTBMU, Fallen Leaf CG			Chipmunk, YP	1:128	June
LTBMU, Fallen Leaf CG			Chipmunk, YP	1:64	June
LTBMU, Fallen Leaf CG			CA G Sq	1:64	June
LTBMU, Fallen Leaf CG			Chipmunk, S	1:128	June
LTBMU, Fallen Leaf CG			Chipmunk, S	1:32	June
LTBMU, Fallen Leaf CG			Chipmunk, YP	1:64	June
Fresno	11	0			
Sierra NF - Camp Edison			CA G Sq	1:1024	August
Kern	0	20			
Weldon			Coyote	1:32	January
Weldon			Coyote	1:32	January
Weldon			Coyote	1:32	January
Mariposa	54	8			
Yosemite NP, Chinquapin, Hwy 41, .8N			Black Bear	1:64	July
Yosemite NP, Glacier Point			CA G Sq	1:256	June
Modoc	54	0			
Modoc NF, Patterson CG and Guard Station			Deer Mouse	1:128	August
Modoc NF, Patterson CG and Guard Station			Chipmunk, YP	1:256	August
Mono	79	0			
Inyo NF, New Shady Rest and Pine Glen Group CG			Chipmunk, YP	1:128	May
Inyo NF, Junction CG			Deer Mouse	1:32	June
Inyo NF, Junction CG			Chipmunk, LP	1:64	June
Nevada	32	0			
Tahoe NF, Boca CG			Chipmunk, YP	1:64	September
Riverside	75	0			
San Bernardino NF, Dark Canyon CG			CA G Sq	1:128	June
San Bernardino NF, Marion Mountain CG			CA G Sq	1:64	June
Sierra	44	0			
Tahoe NF, Logger CG			Chipmunk, YP	1:1024	August
Tahoe NF, Logger CG			Chipmunk, YP	1:256	August
Tahoe NF, Logger CG			Chipmunk, YP	1:256	August
Tulare	66	0			
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:1024	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:1024	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	1:2048	May
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Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:64	May
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:1024	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:1024	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:1024	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	1:256	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:256	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:256	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:32	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:32	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:512	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:64	June
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:64	June
Tuolumne	53	7			
Yosemite NP, Tuolumne Meadows CG			Chipmunk, LP	1:512	June
Yosemite NP, Ranger Camp & Bug Camp			Deer Mouse	1:256	June
Total	**538**	**38**			

Table 2.3 CDPH-VBDS negative plague serological surveillance in wild rodents and carnivores by location, California 2016		
County Location	No. rodents tested	No. carnivores tested
Butte	0	6
Calaveras	3	0
Inyo	27	0
Lassen	25	0
Los Angeles	32	15
Madera	3	0
Mendocino	0	10
Monterey	11	10
Plumas	31	0
Sacramento	0	1
San Bernardino	15	0
San Luis Obispo	14	17
San Mateo	37	0
Santa Barbara	24	0
Shasta	24	0
Siskiyou	15	21
Stanislaus	0	1
Tehama	24	0
Trinity	0	1
Ventura	19	0
Yuba	0	1
Total	**304**	**83**

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 2016, five cases of anaplasmosis caused by *Anaplasma phagocytophilum* were reported to the California Department of Public Health (CDPH). Two met national surveillance criteria for a confirmed case; three met the criteria for a probable case. Case-patients were residents of Alameda, Kern, Sacramento, San Mateo, and Ventura counties. Median age was 58 (range, 31– 65 years) and four were female. All case-patients reported a tick bite, three from other states endemic for *Anaplasma phagocytophilum*, one from Mendocino County, and one from Tulare County.

Babesiosis

Three cases of babesiosis caused by *Babesia microti* were reported to CDPH in 2016; two met national surveillance criteria for a confirmed case and one was a probable case. Case-patients were residents of San Diego, San Francisco, and Yolo counties. Median age of case-patients was 50 years (range, 60 -70) and two were female. No case-patients were hospitalized. All reported travel to the northeastern United States where *B. microti* is endemic, and one 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 confirmed case. The case-patient was a male with exposure reported in Massachusetts, a state endemic for *E. chaffeensis.*

Lyme Disease

A total of 141 cases of Lyme disease caused by *Borrelia burgdorferi* were reported in 2016; 95 of these met the surveillance case definition criteria for a confirmed case, and 46 were probable (Figure 3.1). Of the 95 confirmed cases, case-patients were residents of 33 counties, with Santa Clara County reporting the largest number of cases (11) (Table 3.1).

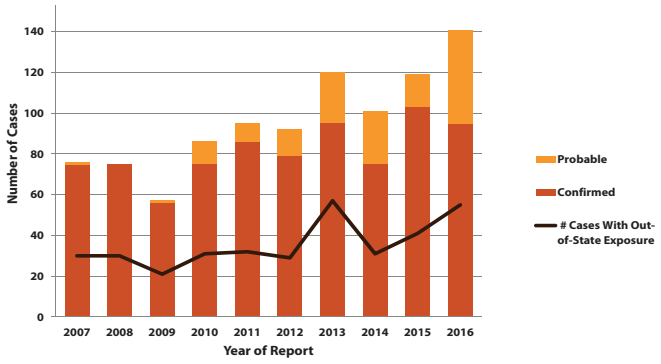

Figure 3.1. Confirmed and probable Lyme disease cases, including cases reporting travel within incubation period, by report year 2007 - 2016

Spotted fever group rickettsiosis

Thirteen cases of Rocky Mountain spotted fever (RMSF), caused by *Rickettsia rickettsii*, were reported to CDPH in 2016; one met the surveillance criteria for confirmed and 12 were probable. The case-patients were residents of Alameda (3), Amador, Contra Costa, El Dorado, Kern, Los Angeles (2), Placer, Sacramento, San Diego, and Sonoma counties. Eight (61.5%) case-patients were male, and median age was 43 years (range, 23 -73 years). Eight (61.5%) reported possible exposure outside their county of residence including to counties in California (Placer and Tehama) or to Colorado, Idaho, Kentucky, Mississippi, Missouri, Tennessee, or Washington.

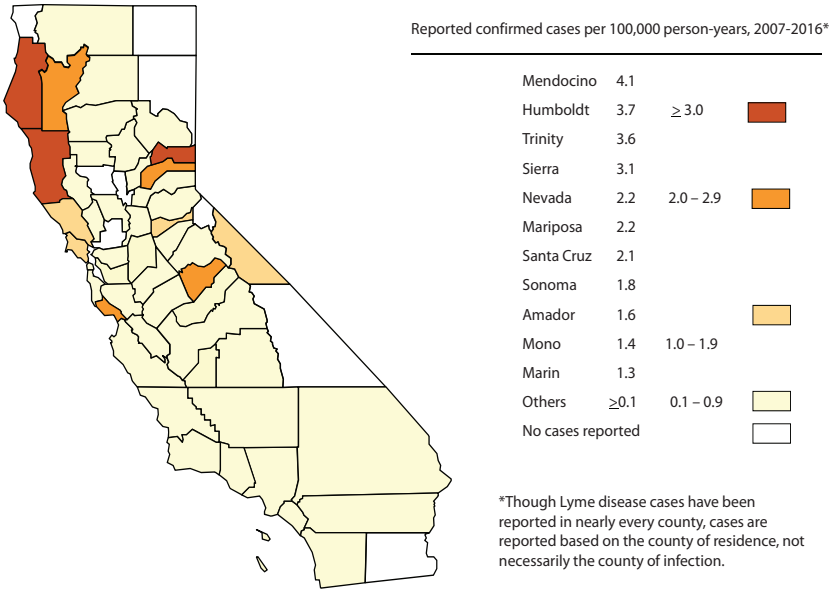

Figure 3.2. Incidence of reported confirmed Lyme disease, by county, California, 2007 - 2016

Tick-borne relapsing fever

Thirteen cases of tick-borne relapsing fever (TBRF), caused by *Borrelia hermsii*, were reported to CDPH in 2016; eight (62%) of these met CDPH working surveillance case definition criteria for a confirmed case, four (31%) were probable and one (8%) was suspect. Median age of confirmed case-patients was 33 years (range, 12 to 69 years) and seven (54%) were male. Case-patients were residents of eight counties: Alameda, El Dorado, Inyo (2), Napa, Santa Clara (2), Santa Cruz, Tulare (4), and Ventura. States or California counties where case-patients (confirmed and probable) were likely exposed in the three weeks prior to illness onset included El Dorado (3), Inyo, Mono (2), Tulare (4), and Tuolumne counties and Oregon. One case had multiple exposure potential in Mono or Inyo counties.

Tick surveillance

Anaplasma phagocytophilum

In 2016, 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 210 adult, 161 nymphal, and 372 larval western blacklegged ticks (*Ixodes pacificus*) from Marin, Napa, and Sonoma counties for the presence of *Anaplasma phagocytophilum*. Two (0.95%) adult and two (1.3%) nymphal western blacklegged ticks tested positive by real-time polymerase chain reaction (RT-PCR) at CDPH Viral and Rickettsial Disease Laboratory (VRDL). One positive of each adult and nymph was collected from Bothe-Napa Valley State Park. CDPH-VBDS and Marin-Sonoma MVCD conducted tick surveillance in Sonoma County as follow-up to a historically confirmed human case exposed in the area. One (3.3%) of 30 adults and 1(1.1%) of 90 nymphs were positive from Austin Creek State Recreational Area, Sonoma County. Also reported to CDPH-VBDS, San Mateo MVCD collected and tested 1,501 adult western blacklegged ticks in 309 pools from Thornewood Open Space Preserve. Three pools were positive for *A. phagocytophilum,* equaling a location-specific minimum infection prevalence (MIP: number of positive pools divided by the number of ticks pooled, multiplied by 100) of 0.9%.

