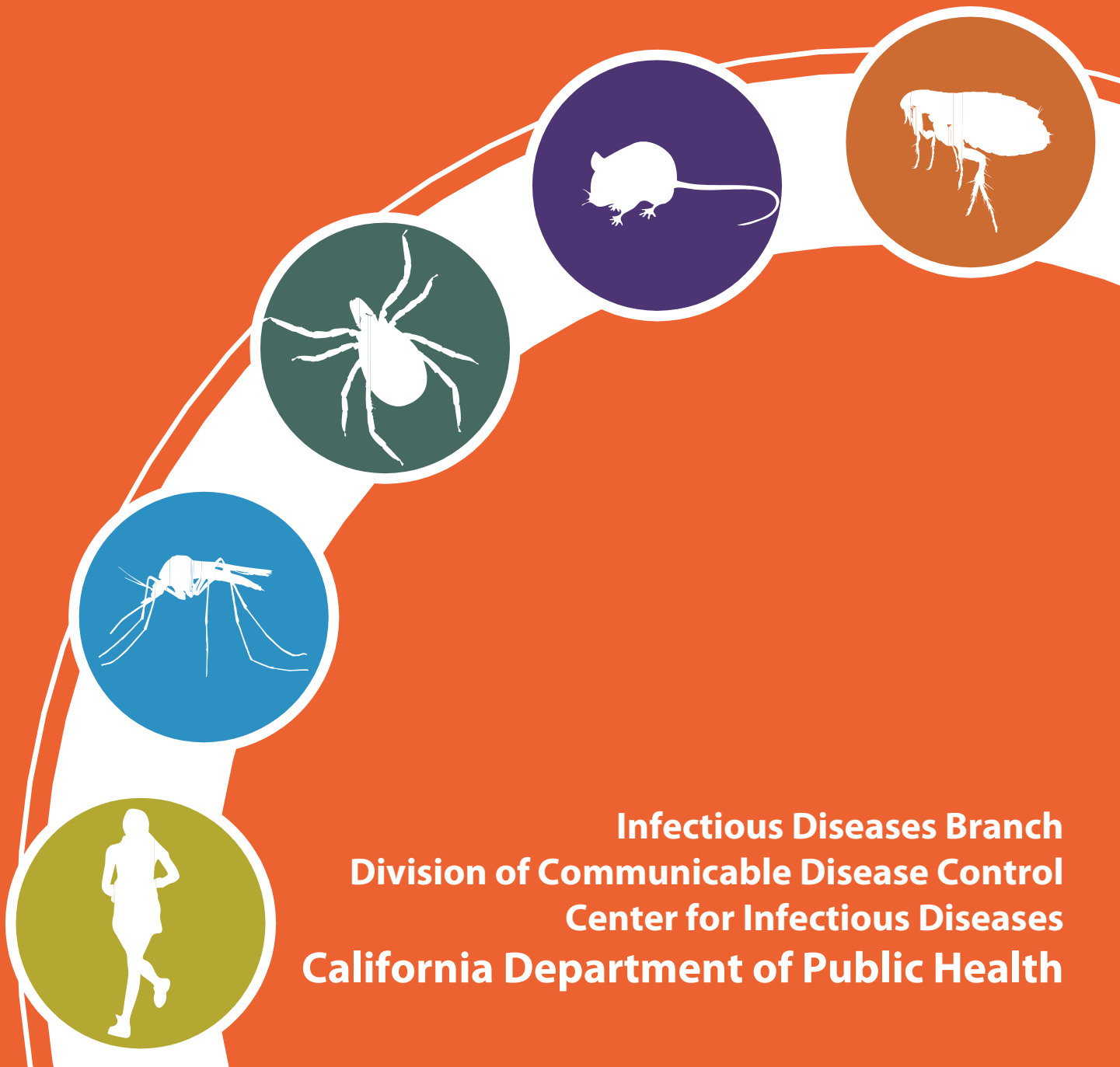
Vector-Borne Disease Section
Annual Report 2017



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

2017

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

CHHS
California Health & Human Services Agency

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California Department of PublicHealth

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Preface

I am pleased to present to you the 2017 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 2017.

In 2017, California experienced elevated West Nile virus (WNV) activity relative to 2016, particularly in southern California. Of the 553 human cases reported, 73% were the severe neuroinvasive form of the disease and there were 44 fatalities. In addition to WNV activity, St. Louis encephalitis virus (SLEV) activity was detected in mosquitoes and sentinel chickens in 14 counties and there were four human cases. This was the first detection of SLEV activity in five northern Central Valley counties since at least 1969.