Rickettsia philipii

In 2016, CDPH-VBDS collected 1,578 adult and 1 nymphal Pacific Coast ticks (*Dermacentor occidentalis*) from Alameda, Butte, El Dorado, Glenn, Humboldt, Lake, Marin, Mariposa, Mendocino, Monterey, Napa, Orange, Plumas, San Bernardino, San Diego, San Joaquin, Santa Clara, Santa Cruz, Solano, Sonoma, Stanislaus, and Ventura counties to

Table 3.1: Reported confirmed Lyme disease cases by county of residence , California, 2007-2016

County	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	TOTAL	Incidence per 100,000 person-years
Alameda	3	6	1	2	2	4	0	4	9	9	40	0.26
Alpine	0	0	0	0	0	0	0	0	0	0	0	0.00
Amador	2	0	0	1	0	0	1	0	2	0	6	1.58
Butte	0	2	2	0	0	0	0	1	0	2	7	0.31
Calaveras	0	0	0	0	0	0	0	0	1	0	1	0.22
Colusa	0	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	0	1	0	1	1	4	5	2	4	5	23	0.21
Del Norte	0	0	0	0	0	0	0	0	0	0	0	0.00
El Dorado	2	1	2	2	0	2	0	2	2	1	14	0.77
Fresno	0	2	0	1	1	4	0	1	1	1	11	0.11
Glenn	0	0	0	0	0	0	0	1	0	0	1	0.35
Humboldt	6	6	4	7	6	4	4	4	6	4	51	3.77
Imperial	0	0	0	0	0	0	0	0	0	0	0	0.00
Inyo	0	0	0	0	0	0	0	0	0	0	0	0.00
Kern	2	5	1	2	0	0	0	0	1	1	12	0.14
Kings	0	0	1	0	0	0	1	0	0	1	3	0.20
Lake	1	0	0	0	0	0	0	0	1	0	2	0.31
Lassen	0	0	0	0	0	0	0	0	0	1	1	0.30
Los Angeles	9	8	3	6	7	2	17	6	7	1	66	0.07
Madera	0	0	0	0	1	0	0	0	0	0	1	0.07
Marin	3	2	1	3	1	3	5	5	5	3	31	1.20
Mariposa	0	0	0	0	0	1	1	1	1	0	4	2.20
Mendocino	5	10	6	6	3	4	0	1	0	1	36	4.09
Merced	0	0	0	0	1	0	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	1	0	0	1	0	0	0	2	1.43
Monterey	0	0	0	1	1	1	1	0	0	1	5	0.12
Napa	3	0	1	0	1	1	0	2	2	2	12	0.86
Nevada	3	2	1	3	6	2	1	1	1	2	22	2.24
Orange	1	1	0	5	6	0	0	0	0	0	13	0.04
Placer	0	1	2	0	1	2	1	0	0	2	9	0.25
Plumas	0	0	0	0	0	0	0	1	0	0	1	0.50
Riverside	0	1	4	0	4	0	2	1	1	3	16	0.07
Sacramento	2	0	1	0	1	1	0	0	0	1	6	0.04
San Benito	0	0	0	0	0	0	0	0	1	0	1	0.18
San Bernardino	0	1	0	0	2	0	1	0	1	0	5	0.02
San Diego	5	3	8	6	8	7	8	8	9	6	68	0.21
San Francisco	4	4	1	2	1	3	4	0	0	0	19	0.23
San Joaquin	0	0	0	0	0	1	0	1	0	1	3	0.04
San Luis Obispo	0	1	0	0	0	1	4	3	3	1	13	0.48
San Mateo	0	2	1	3	0	1	3	6	5	3	24	0.32
Santa Barbara	2	2	0	1	3	0	6	0	4	6	24	0.55
Santa Clara	2	0	2	5	11	4	13	5	10	11	63	0.34
Santa Cruz	5	1	4	8	9	5	5	6	8	6	57	2.12
Shasta	0	0	0	1	1	1	0	0	0	0	3	0.17
Sierra	0	0	0	0	0	1	0	0	0	0	1	3.11
Siskiyou	0	0	0	0	0	1	1	0	1	1	4	0.89
Solano	0	0	0	0	0	0	0	0	0	3	3	0.07
Sonoma	8	10	9	6	6	12	7	11	13	8	90	1.83
Stanislaus	0	1	1	0	0	0	0	0	1	1	4	0.08
Sutter	0	0	0	0	0	0	0	0	0	0	0	0.00
Tehama	0	0	0	0	0	0	0	0	0	2	2	0.31
Trinity	1	0	0	0	2	1	0	1	0	0	5	3.64
Tulare	1	0	0	0	0	1	0	0	1	1	4	0.09
Tuolumne	0	0	0	0	0	0	0	0	1	0	1	0.18
Ventura	4	2	0	1	0	2	2	0	0	3	14	0.17
Yolo	1	0	0	0	0	1	1	0	1	1	5	0.24
Yuba	0	0	0	1	0	2	0	1	0	0	4	0.55
TOTAL	**75**	**75**	**56**	**75**	**86**	**79**	**95**	**75**	**103**	**95**	**814**	**0.21**

test for *Rickettsia philipii*, the agent of Pacific Coast tick fever. Tick collections were usually conducted in collaboration with the local vector control agency. All ticks were tested by RT-PCR at CDPH-VRDL. Adult Pacific Coast ticks positive for *R. philipii* were detected in two counties: Lake (7/182 = 3.9%) and Orange (16/344 = 4.7%).

Borrelia spirochetes

Borrelia burgdorferi sensu lato

In 2016, local, state, and federal agencies in collaboration with CDPH-VBDS collected 11,686 adult, 612 nymphal, and 444 larval western blacklegged ticks from 25 counties to test for *Borrelia* spp., including *B. burgdorferi*, the agent of Lyme disease. Collection and testing data for western blacklegged ticks are 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 21 counties where ticks were tested individually, the overall prevalence of *B. burgdorferi* was 0.6% in adult ticks and 2.9% 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 seven counties where adult ticks were tested in pools, the MIP was 1.1% (Table 3.3).

Borrelia miyamotoi

In 2016, of the western blacklegged ticks collected, 9,116 adult and 612 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 2,367 individually tested ticks, 15 (0.6%) of the adults and 4 (0.7%) of the nymphs tested positive (Table 3.2). Of the 6,749 adult ticks tested in pools, 59 (0.9% MIP) tested positive (Table 3.3).

Borrelia hermsii

CDPH-VBDS conducted environmental assessments in response to reported human cases of tick-borne relapsing fever. In 2016, five soft ticks (*Ornithodoros hermsi*) from a cabin located in Mammoth Lakes, Mono County, were negative, and one of nine soft ticks collected from a cabin located on the Inyo National Forest, Mono County was positive for *Borrelia hermsii*.

Mammal Surveillance

Francisella tularensis

CDPH-VBDS collaborates with CDPH Microbial Disease Laboratory to test mammals for *Francisella tularensis*, the agent of tularemia, by serology, DFA, PCR, and culture. Mammals may be tested for tularemia in response to reported human cases or for environmental risk assessment including specific carcass testing requests. In the past ten years, positive mammals have been identified from Alameda (2005, 2010), Calaveras (2012), Kern (2006), Napa (2013), Plumas (2006), San Luis Obispo (2007), and Solano (2010) counties.

In 2016, mammals were tested from Alameda (16), El Dorado (9), Mariposa (4), Napa (2), Nevada (3), Orange (3), San Luis Obispo (15), Santa Barbara (2), Santa Clara (6), Shasta (1), Siskiyou (1), Solano (1), and Tuolumne (9) counties. All tested negative.

Table 3.2. Infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* spirochetes in *Ixodes pacificus* ticks, California, 2016

	No. Ticks Tested		Positive *B. burgdorferi*		Positive *B. miyamotoi*			
County Location	Adults	Nymphs	Adults (IP)[a]	Nymphs (IP)	Adults (IP)	Nymphs (IP)	Collected by	Laboratory
Alameda								
Joaquin Miller Park	12						CDPH, VBDS	CDPH, VBDS
Redwood RP	671	34	6 (0.9)		5 (0.8)		CDPH, VBDS	CDPH, VBDS
Butte								
Bidwell Park	25						CDPH, VBDS	CDPH, VBDS
Contra Costa								
UC Russel Research Station	11						CDPH, VBDS	CDPH, VBDS
El Dorado								
Folsom Lake SRA	6	343		8 (2.3)		4 (1.2)	CDPH, VBDS	CDPH, VBDS
Glenn								
Mendocino NF	207	4	2 (1.0)		1 (0.5)		CDPH, VBDS	CDPH, VBDS
Marin								
Novato	3	8		2 (25.0)			Marin/Sonoma MVCD; CDPH, VBDS	CDPH, VBDS
China Camp SP	1		0 (0)				Marin/Sonoma MVCD	Marin/Sonoma MVCD
Mariposa								
El Portal	2						CDPH, VBDS	CDPH, VBDS
Sierra NF	6						CDPH, VBDS	CDPH, VBDS
Yosemite NP	26						CDPH, VBDS	CDPH, VBDS
Monterey								
Garrapata SP	8	1					CDPH, VBDS	CDPH, VBDS
Pfeiffer Big Sur SP	36	4			1 (2.8)		CDPH, VBDS	CDPH, VBDS
Napa								
Angwin	123		3 (2.4)		1 (0.8)		Napa MAD; CDPH, VBDS	CDPH, VBDS
Bothe-Napa Valley SP	196	63	1 (0.5)	1 (1.6)	5 (2.6)		Napa MAD; CDPH, VBDS	CDPH, VBDS
Nevada								
South Yuba River SP	22		1 (4.5)				CDPH, VBDS	CDPH, VBDS
Orange								
Aliso & Wood Canyons Wilderness Park	22						CDPH, VBDS	CDPH, VBDS
Cleveland NF	121						CDPH, VBDS	CDPH, VBDS
Cristianitos Regional Trail	2						CDPH, VBDS	CDPH, VBDS
Crystal Cove SP	343	1					CDPH, VBDS	CDPH, VBDS
Laguna Coast Wilderness Park	7						CDPH, VBDS	CDPH, VBDS
Oak Canyon Nature Park	10						CDPH, VBDS	CDPH, VBDS
Plumas								
Feather River Canyon	17	1					CDPH, VBDS	CDPH, VBDS
San Bernardino								
Chino Hills SP	5	1					CDPH, VBDS	CDPH, VBDS
San Bernardino NF	11						CDPH, VBDS	CDPH, VBDS
San Luis Obispo								
Los Padres NF	2						CDPH, VBDS	CDPH, VBDS
San Mateo								
Big Canyon Park	234		0		0		San Mateo MVCD	San Mateo MVCD
Eaton Park	154		0		0		San Mateo MVCD	San Mateo MVCD
Waterdog Lake Park	269		0		1 (0.4)		San Mateo MVCD	San Mateo MVCD
Santa Clara								
Ed Levin County Park	12						CDPH, VBDS	CDPH, VBDS
Santa Cruz								
Anna Jean Cummings Park	29						Santa Cruz MVCD	CDPH, VBDS
Aptos	23						Santa Cruz MVCD	CDPH, VBDS
Big Basin Redwood SP	147	16		1 (6.3)			Santa Cruz MVCD	CDPH, VBDS
Camp Kennolyn	16						Santa Cruz MVCD	CDPH, VBDS
Pescadero Skylark Ranch Camp		45					Santa Cruz MVCD	CDPH, VBDS
Rancho del Oso SP	119				1 (0.8)		Santa Cruz MVCD	CDPH, VBDS
Sierra								
Tahoe NF	14				1 (7.1)		CDPH, VBDS	CDPH, VBDS
Solano								
UC Stebbins Cold Canyon Reserve	42	1					CDPH, VBDS	CDPH, VBDS
Sonoma								
Austin Creek SRA	30	90	1 (3.3)	6 (6.7)			Marin/Sonoma MVCD; CDPH, VBDS	CDPH, VBDS
Stanislaus								
Patterson	7						CDPH, VBDS	CDPH, VBDS
Ventura								
Los Padres NF	31						Ventura EHD; CDPH, VBDS	CDPH, VBDS
Ojai Valley Land Conservancy	3						CDPH, VBDS	CDPH, VBDS
Total	**3,025**	**612**	**14 (0.5)**	**18 (2.9)**	**16 (0.5)**	**4 (0.7)**		

Table 3.3. Minimum infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* in *Ixodes pacificus* ticks, California 2016

County Location	Adults (pools)	Positive *B. burgdorferi* Pools (MIP)[b]	Positive *B. miyamotoi* Pools (MIP)[b]	Collected by	Laboratory
Placer					
Auburn SRA	1791 (371)	21 (1.2)	17 (0.9)	Placer MVCD	Placer MVCD
Folsom Lake SRA	303 (69)	6 (2.0)	1 (0.3)	Placer MVCD	Placer MVCD
Hidden Falls RP	333 (71)	4 (1.2)	0	Placer MVCD	Placer MVCD
Placer Nature Center	43 (13)	3 (7.0)	1 (2.3)	Placer MVCD	Placer MVCD
Steven's Trail	464 (98)	16 (3.4)	9 (1.9)	Placer MVCD	Placer MVCD
Sugar Pine Mountain Loop Trail	139 (32)	5 (3.6)	2 (1.4)	Placer MVCD	Placer MVCD
Marin [a]					
Golden Gate NRA	3 (1)	0		Marin/Sonoma MVCD	Marin/Sonoma MVCD
Marin Municipal Water District Watershed	72 (18)	1 (1.4)		Marin/Sonoma MVCD	Marin/Sonoma MVCD
Mt. Tamalpais SP	11 (3)	0		Marin/Sonoma MVCD	Marin/Sonoma MVCD
Olompali SP	50 (10)	3 (6.0)		Marin/Sonoma MVCD	Marin/Sonoma MVCD
Sacramento [a]					
Ancil Hoffman Park	7 (4)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
East Lake Natoma Trail	513 (105)	3 (0.6)		Sac/Yolo MVCD	Sac/Yolo MVCD
Folsom	31 (11)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
Gold Lake Drive	39 (12)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
Mississippi Bar	185 (41)	1 (0.5)		Sac/Yolo MVCD	Sac/Yolo MVCD
Negro Bar SP	348 (74)	8 (2.3)		Sac/Yolo MVCD	Sac/Yolo MVCD
Nimbus Dam Overlook	126 (28)	1 (0.8)		Sac/Yolo MVCD	Sac/Yolo MVCD
Snipes Pershing Park	245 (52)	3 (1.2)		Sac/Yolo MVCD	Sac/Yolo MVCD
Willow Creek	213 (46)	5 (2.3)		Sac/Yolo MVCD	Sac/Yolo MVCD
Santa Clara					
Calero County Park	376 (150)	0	5 (1.3)	Santa Clara MVCD	Santa Clara MVCD
Foothills Park	124 (57)	1 (0.8)	4 (3.2)	Santa Clara MVCD	Santa Clara MVCD
Henry W. Coe SP	184 (40)	1 (0.5)	0	Santa Clara MVCD	Santa Clara MVCD
Mount Madonna County Park	215 (95)	0	0	Santa Clara MVCD	Santa Clara MVCD
Stevens Creek County Park	327 (123)	0	4 (1.2)	Santa Clara MVCD	Santa Clara MVCD
San Mateo					
Crystal Springs Regional Trail	182 (37)	0	1 (0.5)	San Mateo MVCD	San Mateo MVCD
Edgewood Park	246 (52)	0	2 (0.8)	San Mateo MVCD	San Mateo MVCD
Frontierland Park	6 (2)	0	0	San Mateo MVCD	San Mateo MVCD
Huddart Park	197 (42)	0	2 (1.0)	San Mateo MVCD	San Mateo MVCD
Junipero Serra Park	15 (4)	0	0	San Mateo MVCD	San Mateo MVCD
Los Trancos OSP	152 (31)	2 (1.3)	1 (0.7)	San Mateo MVCD	San Mateo MVCD
Memorial Park	185 (37)	0	0	San Mateo MVCD	San Mateo MVCD
Pulgas Ridge OSP	347 (71)	1 (0.3)	2 (0.6)	San Mateo MVCD	San Mateo MVCD
San Pedro Valley Park	119 (26)	0	0	San Mateo MVCD	San Mateo MVCD
Thornewood OSP	344 (70)	2 (0.6)	7 (2.0)	San Mateo MVCD	San Mateo MVCD
Sonoma [a]					
Annadel SP	68 (15)	2 (2.9)		Marin/Sonoma MVCD	Marin/Sonoma MVCD
Crane Creek RP	140 (36)	0		Marin/Sonoma MVCD	Marin/Sonoma MVCD
Helen Putnam RP	50 (11)	0		Marin/Sonoma MVCD	Marin/Sonoma MVCD
North Sonoma Mountain RP	266 (56)	12 (4.5)		Marin/Sonoma MVCD	Marin/Sonoma MVCD
Shiloh Ranch RP	15 (4)	0		Marin/Sonoma MVCD	Marin/Sonoma MVCD
Yolo [a]					
Cache Creek CG	33 (11)	1 (3.0)		Sac/Yolo MVCD	Sac/Yolo MVCD
Cache Creek, Blue Ridge Trail	154 (33)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
Total	**8,761 (2,062)**	**102 (1.1)**	**58 (0.7)**		

[a] Tested by polymerase chain reaction (PCR) specific for *Borrelia burgdorferi* sensu stricto only.

[b] 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

[c] 6,749 adult ticks tested for *Borrelia miyamotoi*

Abbreviations for tables 3.2, 3.3:

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

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 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. Vector-Borne Disease Section provides surveillance and testing for pesticide resistance in mosquitoes.

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), nine 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 2016, a total of 442 symptomatic and 41 asymptomatic infections with WNV were identified, a 43.8% decrease in infections compared to 2015 (Table 4.1). Of the 442 clinical cases, 113 (26%) were classified as West Nile non-neuroinvasive disease and 329 (74%) were classified as West Nile neuroinvasive disease (i.e., encephalitis, meningitis, or acute flaccid paralysis). Case-patients were residents of 30 counties and 271 (61%) were male. Incidence was highest (20.9 cases per 100,000 persons) in Glenn County (Figure 4.1, Table 4.1). The median age for West Nile non-neuroinvasive cases was 57 years (range, 14 to 91 years), and neuroinvasive cases was 60 years (range, 2 to 94 years). The median age of the 19 WNV-associated fatalities was 76 years (range, 32 to 94 years). Dates of symptom onset ranged from June 12 to December 9, 2016.

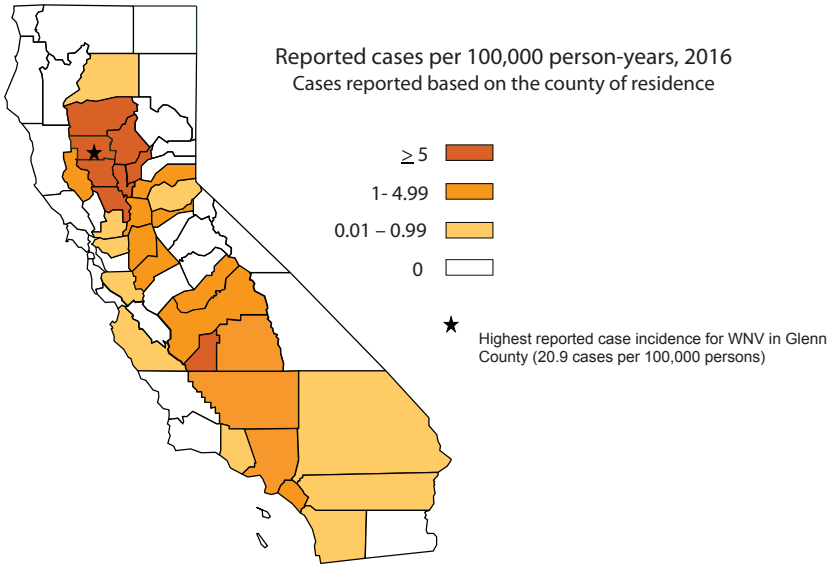

Figure 4.1. Incidence of reported human cases of West Nile virus, by county, California 2016

St. Louis encephalitis virus

Three symptomatic cases of St. Louis encephalitis virus (SLEV) infection were identified in 2016. These were the first human cases of SLEV disease reported in California since 1997. Case-patients were residents of three counties (Table 4.5) and two were male. The median age was 68 years, and dates of symptom onset ranged from July 1 to September 2, 2016.