The number of human cases of Zika virus (126) dropped substantially compared to 2016 (486 cases), which was the peak year of the Zika epidemic in the Americas. However, the *Aedes* mosquito vectors of Zika, dengue, and chikungunya continued to expand their range in California in 2017. *Aedes aegypti* (yellow fever mosquito) infestations were found in two additional counties, with detections expanding from 127 cities in 2016 to 197 in 2017. The range of *Aedes albopictus* (Asian tiger mosquito) increased in southern California but they were not detected in new counties. VBDS continued to work closely with colleagues in counties bordering Mexico to enhance surveillance and response to potential *Aedes*-borne diseases along the border.

There was evidence of plague activity in 10 of the 28 counties where surveillance was conducted; there were no human cases but epizootics in the Tahoe Basin prompted intervention to reduce plague risk. Another flea-borne disease, typhus fever, was reported from Los Angeles and Orange counties. Similar to past years, there were 92 human cases of which 77% required hospitalization. Five cases of hantavirus infection were reported in 2017, with one fatality. For several cases, follow-up investigations indicated potential exposure at workplace or living facilities.

Human cases of six tick-borne diseases were reported in California in 2017, including 156 cases of Lyme disease. Although the number of Lyme disease cases has increased in some regions of the United States, the number of cases reported in California has not fluctuated substantially over the last ten years. VBDS activities in 2017 included expanding nymphal tick surveillance and laboratory capacity, mapping of *Ixodes pacificus* distribution, and enhancing outreach on tick-bite prevention through social media. 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, 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, 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 2017 are listed here.

Rodent-borne Diseases

Alameda County Mosquito Abatement District (MAD); Alameda County Vector Control Services District; Coachella Valley Mosquito and Vector Control District (MVCD); County of San Diego Vector Control Program (VCP); Napa MAD; National Park Service (NPS); Northwest MVCD; Orange County MVCD; Riverside County Department of Environmental Health VCP; San Bernardino County VCP; San Mateo MVCD; Santa Clara County Vector Control District (VCD); United States Forest Service (USFS); University of California Davis School of Veterinary Medicine Department of Veterinary Medicine and Epidemiology; West Valley MVCD.

Flea-borne Diseases

Army Corps of Engineers; Centers for Disease Control and Prevention (CDC); County of El Dorado, Environmental Management Division; Los Angeles County Agricultural Commissioner; Los Angeles County Department of Public Health-Vector Management; NPS; Nevada County Environmental Health Department; Riverside County VCP; San Diego VCP; San Bernardino County VCP; San Mateo MVCD; United States Department of Agriculture Animal and Plant Health Inspection Service, Wildlife Services; USFS; West Valley MVCD.

Tick-borne Diseases

Butte County MVCD; California Department of Fish and Wildlife (CDFW); Davis Arbovirus Research Training (DART) Laboratory; Imperial County Public Health Department; Marin County HHS; Marin-Sonoma MVCD; Napa County MAD; NPS; Orange County MVCD; Placer County MVCD; Sacramento-Yolo County MVCD; San Bernardino County VCP; San Diego VCP; San Mateo County MVCD; Santa Clara County VCD; Santa Cruz County MVCD; Shasta MVCD; Sutter-Yuba MVCD; USFS.

Mosquito-borne Diseases

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

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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, 2017. California Department of Public Health, Sacramento, California, 2018. pp 1-3.

2 Flea-borne Diseases
Tucker, J. and Porse, C. Chapter 2: Flea-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2017. California Department of Public Health, Sacramento, California, 2018. pp 4-6.

3 Tick-borne Diseases
Yoshimizu, M.; Kjemtrup, A. and Porse, C. Chapter 3: Tick-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2017. California Department of Public Health, Sacramento, California, 2018. pp 7-12.

4 Mosquito-Borne Diseases
Feiszli,T.; Snyder, R.; Porse, C. and Metzger, M. Chapter 4: Mosquito-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2017. California Department of Public Health, Sacramento, California, 2018. pp 13-20.

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, 2017. California Department of Public Health, Sacramento, California, 2018. pp 21-24.

6 Vector Control Technician Certification Program
Niemela, M. Chapter 6: Vector Control Technician Certification Program. In: Vector-Borne Disease Section Annual Report, 2018. California Department of Public Health, Sacramento, California, 2018. pp 25-26.

7 Public Information Materials, Publications
Nicolici, A. and Erickson, C. Chapter 7: Public Information Materials, Publications. In: Vector-Borne Disease Section Annual Report, 2017. California Department of Public Health, Sacramento, California, 2018. pp 27-28.

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, 16110-116112; 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 vectors and vector-borne diseases, 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.

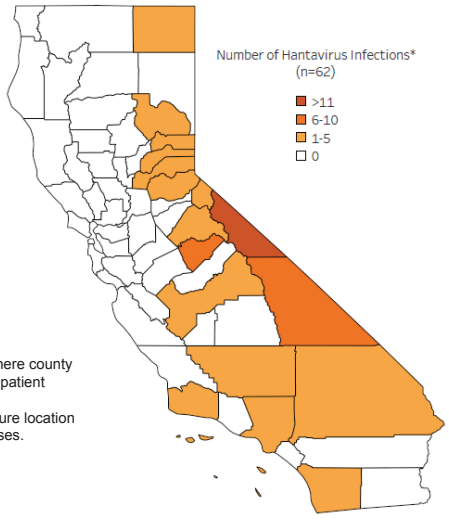
Human disease surveillance

In 2017, hantavirus infection, which includes both hantavirus pulmonary syndrome (HPS) and non-pulmonary hantavirus infection, was diagnosed in five California residents. The first was an Orange County resident who survived HPS. The case-patient's exposure occurred in Utah. The second case was reported in a Sacramento County resident who survived HPS. The case-patient was exposed in Mono County at workplace or living facilities. California Department of Public Health, Vector-Borne Disease Section (CDPH-VBDS) collected 16 deer mice (*Peromyscus maniculatus*) from these facilities: antibodies to Sin Nombre virus (SNV) were detected in six (38%) of the mice. The third case of HPS was reported in an Alameda County resident who survived the infection. Laboratory tests confirmed exposure likely occurred while visiting Nevada or Placer counties. None of the 20 deer mice collected from locations visited by the case-patient tested positive for SNV antibodies. The fourth case was reported in a Mono County resident who survived non-pulmonary hantavirus infection following exposure at workplace or living facilities. A fifth and fatal HPS case identified in 2017 occurred in a Los Angeles resident. Exposure likely occurred in the Tehachapi Mountains in Los Angeles County. Since 1980, hantavirus infection has been diagnosed in 80 California residents, with the majority of cases exposed to SNV in the interior mountain ranges of the state or eastern Sierra (Figure 1.1).

Rodent surveillance

In 2017, 1,175 rodents (Genera: *Neotoma, Microtus, Peromyscus, and Reithrodontomys*) were tested for antibodies to SNV (Table 1.1). Of 1,034 *Peromyscus* spp. sampled, 69 (6.7%) were positive for SNV antibodies. Seroprevalence in deer mice, the primary reservoir for SNV, was 11.4% (Table 1.1). At least one deer mouse was SNV antibody-positive in 11 of 25 counties sampled in 2017 (Table 1.2). SNV antibody has been detected in deer mice from 22 of 38 counties sampled in the last 10 years; prevalence ranged from 0.0% to 33.3% (average 9.4%) over that time period (Table 1.2).

Additionally, 8 (9.6%) of 83 western harvest mice (*Reithrodontomys megalotis*) demonstrated reactivity to SNV (Table 1.1). None of five voles (*Microtus* spp.) and none of 53 woodrats (*Neotoma* spp.) demonstrated reactivity to SNV (Table 1.1). Seropositivity in these rodents may represent



*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 infections (1980 – 2017)

Table 1.1 Serologic evidence of hantavirus (Sin Nombre) infection in California rodents, 2008 - 2017

		2017			2008-2017		
Species	Common name	No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
Peromyscus boylii	brush mouse	33	0	0.0	807	7	0.9
Peromyscus californicus	parasitic mouse	121	1	0.8	1,418	21	1.5
Peromyscus crinitus	canyon mouse	22	2	9.1	101	2	2.0
Peromyscus eremicus	cactus mouse	20	0	0.0	1,769	49	2.8
Peromyscus e. fraterculus	northern Baja mouse	230	3	1.3	1,409	13	0.9
Peromyscus maniculatus	deer mouse	551	63	11.4	4,800	450	9.4
Peromyscus truei	piñon mouse	57	0	0.0	325	3	0.9
Peromyscus sp.	unspeciated *Peromyscus*				2	0	
Peromyscus spp. subtotal		1,034	69	6.7	10,631	545	5.1
Reithrodontomys megalotis	western harvest mouse	83	8	9.6	1,033	104	10.1
Neotoma spp.	woodrats	53	0	0.0	435	2	0.5
Microtus spp.	voles	5	0	0.0	159	24	15.1