Table 4.1. Reported WNV human cases by county of residence, California, 2007-2016

County	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2016 incidence per 100,000 person-years	10 year incidence per 100,000 person-years
Alameda	0	1	0	1	0	2	0	1	0	0	0.00	0.03
Alpine	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Amador	0	0	0	0	1	0	0	0	0	1	2.65	0.53
Butte	16	6	2	1	3	10	24	24	53	21	9.35	7.12
Calaveras	0	1	0	0	0	0	0	0	0	0	0.00	0.22
Colusa	2	1	0	0	0	3	2	3	1	2	9.11	6.38
Contra Costa	3	4	5	4	3	4	5	5	1	4	0.36	0.34
Del Norte	0	0	0	0	0	0	0	0	0	0	0.00	0.00
El Dorado	0	1	1	0	1	0	1	0	0	1	0.54	0.27
Fresno	17	3	13	23	9	24	8	43	8	14	1.42	1.65
Glenn	7	1	0	2	1	7	9	10	19	6	20.93	21.63
Humboldt	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Imperial	3	0	0	0	0	1	0	1	1	0	0.00	0.32
Inyo	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Kern	140	2	18	15	18	25	25	11	11	17	1.92	3.18
Kings	7	2	3	1	1	3	1	4	0	8	5.32	2.00
Lake	0	0	0	0	0	1	0	1	2	1	1.56	0.78
Lassen	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Los Angeles	36	156	20	4	58	163	151	253	286	151	1.47	1.25
Madera	2	0	1	7	2	3	3	3	4	6	3.86	2.00
Marin	0	0	0	0	0	0	2	0	1	0	0.00	0.11
Mariposa	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Mendocino	2	0	0	0	0	0	0	1	2	0	0.00	0.57
Merced	4	1	4	1	1	13	0	1	1	0	0.00	0.96
Modoc	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Mono	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Monterey	0	0	1	0	0	1	0	0	0	1	0.23	0.07
Napa	1	0	0	0	0	0	1	0	0	0	0.00	0.14
Nevada	0	0	0	0	0	0	0	0	2	0	0.00	0.20
Orange	9	71	4	1	10	42	10	263	92	32	1.01	1.68
Placer	4	6	0	3	1	12	6	7	0	7	1.87	1.23
Plumas	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Riverside	17	62	3	0	7	19	35	14	127	11	0.47	1.26
Sacramento	25	13	0	12	4	29	11	10	4	25	1.67	0.89
San Benito	0	0	0	0	0	0	0	0	0	0	0.00	0.00
San Bernardino	4	36	2	5	4	33	13	21	54	8	0.37	0.84
San Diego	15	35	4	0	0	1	0	11	42	20	0.61	0.39
San Francisco	0	0	0	1	0	1	1	0	0	0	0.00	0.03
San Joaquin	10	12	10	6	5	13	8	9	2	13	1.77	1.20
San Luis Obispo	0	0	0	0	0	0	0	0	0	0	0.00	0.00
San Mateo	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Santa Barbara	0	1	0	0	1	0	1	0	0	0	0.00	0.07
Santa Clara	4	1	0	0	1	0	2	10	8	1	0.05	0.14
Santa Cruz	0	0	0	0	1	0	0	0	0	0	0.00	0.04
Shasta	9	1	0	0	0	1	1	2	3	1	0.56	1.01
Sierra	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Siskiyou	0	0	0	0	0	0	0	0	1	0	0.00	0.22
Solano	1	1	0	0	0	2	1	5	1	4	0.93	0.35
Sonoma	1	0	0	0	0	0	0	0	0	0	0.00	0.02
Stanislaus	21	17	14	12	11	26	17	33	13	26	4.81	3.52
Sutter	3	0	0	0	0	8	10	8	2	12	12.33	4.42
Tehama	4	4	0	0	1	4	5	4	5	5	7.82	5.01
Trinity	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Tulare	10	5	4	12	11	7	5	21	13	10	2.14	2.10
Tuolumne	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Ventura	1	0	0	0	0	7	2	1	6	7	0.82	0.28
Yolo	2	1	2	0	0	10	6	15	8	16	7.46	2.80
Yuba	0	0	1	0	3	4	13	6	10	11	14.80	6.46
Total WNV disease	**380**	**445**	**112**	**111**	**158**	**479**	**379**	**801**	**783**	**442**	**1.13**	**1.04**
Asymptomatic Infections[a]	29	53	17	20	18	48	54	91	77	41		
Total WNV infections	**409**	**498**	**129**	**131**	**176**	**527**	**433**	**892**	**860**	**483**	**1.23**	**1.16**

[a] WNV infections detected through blood bank screening; no associated illness reported

Malaria

In 2016, 121 confirmed cases of malaria were reported to CDPH. Case-patients were residents of 20 California counties and 72 (60%) were male. The median age was 35 years (range, 0 to 81 years). Of the 95 cases for which the *Plasmodium* species was determined, 67 were *P. falciparum*, 21 *P. vivax*, 3 *P. malariae,* and 4 *P. ovale.* All case-patients reported compatible travel history to malaria-endemic areas including Africa (88), Asia (11), India (13), Central America (6), and South America (3).

Dengue

In 2016, 200 cases of dengue were reported to CDPH; 67 of these met the criteria for a confirmed case, and 133 were probable. Case-patients were residents of 31 California counties, 109 (54%) were female, and the median age was 39 years (range, 1 to 88 years). No locally acquired cases were reported. Travel region history included South East Asia (53), North America (includes Hawaii [6] and Mexico [40]), India (31), Central America (24), South Pacific (16), South America (13), Caribbean (9), Asia (3), and Africa (2). Exposure region was not available for three case-patients.

Chikungunya

Fifty-seven cases of chikungunya were reported to CDPH in 2016; 14 of these met the criteria for a confirmed case and 43 were probable. Case-patients were residents of 16 California counties, 33 (58%) were female and the median age was 40 years (range 6 to 81 years). No locally acquired cases were reported. All case-patients reported travel to chikungunya-endemic or outbreak areas including India (33), Latin America (18), South America (4) and South East Asia (1). Exposure region was not available for one travel-associated case-patient.

Zika

In 2016, 486 infections of Zika virus were reported to CDPH; 370 of these met the criteria for a confirmed infection and 116 were probable infections. Case-patients were residents of 35 counties (Figure 4.2 , Table 4.2), 315 (65%) were female, and the median age was 36 years (range, 0 to 89 years). All infections were travel-associated. Reported travel by 478 case-patients was to Zika-endemic or outbreak areas including North America (Florida [4] and Mexico [172]), Central America (168), the Caribbean (75), U.S. Territories (26), South

Table 4.2: Reported *Aedes* transmitted diseases in humans by county, California, 2016

County	Chikungunya	Dengue	Zika	TOTAL
Alameda	10	16	32	58
Alpine	0	0	0	0
Amador	0	0	0	0
Butte	0	0	2	2
Calaveras	0	0	0	0
Colusa	0	0	0	0
Contra Costa	2	10	26	38
Del Norte	0	0	0	0
El Dorado	0	1	0	1
Fresno	3	6	6	15
Glenn	0	0	0	0
Humboldt	0	1	2	3
Imperial	0	0	0	0
Inyo	0	0	0	0
Kern	0	0	5	5
Kings	0	0	1	1
Lake	0	1	1	2
Lassen	0	0	0	0
Los Angeles	9	52	105	166
Madera	0	0	0	0
Marin	0	4	9	13
Mariposa	0	0	0	0
Mendocino	0	1	0	1
Merced	0	0	3	3
Modoc	0	0	0	0
Mono	0	0	0	0
Monterey	0	1	5	6
Napa	0	0	2	2
Nevada	0	0	1	1
Orange	1	12	31	44
Placer	0	2	1	3
Plumas	0	0	0	0
Riverside	1	3	14	18
Sacramento	1	3	7	11
San Benito	0	0	1	1
San Bernardino	2	7	17	26
San Diego	6	23	83	112
San Francisco	3	4	28	35
San Joaquin	0	3	7	10
San Luis Obispo	0	1	1	2
San Mateo	1	7	12	20
Santa Barbara	0	5	8	13
Santa Clara	14	20	34	68
Santa Cruz	1	1	3	5
Shasta	0	0	0	0
Sierra	0	0	0	0
Siskiyou	0	0	0	0
Solano	1	3	3	7
Sonoma	0	2	10	12
Stanislaus	0	4	4	8
Sutter	1	0	0	1
Tehama	0	1	0	1
Trinity	0	0	0	0
Tulare	0	1	4	5
Tuolumne	0	1	0	1
Ventura	1	3	9	13
Yolo	0	1	6	7
Yuba	0	0	3	3
TOTAL	**57**	**200**	**486**	**743**

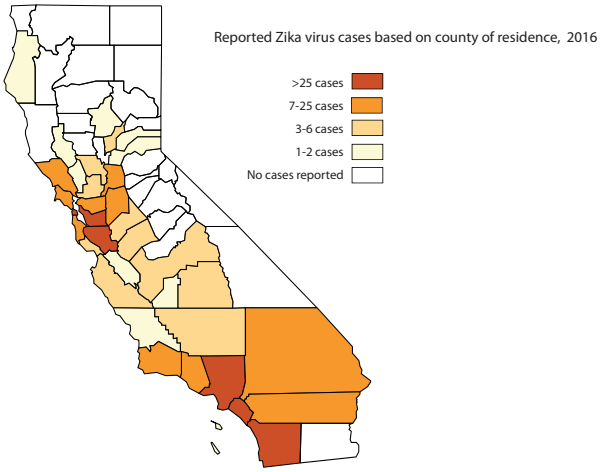

Figure 4.2. Counties with travel-associated Zika virus cases, California, 2016

America (18), South East Asia (8), Pacific Islands (2), and Africa (1). Exact travel exposure region was not discernible for four case-patients. Five case-patients were infected through sexual contact with an infected returned traveler, and three case-patients were congenital infections. Four infections were identified through blood bank testing. Eighty case-patients were pregnant at time of diagnosis.