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, doing business as Heluna Health (HH), 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 with YOSE and HH staff in 2017 on hantavirus prevention. Activities included rodent surveillance to estimate deer mouse abundance and SNV prevalence, facility evaluations, and improving employee training and public education. In 2017, deer mouse surveillance was conducted in three areas of the park. One (1.9%) of 54 deer mice trapped in Yosemite Valley was positive for SNV antibodies, as was 1 (9.1%) of 11 deer mice trapped in Tuolumne Meadows. At Wawona, none of ten deer mice were reactive to SNV antibodies. In addition, 57 buildings were evaluated for rodent-borne disease risks. HH staff provided recommendations to YOSE and its associated partners based on surveillance results and facility evaluations.

Lassen Volcanic National Park hantavirus prevention

The National Park Service and HH entered into a master agreement in May 2014 that allows park units within California to obtain vector-borne disease related services from HH and CDPH. Lassen Volcanic National Park (LAVO) initiated a task agreement in 2017 for services that included hantavirus risk reduction, including facility evaluations and deer mouse surveillance to estimate rodent abundance and SNV prevalence. In 2017, deer mouse surveillance was conducted in two areas of LAVO. At Drakesbad Guest Ranch, 4 (20%) of 20 deer mice were positive for SNV antibodies, while none of three deer mice at Juniper Lake Ranger Station were reactive to SNV antibodies. In addition, seven buildings in LAVO were evaluated for vector-borne disease risks. HH staff provided recommendations to LAVO and its associated partners based on surveillance results and facility evaluations.

Table 1.2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus* in California, 2008-2017

	2017			2008-2017		
County	No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
Alameda	7	0	0.0	118	0	0.0
Amador	4	0	0.0	8	0	0.0
Butte	6	0	0.0	6	0	0.0
Colusa				2	0	0.0
Contra Costa				13	0	0.0
El Dorado	36	7	19.4	418	101	24.2
Fresno	8	0	0.0	8	0	0.0
Glenn				5	0	0.0
Humboldt	13	0	0.0	13	0	0.0
Inyo	11	5	45.5	26	8	30.8
Kern	19	0	0.0	25	1	4.0
Lassen	3	0	0.0	97	7	7.2
Los Angeles	16	0	0.0	24	0	0.0
Mariposa	46	1	2.2	233	24	10.3
Modoc				35	8	22.9
Mono	16	6	37.5	159	32	20.1
Napa				12	2	16.7
Nevada	16	0	0.0	31	2	6.5
Orange	20	2	10.0	451	42	9.3
Placer	17	0	0.0	89	4	4.5
Plumas	38	8	21.1	78	17	21.8
Riverside	7	1	14.3	409	32	7.8
San Benito				5	0	0.0
San Bernardino	5	0	0.0	280	5	1.8
San Diego	102	4	3.9	1,501	55	3.7
San Francisco				13	0	0.0
San Mateo	66	9	13.6	139	25	18.0
Santa Clara	1	0	0.0	16	0	0.0
Santa Cruz				14	0	0.0
Shasta				91	18	19.8
Sierra				36	1	2.8
Siskiyou	59	18	30.5	103	21	20.4
Sutter	9	0	0.0	9	0	0.0
Tehama				81	16	19.8
Trinity				3	0	0.0
Tulare	7	0	0.0	15	0	0.0
Tuolumne	19	2	10.5	231	28	12.1
Ventura				3	1	33.3
Total	**551**	**63**	**11.4**	**4,800**	**450**	**9.4**

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

Ninety-two cases of typhus fever were reported to the California Department of Public Health (CDPH) in 2017. Fifty-one of these were classified as confirmed cases according to CDPH working surveillance definition and 41 were probable. Seventy-one (77%) of the case-patients required hospitalization. Case-patients were residents of Los Angeles (79), Orange (11), San Luis Obispo, and Santa Clara counties. Typhus is considered endemic in parts of Orange and Los Angeles counties. The case-patients from San Luis Obispo and Santa Clara counties reported travel outside the United States during the incubation period.

Plague

No cases of plague in humans were reported in 2017.

Animal disease surveillance

Domestic pets

No cases of plague in domestic pets were reported in 2017.

Wild animals

The CDPH-VBDS plague surveillance program tested 922 wild rodents and 90 carnivores from 28 California counties in 2017. Plague bacteria (*Yersinia pestis*) was detected in one rodent from Nevada County (Figure 2.1, Table 2.1). Additionally, 14 rodents and 4 carnivores from 10 counties tested positive for serum antibodies to *Yersinia pestis* (Table 2.2). Independent county-wide plague surveillance programs included San Diego County Department of Environmental Health, Vector Control Program and Los Angeles County Public Health - Vector Management. San Diego tested 431 rodents, finding two California ground squirrels (*Otospermophilus beecheyi*) from Doane and Cedar campgrounds in Palomar State Park reactive to plague antibody. Los Angeles tested 85 California ground squirrels: all were negative (data from these programs are not included in tables).

The rodent species tested for plague antibodies in 2017 included: 290 chipmunks (*Tamias* spp.), 273 mice and voles (*Peromyscus* spp. and *Microtus* spp.), 228 California ground squirrels, 98 golden-mantled ground squirrels (*Callospermophilus lateralis*), 14 wood rats (*Neotoma* spp.), 8 Douglas squirrels (*Tamiasciurus douglasii*), 2 Belding's ground squirrels (*Urocitellus beldingi*), and 2 marmots (*Marmota flaviventris*) .

Plague antibodies were detected in five yellow-pine chipmunks (*Tamias amoenus*) from Nevada County, three shadow chipmunks (*Tamias senex*) from El Dorado, Plumas, and Tuolumne counties, two lodgepole chipmunks (*Tamias speciosus*) from Mono and Tulare counties, two California ground squirrels from Riverside County, and two deer mice (*Peromyscus maniculatus*) from Siskiyou County (Table 2.2).

A total of 90 wild carnivores were tested for plague antibodies including: 44 coyotes (*Canis latrans*), 34 black bears (*Ursus americanus*), 8 mountain lions (*Puma concolor*), 3 badgers (*Taxidea taxus*), and 1 bobcat (*Lynx rufus*). Three seropositive black bears were detected in Butte and Mariposa counties and one coyote was seropositive from Siskiyou County (Table 2.2).

Rodent Flea Testing

A total of 689 fleas collected from sylvatic rodents or their burrows were identified to species, combined into 243 pools, and tested for the presence of *Yersinia pestis* bacteria. One flea pool (*Eumolpianus eumolpi*) collected from a yellow-pine chipmunk in Nevada County, tested positive.

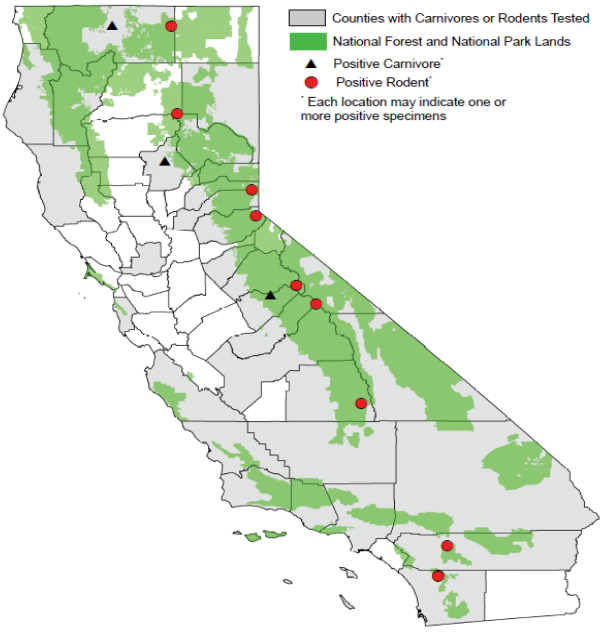


Figure 2.1. Approximate locations of carnivores or rodents on federal lands that tested positive for serum antibodies to *Yersinia pestis*, California 2017

Table 2.1 CDPH-VBDS Plague bacteriological testing in wild rodents by location, California 2017

County Location	No. rodents tested	Positive Specimens Species	Result	Month
El Dorado	4			
Nevada	3			
Martis Creek Recreational Area, Alpine Meadows CG		Chipmunk, YP	Pos	August
Total	**7**			

Abbreviations for Table 2.1, 2.2

Chipmunk, S: Shadow chipmunk (*Tamias senex*)
Chipmunk, LP: Lodgepole chipmunk (*Tamias speciosus*)
Chipmunk, YP: Yellow-pine chipmunk (*Tamias amoenus*)
CaGSq: California ground squirrel (*Otospermophilus beecheyi*)
Black bear (*Ursus americanus*)
LTBMU: Lake Tahoe Basin Management Unit
Coyote (*Canis latrans*)
NF: National Forest
NP: National Park
NM: National Monument
CG: Campground
Pos: Plague bacterium, *Yersinia pestis*