Mosquito surveillance

In 2016, a total of 1,194,259 mosquitoes (44,606 pools) collected in 37 counties were tested at the University of California, Davis Arbovirus Research and 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. Two local agencies also tested an additional 8,034 mosquitoes (328 pools) for WNV using a commercial rapid assay-RAMP® (Rapid Analyte Measurement Platform, Response Biomedical Corp) (Table 4.3).

West Nile virus (WNV) was detected in 3,528 mosquito pools from 31 counties; 3,485 were positive by qRT-PCR and 43 were positive by RAMP only (Tables 4.3, 4.8). St. Louis encephalitis virus was detected in 180 mosquito pools from eight counties (Table 4.5). Statewide, the WNV minimum infection rate (MIR), defined as the number of infected mosquito pools divided by the total number of mosquitoes tested multiplied by 1,000, of WNV in all mosquitoes tested

Table 4.3. West Nile Virus (WNV) positive mosquito pools and minimum infection rate, by county, California 2016

County	No. mosquitoes tested[a]	No. mosquito pools tested	WNV positive pools[a]	WNV Minimum Infection Rate[b]
Alameda	4,486	282	2	0.4
Alpine	0			
Amador	0			
Butte	18,600	396	48	2.6
Calaveras	0			
Colusa	0			
Contra Costa	15,594	493	11	0.7
Del Norte	0			
El Dorado	0			
Fresno	37,780	1,094	185	4.9
Glenn	2,635	54	11	4.2
Humboldt	0			
Imperial	2,587	527	1	0.4
Inyo	0			
Kern	24,645	629	80	3.2
Kings	16,205	521	118	7.3
Lake	20,289	685	39	1.9
Lassen	0			
Los Angeles	110,665	3,188	436	3.9
Madera	15,178	473	101	6.7
Marin	2,662	151	0	0.0
Mariposa	0			
Mendocino	0			
Merced	9,017	348	12	1.3
Modoc	0			
Mono	0			
Monterey	215	5	0	0.0
Napa	3,430	162	4	1.2
Nevada	0			
Orange	140,761	5,084	444	3.2
Placer	36,863	2,676	103	2.8
Plumas	0			
Riverside	190,148	5,644	32	0.2
Sacramento	92,981	5,652	455	4.9
San Benito	0			
San Bernardino	91,634	3,727	82	0.9
San Diego	14,370	647	99	6.9
San Francisco	972	45	0	0.0
San Joaquin	67,456	2,769	350	5.2
San Luis Obispo	814	22	0	0.0
San Mateo	690	235	5	7.2
Santa Barbara	7,896	205	0	0.0
Santa Clara	4,289	357	13	3.0
Santa Cruz	4,237	320	3	0.7
Shasta	13,882	485	12	0.9
Sierra	0			
Siskiyou	0			
Solano	10,604	298	16	1.5
Sonoma	14,095	595	2	0.1
Stanislaus	55,150	1,458	259	4.7
Sutter	10,586	277	68	6.4
Tehama	0			
Trinity	0			
Tulare	89,216	2,688	260	2.9
Tuolumne	0			
Ventura	522	12	0	0.0
Yolo	66,277	2,593	259	3.9
Yuba	4,862	137	18	3.7
Total	**1,202,293**	**44,934**	**3,528**	**2.9**

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

[b] Minimum Infection Rate = (No. pools positive/No. mosquitoes tested) X 1,000

was 2.9; the MIR was highest (7.3) in Kings County (Table 4.3, Figure 4.3). Since 2003, the MIR of WNV in California has ranged from a low of 0.08 (2003) to a high of 3.9 (2014). West Nile virus was identified from seven *Culex species (Cx. erythrothorax, Cx. pipiens, Cx. quinquefasciatus, Cx. restuans, Cx. stigmatosoma, Cx. tarsalis, and Cx. thriambus*) and two *Aedes* species (*Ae. aegypti* and *Ae. albopictus*) (Table 4.4). St. Louis encephalitis virus was identified in *Cx. quinquefasciatus* and *Cx. tarsalis*. In 2016, the first detection of WNV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in Los Angeles County on April 6. The last detection of WNV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in Orange County on December 14. The first and last detection of SLEV in mosquitoes were from *Cx. quinquefasciatus* pools collected on May 11 (Kern County) and November 10 (Riverside County).

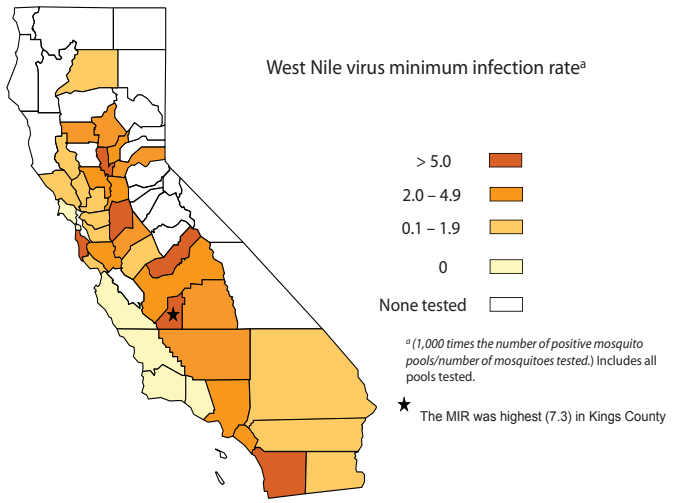

Figure 4.3. West Nile Virus minimum infection rate of *Culex* spp. mosquitoes, by county, California, 2016

Table 4.4. West Nile virus (WNV) positive mosquito pools and minimum infection rate, by mosquito species, California 2016

Mosquito Species	No. Pools Tested	No. Mosquitoes	WNV +	Minimum Infection Rate[a]
***Culex* species**				
Cx. erythrothorax	1,972	80,512	8	0.1
Cx. pipiens	8,887	155,602	614	3.9
Cx. quinquefasciatus	15,680	460,739	1,502	3.3
Cx. restuans	4	122	1	8.2
Cx. stigmatosoma	977	12,010	12	1.0
Cx. tarsalis	15,766	479,382	1,386	2.9
Cx. territans	1	7	0	0.0
Cx. thriambus	124	556	1	1.8
unknown	8	74	0	0.0
All *Culex*	**43,419**	**1,189,004**	**3,524**	**3.0**
***Anopheles* species**				
An. franciscanus	17	52	0	0.0
An. freeborni	15	38	0	0.0
An. hermsi	10	151	0	0.0
An. punctipennis	1	3	0	0.0
All *Anopheles*	**43**	**244**	**0**	**0.0**
***Aedes* species**				
Ae. aegypti	925	4,611	3	0.7
Ae. albopictus	258	2,412	1	0.4
Ae. dorsalis	1	2	0	0.0
Ae. increpitus	1	3	0	0.0
Ae. sierriensis	1	8	0	0.0
Ae. squamiger	3	47	0	0.0
Ae. vexans	7	339	0	0.0
Ae. washinoi	6	175	0	0.0
All *Aedes*	**1,202**	**7,597**	**4**	**0.5**
Other species				
Culiseta incidens	205	4,564	0	0.0
Culiseta inornata	46	324	0	0.0
Culiseta particeps	17	460	0	0.0
Unknown	2	100	0	0.0
All other	**270**	**5,448**	**0**	**0.0**

[a] Minimum Infection Rate = (No. pools positive/No. mosquitoes tested) X 1,000

Three human SLEV disease cases were detected in 2016; these were the first reported SLEV cases in California since 1997.

Animal surveillance

Chicken serosurveillance

In 2016, 30 local mosquito and vector control agencies in 26 counties maintained 144 sentinel chicken flocks (Table 4.6). Blood samples were collected from chickens every other week and tested for antibodies to SLEV, WNV, and Western Equine Encephalitis virus (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 10,295 chicken blood samples tested, 343 seroconversions to WNV were detected among 82 flocks in 19 counties (Tables 4.6, 4.8). In addition, four SLEV seroconversions were detected among three flocks in two counties (Table 4.5). Statewide, 32% of sentinel chickens seroconverted to WNV. Since 2003, the percentage of WNV seroconversions in chickens has ranged from a low of 3.2% (2003) to a high of 37% (2015). In 2016, the first WNV seroconversion was detected in San Diego County on May 17, and the last seroconversion was detected in Los Angeles County on November 9. The first SLEV seroconversion was detected on July 12 in

Table 4.5. Infections with St. Louis encephalitis virus in humans, mosquito pools, and sentinel chickens, by county, California, 2016

County	Humans	Mosquito Pools	Sentinel Chickens
Fresno	1	1	NT
Kern	1	75	NT
Kings	0	4	NT
Los Angeles	0	2	2
Madera	0	3	0
Orange	0	2	NT
Riverside	0	92	NT
Sacramento	1	0	0
San Bernardino	0	0	2
Tulare	0	1	NT
State Totals	**3**	**180**	**4**

NT= no samples tested

San Bernardino County, and the last seroconversion was detected in Los Angeles County on October 5.

Dead bird surveillance for West Nile virus

In 2016, the WNV hotline and website received 10,632 dead bird reports from the public in 53 counties (Table 4.7). Oral swabs from dead bird carcasses were tested either at the DART laboratory by qRT-PCR or at one of 14 local agencies by qRT-PCR or RAMP. Of the 2,880 carcasses deemed suitable for testing, WNV was detected in 1,352 (47%) carcasses from 33 counties; 1,300 by qRT-PCR and 52 by RAMP (Tables 4.7, 4.8, Figure 4.4). Since 2003, the prevalence of WNV positive dead birds

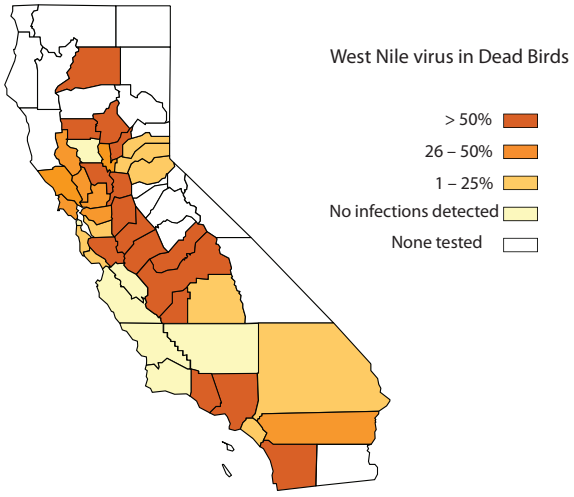

Figure 4.4. Prevalence of West Nile virus infection in dead birds, California, 2016

Table 4.6. Results of testing sentinel chickens for West Nile (WNV) virus, by county, California 2016

County	No. flocks	No. chickens[a]	No. WNV positive flocks	WNV positive sera
Alameda	2	10	0	0
Alpine	0			
Amador	0			
Butte	7	42	7	38
Calaveras	1	7	0	0
Colusa	1	10	1	9
Contra Costa	5	50	2	5
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	11	2	5
Lassen	0			
Los Angeles	50	328	33	126
Madera	0			
Marin	0			
Mariposa	0			
Mendocino	0			
Merced	8	48	8	35
Modoc	0			
Mono	0			
Monterey	0			
Napa	0			
Nevada	4	24	1	1
Orange	0			
Placer	2	12	2	7
Plumas	0			
Riverside	0			
Sacramento	2	10	1	3
San Benito	1	10	0	0
San Bernardino	10	80	6	23
San Diego	2	20	1	9
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	1	1
Santa Cruz	2	20	0	0
Shasta	7	52	3	3
Sierra	0			
Siskiyou	0			
Solano	3	35	2	10
Sonoma	0			
Stanislaus	0			
Sutter	6	42	6	33
Tehama	3	30	2	8
Trinity	0			
Tulare	0			
Tuolumne	0			
Ventura	5	52	0	0
Yolo	2	10	1	4
Yuba	2	14	2	13
Total	**144**	**1,063**	**82**	**343**

[a] Reflects planned standard number of chickens per flock. Actual number may vary due to mortality or replacement of seroconverted chickens.

Table 4.7. Dead birds reported, tested[a], and positive for West Nile virus, by county, California 2016

County	Reported	Tested	Positive	(%)
Alameda	323	51	11	(21.6)
Alpine	0			
Amador	10	0		
Butte	185	43	22	(51.2)
Calaveras	25	0		
Colusa	5	1	0	(0)
Contra Costa	861	75	33	(44.0)
Del Norte	0			
El Dorado	108	16	4	(25.0)
Fresno	214	8	6	(75.0)
Glenn	15	6	4	(66.7)
Humboldt	19	0		
Imperial	1	0		
Inyo	2	0		
Kern	63	1	0	(0)
Kings	22	6	4	(66.7)
Lake	58	16	5	(31.3)
Lassen	0			
Los Angeles	1,103	188	124	(66.0)
Madera	27	9	5	(55.6)
Marin	106	10	5	(50.0)
Mariposa	6	0		
Mendocino	20	0		
Merced	76	9	5	(55.6)
Modoc	6	0		
Mono	2	0		
Monterey	46	1	0	(0)
Napa	42	3	1	(33.3)
Nevada	41	10	2	(20.0)
Orange	683	408	91	(22.3)
Placer	308	190	30	(15.8)
Plumas	0			
Riverside	157	41	16	(39.0)
Sacramento	1,771	701	411	(58.6)
San Benito	5	1	0	(0)
San Bernardino	109	27	5	(18.5)
San Diego	737	367	264	(71.9)
San Francisco	52	8	0	(0)
San Joaquin	317	70	37	(52.9)
San Luis Obispo	31	5	0	(0)
San Mateo	529	111	15	(13.5)
Santa Barbara	41	3	0	(0)
Santa Clara	882	163	89	(54.6)
Santa Cruz	125	26	2	(7.7)
Shasta	53	4	3	(75.0)
Sierra	0			
Siskiyou	5	0		
Solano	144	30	13	(43.3)
Sonoma	175	24	8	(33.3)
Stanislaus	299	26	14	(53.8)
Sutter	79	24	10	(41.7)
Tehama	28	0		
Trinity	1	0		
Tulare	76	16	3	(18.8)
Tuolumne	2	0		
Ventura	230	46	34	(73.9)
Yolo	367	129	72	(55.8)
Yuba	40	7	4	(57.1)
Totals	**10,632**	**2,880**	**1,352**	**(46.9)**

[a] Tested by the University of California Davis Arboviral Research and Training or local mosquito/vector control agency

has ranged from a low of 5% (2003) to a high of 60% (2014). In 2016, the first WNV positive dead bird was a Cooper's hawk reported from San Diego County on January 20, and the last WNV positive dead bird was an American crow reported from Orange County on December 27.

Invasive mosquito surveillance

Invasive *Aedes* mosquitoes have been detected in California since 2011 when *Aedes albopictus*, also known as the Asian tiger mosquito, was first discovered in Los Angeles County. *Ae. aegypti*, also known as the yellow fever mosquito, was later detected in 2013 in Fresno, Madera, and San Mateo counties, followed in 2014 by *Ae. notoscriptus*, native to Australia, in Los Angeles County. All three species live in close association with human-made environments and are container breeders. *Aedes aegypti* is the primary worldwide vector of chikungunya, dengue, yellow fever, and Zika viruses, *Aedes albopictus* can serve as a vector of these arboviruses, and *Ae. notoscriptus* is an important urban vector of dog heartworm in Australia. The emergence of Zika virus required local vector control agencies to prepare for and respond to travel-associated human cases to minimize the potential for local transmission to occur in areas with established populations of *Ae. aegypti* or *Ae. albopictus*. In 2016, a total of 4,611 *Ae. aegypti* and 2,412 *Ae. albopictus* tested negative for dengue, chikungunya, and Zika. Three *Ae. aegypti* and one *Ae. albopictus* were positive for WNV (Table 4.4).

Since 2011, surveillance by local vector control agencies confirmed the presence of invasive *Aedes* mosquitoes in 127 cities or census-designated places (CDP) in 12 counties (Figure 4.5). In 2016, new detections in cities and CDPs increased for Ae. *aegypti* (14 new detections), *Ae. albopictus* (17 new detections), and *Ae. notoscriptus* (5 new detections). Surveillance and control efforts encouraged public involvement as invasive *Aedes* continued to spread in the urban environment. Affected agencies incorporated *Aedes*-specific traps including ovicups, Biogents Sentinel traps, and autocidal gravid ovitraps into the surveillance programs. In 2016, VBDS optimized molecular assays to test for pesticide resistance in *Aedes aegypti* mosquitoes and anticipates adding this service to surveillance and control efforts.

Table 4.8. Infections with West Nile virus in humans, dead birds, mosquito pools, and sentinel chickens, by county, California, 2016

County	Humans [a]	Dead Birds	Mosquito Pools	Sentinel Chickens
Alameda	0	11	2	0
Alpine	0	NT	NT	NT
Amador	1	NT	NT	NT
Butte	21	22	48	38
Calaveras	0	NT	NT	0
Colusa	2	0	NT	9
Contra Costa	4	33	11	5
Del Norte	0	NT	NT	NT
El Dorado	1	4	NT	NT
Fresno	16	6	185	NT
Glenn	6	4	11	10
Humboldt	0	NT	NT	NT
Imperial	0	NT	1	NT
Inyo	0	NT	NT	NT
Kern	17	0	80	NT
Kings	8	4	118	NT
Lake	1	5	39	5
Lassen	0	NT	NT	NT
Los Angeles	163	124	436	126
Madera	7	5	101	NT
Marin	0	5	0	NT
Mariposa	0	NT	NT	NT
Mendocino	0	NT	NT	NT
Merced	0	5	12	35
Modoc	0	NT	NT	NT
Mono	0	NT	NT	NT
Monterey	1	0	0	NT
Napa	0	1	4	NT
Nevada	0	2	NT	1
Orange	36	91	444	NT
Placer	7	30	103	7
Plumas	0	NT	NT	NT
Riverside	12	16	32	NT
Sacramento	29	411	455	3
San Benito	0	0	NT	0
San Bernardino	8	5	82	23
San Diego	22	264	99	9
San Francisco	1	0	0	NT
San Joaquin	14	37	350	NT
San Luis Obispo	1	0	0	NT
San Mateo	0	15	5	0
Santa Barbara	0	0	0	0
Santa Clara	1	89	13	1
Santa Cruz	0	2	3	0
Shasta	1	3	12	3
Sierra	0	NT	NT	NT
Siskiyou	0	NT	NT	NT
Solano	4	13	16	10
Sonoma	0	8	2	NT
Stanislaus	30	14	259	NT
Sutter	14	10	68	33
Tehama	6	NT	NT	8
Trinity	0	NT	NT	NT
Tulare	11	3	260	NT
Tuolumne	0	NT	NT	NT
Ventura	7	34	0	0
Yolo	20	72	259	4
Yuba	11	4	18	13
State Totals	**483**	**1,352**	**3,528**	**343**