Table 2.2 CDPH-VBDS plague serological surveillance results in wild rodents and carnivores by location, California 2017

County Location	No. rodents tested	No. carnivores tested	Antibody positive specimens Species	Titer	Month
Butte	**0**	**20**			
Paradise			Black Bear	1:64	September
Paradise			Black Bear	1:512	September
Calaveras	**0**	**5**			
El Dorado	**24**	**7**			
LTBMU, Fallen Leaf CG			Chipmunk, S	1:256	June
Fresno	**23**	**1**			
Humboldt	**22**	**0**			
Inyo	**12**	**0**			
Kern	**55**	**7**			
Lassen	**9**	**0**			
Los Angeles	**42**	**6**			
Madera	**0**	**4**			
Mariposa	**34**	**3**			
Yosemite NP, Crane Flat CG			Black Bear	1:256	September
Mendocino	**0**	**6**			
Mono	**110**	**0**			
Inyo NF, Woods Lodge			Chipmunk, LP	1:128	August
Monterey	**0**	**2**			
Nevada	**100**	**0**			
Martis Creek Recreational Area, Alpine Meadows CG			Chipmunk, YP	1:256	July
Martis Creek Recreational Area, Alpine Meadows CG			Chipmunk, YP	1:32	September
Martis Creek Recreational Area, Alpine Meadows CG			Chipmunk, YP	1:128	September
Martis Creek Recreational Area, Alpine Meadows CG			Chipmunk, YP	1:128	September
Martis Creek Recreational Area, Alpine Meadows CG			Chipmunk, YP	1:256	September
Placer	**1**	**0**			
Plumas	**96**	**0**			
Lassen Volcanic NP, Drakesbad Guest Ranch			Chipmunk, S	1:128	July
Riverside	**32**	**0**			
San Bernardino NF, Boulder Basin CG			CA G Sq	1:32	August
San Bernardino NF, Boulder Basin CG			CA G Sq	1:64	September
San Bernardino	**95**	**0**			
San Luis Obispo	**0**	**1**			
San Mateo	**52**	**0**			
Santa Barbara	**14**	**0**			
Sierra	**27**	**0**			
Siskiyou	**109**	**24**			
Montague			Coyote	1:32	March
Lava Beds NM, Blue Grotto cave			Deer Mouse	1:512	May
Lava Beds NM, CG			Deer Mouse	1:64	May
Trinity	**0**	**4**			
Tulare	**17**	**0**			
Sequoia NF, Troy Meadow CG			Chipmunk, LP	1:64	June
Tuolumne	**19**	**0**			
Yosemite NP, Tuolumne Meadows			Chipmunk, S	1:32	August
Ventura	**22**	**0**			
Total	**915**	**90**			

3 Tick-borne Diseases

At least nine 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 2017, seven cases of anaplasmosis caused by *Anaplasma phagocytophilum* were reported to the California Department of Public Health (CDPH): four met national surveillance criteria for a confirmed case; three met the criteria for a probable case. Case-patients were residents of Alameda, Humboldt, Marin (2), Santa Barbara (2), and Sonoma counties. Median age was 58 (range, 28-81 years) and four (57%) were male. Four case-patients reported a tick bite, three from states endemic for *Anaplasma phagocytophilum*, and one from Trinity County.

Babesiosis

Five cases of babesiosis were reported to CDPH in 2017. Four met national surveillance criteria for a confirmed case and one was a probable case. *Babesia microti* was identified in four of the cases; one confirmed case did not have infecting *Babesia* species identified. Case-patients were residents of Orange, San Francisco, Santa Clara, Shasta, and Ventura counties. Median age of case-patients was 59 years (range, 38 -98 years) and three (60%) were female. Three case-patients were hospitalized. Four reported travel to the northeastern United States where *B. microti* is endemic and three recalled a tick-bite while there. One confirmed case-patient infected with uncharacterized *Babesia* sp. had recent travel history throughout southern California.

Ehrlichiosis

Three cases of Ehrlichiosis caused by *Ehrlichia chaffeensis* were reported to CDPH. One case met surveillance criteria for a confirmed case and was fatal; the two other were probable cases. Case-patients were residents of Alameda, San Bernardino, and Santa Barbara. Two of the case-patients reported travel to *E. chaffeensis*–endemic states (New York and Virginia) and one case had unknown travel history.