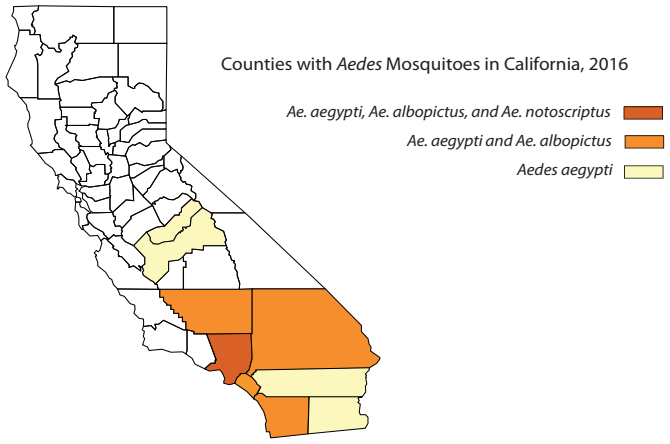

Figure 4.5. Invasive *Aedes* Mosquito Detections, by County, California, 2016

5 U.S. Forest Service Cost-Share Agreement

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

Major objectives and activities related to the United States Department of Agriculture Forest Service (USFS) cost-share agreement include:

- Surveillance of and response to vector-borne diseases (VBD) including visual campground assessment, small mammal trapping and testing, and tick collection and testing
- Flea treatment of campgrounds if plague risk deemed elevated
- Forest Service facility and campground evaluations and recommendations for VBD risk reduction
- Education of personnel, concessionaires, and the public in the 18 National Forests in California through safety presentations, videos, and social media
- Provision of public health educational materials to concessionaires, USFS offices, and public information displays
- Responded to other insect and vector-related queries from USFS personnel

This report briefly reviews activities carried out under the agreement by the California Department of Public Health, Vector-Borne Disease Section (CDPH-VBDS) and local collaborators in 2016. For each forest, activities and testing results for selected vector-borne diseases are summarized in Tables 5.1 through 5.3, and highlights are described below.

2016 U.S. Forest Service Highlights

Campground closure and flea treatment to interrupt plague transmission were performed in two Forests: Lake Tahoe Basin Management Unit (LTBMU) and Sequoia National Forest (Tables 5.1, 5.2).

Fifty-six (8.6%) of 648 rodents tested positive for exposure to plague, an increase from 7.5% in 2015 and the highest level since recording USFS Region 5 statistics began in 1998 (Table 5.3).

Seven (39%) of 18 Region 5 Forests had evidence of plague activity (Inyo, LTBMU, Modoc, San Bernardino, Sequoia, Sierra, and Tahoe National Forests) (Tables 5.1- 5.3).

Tick-borne relapsing fever (TBRF) cases with exposure in structures on National Forest lands led to VBDS field investigations on the Inyo and Stanislaus National Forests. One soft tick collected from the Inyo National Forest tested positive for *Borrelia hermsii*, the causative agent for TBRF (Tables 5.2, 5.3).

Table 5.1: Summary of United States Forest Service activities (Region 5) performed by the California Department of Public Health under the CDPH-VBDS Cost-Share Agreement, 2016

National Forest	Disease Risks Addressed	Facility Evaluation	Presentation Audiences	Forest Locations Visited[1]
Angeles	Hantavirus; Plague	San Dimas Experimental Forest	Forest Supervisors Office	Jackson Lake Picnic Area; Jackson Lake, Mountain Oak, and Table Mountain campgrounds
Cleveland	Hantavirus; Plague; Tick-borne diseases			Holy Jim Canyon; Maple Springs Rd.; Maple Springs Truck Trail
Eldorado	Hantavirus; Plague	Lumberyard Fire Station, Crystal Basin Information Station	Lumberyard Fire Station, Dew Drop Fire Station, Georgetown Ranger Station	Leek Springs Fire Lookout; China Flat Campground; Pacific and Placerville Ranger Districts
Inyo	Plague; Tick-borne diseases	Crooked Creek Research Station for TBRF	Bishop All-Employee Safety Meeting, Rock Creek Fire Incident Command Center	Supervisor's Office; Schulman Grove Visitor Center; Cottonwood Canyon; Ellery, Four Jeffrey, Grandview, Holiday, North Lake, Rock Creek, Saddleback Lake, Sherwin Creek, Tuff, and Upper Grays Meadow campgrounds; Long-term leased lands in and around Mammoth Lakes and June Lake
Klamath	Hantavirus; Plague	Ti Bar Wildland Fire Station; Oak Bottom Station		
Lake Tahoe Basin Management Unit	Hantavirus; Plague; Tularemia		California Land Management (concessionaire)	LTBMU Supervisors Office; Tallac Historic Site; Taylor Creek Visitor Center
Lassen	Plague	Almanor Ranger District Office	Almanor Ranger District	
Los Padres	Plague; Tick-borne diseases			Ojai, Santa Barbara, and Santa Lucia Ranger District Offices; Arroyo Seco, Cerro Alto, Chuchupate, Los Prietos, Upper Oso, and Wheeler Gorge campgrounds; Sisar Canyon Trail
Mendocino	Plague; Tick-borne diseases		Alder Springs Fire Station	
Modoc	Hantavirus; Plague			Blue Lake and Medicine Lake campgrounds
Plumas	Tick-borne diseases		Feather River Ranger District	Laufman Fire Station; Bucks Lake and Blue Lake; Big Cove, Chilicoot, Cottonwood Springs Group, Frenchman, Grasshopper Flat, Grizzly, Lighting Tree, and Spring Creek campgrounds; Chambers Creek and Pacific Crest trails
San Bernardino	Hantavirus; Plague; Tick-borne diseases			Lytle Creek Ranger Station; Loch Leven; Middle Fork Lytle Creek, Momyer-Alger Creek, Penstock Rd., San Sevaine Rd., and Warm Springs Truck trails; San Gorgonio campground
Sequoia	Plague		Kern River Ranger District	Fish Creek, Live Oak, and Stony Creek campgrounds
Shasta-Trinity	Plague	Big Bar Fire Station		
Sierra	Plague; Tick-borne diseases			Bass Lake, Dorabelle, Forks, and Wishon campgrounds
Six Rivers	Hantavirus; Plague	Orleans Ranger District Office		
Stanislaus	Plague	Camp Jack Hazard	Calaveras Ranger District; Groveland Ranger District; Mi-Wok Ranger District	Forest Supervisor's Office; Big Meadow; Camp Wolfboro; New Spicer Reservoir; Stanislaus River; Union Reservoir; Union Valley West; Cottonwood and Douglas picnic areas; Cascade Creek, Clark Fork Horse, Eureka Valley, Pigeon Flat, Pioneer Trail Group, and Sand Flat campgrounds; Arnot Creek, Clark Fork, Columns of the Giants, County Line, Disaster Creek, Kennedy Meadows, Saint Mary's Pass, Sonora Pass, and Wheats Meadow trailheads; Donnell Vista Point; Baker, Boulder Flat, Brightman Flat, Camp Llahona Alp, Clark Fork, Dardanelles, Deadman, Fraser Flat, Meadowview, Mill Creek, Peaceful Pines, Pinecrest, Sand Flat (Alp), and Utica Reservoir campgrounds; Spicer Meadow Trailhead
Tahoe	Hantavirus; Plague; Tick-borne diseases	Saddleback Fire Lookout	American River Ranger District; Sierraville Ranger District; Truckee Ranger District; Yuba River Ranger District	Berger Creek Campground and Packer Lake Day Use Area; Boca, Boca Springs, Boyington Mill, Emigrant, Goose Meadows, Granite Flat, Lakeside, Logger, Prosser, Silver Creek, Hampshire Rocks, White Cloud, and Skillman Horse campgrounds; South Yuba River Trail

[1] Locations visited by VBDS biologists and not already listed under facility evaluation.

Table 5.2: Unique services and findings, performed by the California Department of Public Health under the United States Forest Service Activities (Region 5), CDPH-VBDS Cost-Share Agreement, 2016

National Forest	Unique Services/ Unusual Findings
Eldorado	Upon Forest Service Staff request, provided recommendations for yellow jacket infestation prevention and control at Sand Flat and Silver Fork campgrounds.
Inyo	Collected a *Ornithodoros coriaceus* soft tick. Provided tick identification and disease prevention session at Rock Creek Fire Incident Command Center.
Lake Tahoe Basin Management Unit	Closed Fallen Leaf campground and conducted flea suppression due to plague positive flea pool and rodent serologies. Provided historic plague data and reviewed a USFS document to be presented to the Nevada State Legislature.
Lassen	Provided Almanor Ranger District Engineers with rodent management and exclusion document and onsite rodent exclusion recommendations during new facility construction.
Los Padres	Provided Mt. Pinos District Resource Officer with hantavirus "tool kit" and flash drive.
Modoc	Provided recommendations on plague risk reduction in response to plague positive rodent serologies from Patterson Meadow campground.
Plumas	Evaluated rodent exclusion work conducted at the Feather River Ranger District.
San Bernardino	Provided recommendations on plague risk reduction in response to plague positive rodent serologies from Dark Canyon and Marion Mountain campgrounds.
Sequoia	Closed Troy Meadow campground and conducted flea suppression due to high rodent seroprevalence for plague.
Sierra	Provided recommendations on plague risk reduction in response to plague positive rodent serology from Camp Edison campground. Detected spotted fever group *Rickettsia* in a tick from Hite Cove Trail.
Six Rivers	Met with Willow Creek Fire Station Captain regarding rodent ingress issues.
Stanislaus	Identified a tick (*Ixodes pacificus*)submitted from an employee.
Tahoe	Provided recommendations on plague risk reduction in response to plague positive rodent serologies at Boca and Stampede Reservoir campgrounds. Detected *Borrelia miyamotoi* from one *Ixodes pacificus* tick from Convict Flat Day Use Area.
R5 (District Level)	Held annual meeting with Region 5 leadership. Updated spatial maps of plague and tick surveillance on USFS lands. Provided pre-season letter for distribution throughout Region 5. Updated Region 5 liaison and Safety Officer regarding increased plague activity. Provided hantavirus facility risk assessment reports.

Table 5.3: Testing results for selected vector-borne disease agents in U.S. National Forests, California, 2016

National Forest	Hantavirus		*Yersinia pestis*						*Francisella tularensis*		*Borrelia* spp.[b]		*Rickettsia spp.*[c]	
	Peromyscus mice		Rodents		Flea pools		Carnivores[a]		Rodents		*Ixodes* ticks		*Dermacentor* ticks	
	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested
Angeles	0	15	0	98			0	7						
Cleveland			0	2							0	48	0	42
Eldorado	0	18	0	9			0	1						
Inyo			3	108	0	11	0	3			1	14[d]	0	4
Klamath	0	15					0	21						
Lake Tahoe BMU	1	2	16	69	1	40			0	8				
Lassen							0	1						
Los Padres			0	69			0	14			0	33	0	7
Mendocino							0	5			0	61	0	29
Modoc	1	15	2	69										
Plumas			0	20	0	2					0	18	0	17
San Bernardino	0	26	2	42							0	194		
Sequoia			28	70	0	24	3	3						
Shasta-Trinity							0	1						
Sierra			1	14	0	9	0	3			0	6	1	18
Six Rivers	0	3	0	3										
Stanislaus			0	17			0	8						
Tahoe	0	11	4	58	0	30					1	14		
Total, all forests	**2**	**105**	**56**	**648**	**1**	**116**	**3**	**67**	**0**	**8**	**2**	**374**	**1**	**117**

[a] 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.

[b] *Borrelia* spp. results do not differentiate *Borrelia burgdorferi,* causative agent for Lyme disease, and *Borrelia miyamotoi,* a relapsing fever-type spirochete.

[c] *Rickettsia* spp results do not differentiate between *Rickettsia philipii,* causative agent for Pacific Coast Tick Fever, and *Rickettsia rickettsii* , causative agent for Rocky Mountain spotted fever.

[d] Reflects *Borrelia hermsii* testing by UC Irvine on *Ornithodoros hermsi* ticks collected during tick-borne relapsing fever case investigations.

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 (VBDS) approved 141 continuing education events in 2016. Successful examinees who 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 2016, 1,311 Vector Control Technicians employed at 112 local public health agencies and the California Department of Public Health (CDPH) held 3,100 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, 78 are signatory to a cooperative agreement with CDPH.

In 2016, 899 individuals employed at 78 agencies held full certification status. In addition, 412 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: https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Vector-Control-Technician-Certification-Program.aspx

Table 6.1. Results of certification examinations administered in 2016

Exam section	No. Exams Given	No. Passed (%)
Core	144	104 (72)
Mosquito Control	156	83 (53)
Terrestrial Invertebrate Control	124	69 (56)
Vertebrate Vector Control	96	71 (74)
Totals	**520**	**327 (67)**

Table 6.2. Vector Control Technician certificates in effect as of December 2016

	No. Certificates		
Certification Category	**Full Status**	**Limited Status**	**Total**
Mosquito Control	882	266	1,148
Terrestrial Invertebrate Vector Control	697	222	919
Vertebrate Vector Control	712	321	1,033
Totals	**2,291**	**809**	**3,100**

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 approaches including presentations, development and distribution of printed and electronic materials, and maintenance of 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.

New public education materials in 2016

Mosquitoes

- *Guide to Mosquitoes in California* (online table)
- *Invasive Aedes* (online brochure)
- *Protect Yourself from Mosquito Bites* (English/Spanish; poster)
- *Aedes aegypti fact sheet* (flier)

Mosquito-borne disease

- *Guidance for Surveillance of and Response to Invasive Aedes Mosquitoes and Dengue, Chikungunya, and Zika in California* (guidance)
- *Operational Checklist for Local Health Departments, Local Vector Control Agencies, and the California Department of Public Health in the Event of Local Dengue, Chikungunya, or Zika Transmission* (checklist, forms)
- *Dengue Fact Sheet* (flier)
- *Hoja de Información Sobre Dengue* (flier)
- *Chikungunya Fact Sheet* (flier)
- *Hoja de Información Sobre Chikungunya* (flier)
- *California Zika Response Activities and Resources* (resource list)
- *Zika Questions and Answers* (English/Spanish, flier)
- *Zika Virus Information for Healthcare Providers* (flier)[1]
- *Procedures for Blood Donors Who Test Positive for Zika Virus* (guidance)
- *Guidance for Reporting and Follow-up of Zika Virus Infected Blood Donors and Potential Local Transmission of Zika Virus in California* (guidance)
- *Zika + Pregnancy* (English/Spanish, toolkit)[1]
- *Zika + Sex* (English/Spanish, toolkit)[1]
- *Zika + Travel* (English/Spanish, toolkit)[1]
- *Zika Local Transmission Door Hangers* (English/Spanish)

Other Vector-Borne Diseases

- Category A, B, C, D Study Materials for Vector Control Certification Program (web presentations)

[1]All Zika toolkits co-created with the CDPH Center Family Health

Publications*

Billeter, SA; Vissotto de Paiva Diniz, PP; Jett, LA; Wournell, AL; **Kjemtrup, AM**; **Padgett, KA; Hardstone-Yoshimizu, M; Metzger, ME**; Barr, MC. Detection of *Rickettsia* Species in Fleas Collected from Cats in Regions Endemic and Nonendemic for Flea-Borne Rickettsioses in California. Vector-borne and Zoonotic Diseases 2016 16(3):151-6. doi: 10.1089/vbz.2015.1869

Danforth, M; Novak, M; Petersen, J; Mead, P; Kingry, L; Weinburke, M; Buttke, D; **Hacker, G; Tucker, J; Niemela, M; Jackson, B; Padgett, K; Liebman, K;** Vugia, D; **Kramer, V**. Investigation of Response to Two Plague Cases, Yosemite National Park, California, USA, 2015. Emerging Infectious Diseases 2016 22(12): 2045. doi: 10.3201/eid2212.160560

Feiszli, T; Padgett, K; Simpson, J; Barker, CM; Fang, Y; Salas M; **Foss, L**; Messenger S; and **Kramer, V**. Surveillance for Mosquito-borne Encephalitis Virus Activity in California, 2015. Proceedings and Papers of the 84th Annual Conference of the Mosquito and Vector Control Association of California, 2016 84: 124-129.

Foss, L; Reisen, WK; Fang, Y; **Kramer, V; Padgett, K**. 2016. Evaluation of nucleic acid preservation cards for West Nile virus testing in dead birds. PLoS ONE 11(6): e0157555. Doi: 10.1371/journal.pone.0157555.

Foss, L and Padgett, K. 2016. Public Usage of the West Nile Virus Dead Bird Hotline and Website in 2015. Proc. Mosq. Vector Control Assoc. Calif. 84:37-42.

Lane, R; **Kjemtrup, AM**. Pest Notes: Lyme Disease in California UC ANR Publication 7485 (http://ipm.ucanr.edu/PMG/PESTNOTES/pn7485.html)

Osikowicz, LM; **Billeter, SA**; Rizzo; MF, Rood, MP; Freeman, AN; **Burns, JE; Hu, R**; Juieng, P; Loparez, V; Kosoy, M. Distribution and diversity of *Bartonella washoensis* strains in ground squirrels from California and their potential link to human cases. Vector-borne and Zoonotic Diseases 2016 16(11):683-690. doi: 10.1089/vbz.2016.2009.

Padgett, KA; Bonilla, D; Eremeeva, ME; Glaser, C; Lane, RS; **Cole-Porse, C**; Castro, MB; Messenger, S; Espinosa, A; **Hacker, J**; **Kjemtrup, A**; Ryan, B; Scott, J; **Hu, R**; **Yoshimizu, MH**; Dasch, GA, **Kramer, V**. The Eco-epidemiology of Pacific Coast Tick Fever in California. PLoS Neglected Tropical Diseases. 2016 10 (10): 1-17. Doi:10.1371/journal.pntd.0005020

Russell, K; Hills SL; Oster, AM; **Cole- Porse, C**; Danyluk, G; Cone, M; Brooks, R; Scotland, S; Schiffman, E; Fredette, C; White, JL; Ellingson, K; Hubbard, S; Cohn A; Fischer, M; Mead, P; Powers, AM; Brooks, JT. Male-to-Female Sexual Transmission of Zika Virus- United States, January-April 2016. Clinical Infectious Diseases 2016: ciw692.

Shender, L; **Niemela, M**; Conrad, P; Goldstein, T; Mazet, J. Habitat Management to Reduce Human Exposure to *Trypanosoma cruzi* and Western Conenose Bugs (Triatoma protracta). EcoHealth. 2016 13, 525–534.

Ziedins,AC; Chomel, BB; Kasten, RW; **Kjemtrup, AM**; Chang, C. Molecular epidemiology of *Bartonella* species isolated from ground squirrels and other rodents in northern California.Epid and Inf.; Doi: 10.1017/S0950268816000108.

*Bolded names are 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, https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/VBDS.aspx