Lyme Disease

A total of 156 cases of Lyme disease caused by *Borrelia burgdorferi* were reported in 2017; 86 of these met the surveillance case definition criteria for a confirmed case, 64 were probable, and 6 were suspect cases with erythema migrans (EM) rash with exposure in California (Figure 3.1). Of the 86 confirmed cases, case-patients were residents of

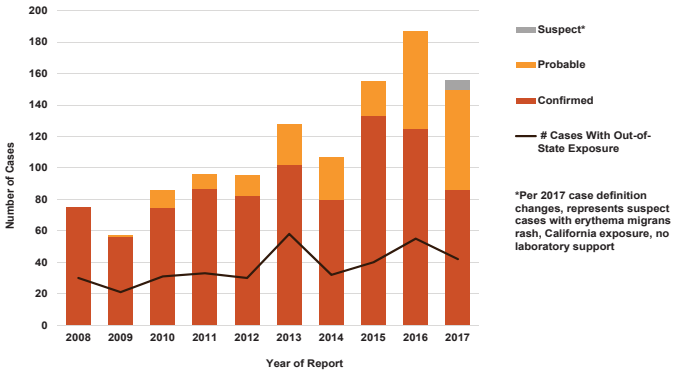


Figure 3.1. Confirmed and probable Lyme disease cases, including cases reporting travel within incubation period, by report year 2008 - 2017

28 counties, with Santa Cruz County reporting the largest number of cases (13) (Table 3.1). The median age of confirmed Lyme disease case-patients was 44 (range, 3 to 87 years) and 44 (51%) were female. Of the 32 confirmed case-patients for whom race was reported, 27 (84%) self-identified as white, 2 (6%) as Asian, 2 (6%) as other and 1 (3%) as black. EM was identified in 34 (43%) confirmed case-patients, 29

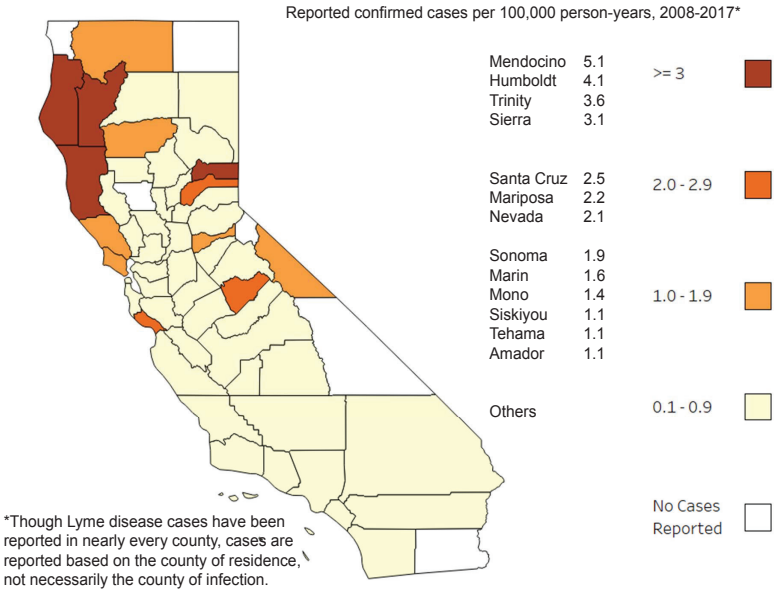


Figure 3.2. Incidence of reported confirmed Lyme disease, by county, California, 2008 - 2017

(85%) of whom had onset of EM noted between May and September. Of the 70 (44.8%) case-patients reporting travel history within the incubation period, 40 (57%) reported exposure outside of California, most commonly in the northeastern United States (Figure 3.1). Between 2008 and 2017, the highest incidence of Lyme disease was in the northwest and northern counties with western-facing Sierra slopes (Figure 3.2).

Spotted fever group rickettsiosis

Twelve cases of Rocky Mountain spotted fever (RMSF), caused by *Rickettsia rickettsii*, were reported to CDPH in 2017; all met the surveillance criteria for a probable case. The case-patients were residents of Alameda (2), Los Angeles (5), Riverside (2), San Bernardino, San Diego, and San Francisco counties. Eight (67%) case-patients were male, and median age was 40 years (range,11-69 years). Eight (67%) reported possible exposure outside their county of residence including two counties in California (Los Angeles and Santa Cruz) or to Arizona, Arkansas, Mexico (2), Central America, or the Middle East.

Tick-borne relapsing fever

Five cases of tick-borne relapsing fever (TBRF), caused by *Borrelia hermsii*, were reported to CDPH in 2017; four (80%) of these met CDPH working surveillance case definition criteria for a confirmed case, and one (20%) was suspect. Median age of confirmed case-patients was 28 years (range, 10 to 67 years) and three (60%) were female. Case-patients were residents of five counties: Inyo, San Mateo, Santa Clara, Sonoma, and Ventura. States or California counties where case-patients (confirmed and probable) were likely exposed in the three weeks prior to illness onset included Colorado, El Dorado, Fresno, and Mono. County of exposure was unknown for one case-patient.

Tick surveillance

Anaplasma phagocytophilum

In 2017, 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 255 adult, 224 nymphal, and 71 larval western blacklegged ticks (*Ixodes pacificus*) from Humboldt, Marin, Napa, and Sonoma counties for the presence of *Anaplasma phagocytophilum*. One (1.6%) adult and six (2.7%) nymphal western blacklegged ticks tested positive by real-time polymerase chain reaction (RT-PCR) at CDPH-VBDS (Table 3.2). One positive of each adult and nymph were collected from Austin Creek State Recreation Area, Sonoma County, and five positive nymphs were collected from Bothe-Napa Valley State Park, Napa County.

Table 3.1: Reported confirmed Lyme disease cases by county of residence, California, 2008-2017

County	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL	Incidence per 100,000 person-years
Alameda	6	1	2	2	4	4	4	10	10	3	46	0.29
Alpine	0	0	0	0	0	0	0	0	0	0	0	0.00
Amador	0	0	1	0	0	1	0	2	0	0	4	1.06
Butte	2	2	0	0	0	0	1	0	2	0	7	0.31
Calaveras	0	0	0	0	0	0	0	1	0	0	1	0.22
Colusa	0	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	1	0	1	1	4	5	3	7	6	7	35	0.32
Del Norte	0	0	0	0	0	0	0	0	0	0	0	0.00
El Dorado	1	2	2	0	2	0	3	2	1	2	15	0.83
Fresno	2	0	1	1	4	0	1	1	1	0	11	0.11
Glenn	0	0	0	0	0	0	1	0	0	1	2	0.70
Humboldt	6	4	7	5	5	4	4	6	11	4	56	4.14
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	5	1	2	0	0	0	0	1	1	1	11	0.13
Kings	0	1	0	0	0	1	0	0	1	0	3	0.20
Lake	0	0	0	0	0	0	1	1	1	0	3	0.47
Lassen	0	0	0	0	0	0	0	1	1	0	2	0.61
Los Angeles	8	3	6	9	2	18	6	8	2	2	64	0.06
Madera	0	0	0	1	0	0	0	0	1	1	3	0.20
Marin	2	1	3	1	3	6	6	8	9	3	42	1.63
Mariposa	0	0	0	0	1	1	1	1	0	0	4	2.20
Mendocino	10	6	6	3	4	0	1	7	3	5	45	5.12
Merced	0	0	0	1	0	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	1	0	0	1	0	0	0	0	2	1.43
Monterey	0	0	1	1	1	1	0	0	1	0	5	0.12
Napa	0	1	0	1	1	0	2	3	2	0	10	0.72
Nevada	2	1	3	6	2	1	1	1	2	2	21	2.14
Orange	1	0	5	6	0	0	0	0	0	3	15	0.05
Placer	1	2	0	1	2	1	1	1	2	2	13	0.36
Plumas	0	0	0	0	0	0	1	0	0	0	1	0.50
Riverside	1	4	0	4	0	2	1	1	3	3	19	0.08
Sacramento	0	1	0	1	1	0	0	2	1	5	11	0.08
San Benito	0	0	0	0	0	0	0	1	0	0	1	0.18
San Bernardino	1	0	0	2	0	1	0	2	0	0	6	0.03
San Diego	3	8	6	8	7	8	8	9	7	0	64	0.20
San Francisco	4	1	2	1	3	5	0	0	0	6	22	0.26
San Joaquin	0	0	0	0	1	0	1	0	1	0	3	0.04
San Luis Obispo	1	0	0	0	1	4	3	3	1	1	14	0.51
San Mateo	2	1	3	0	1	3	6	7	4	2	29	0.39
Santa Barbara	2	0	1	3	0	6	0	5	6	1	24	0.55
Santa Clara	0	2	5	11	4	13	5	10	11	2	63	0.34
Santa Cruz	1	4	8	9	5	5	6	8	8	13	67	2.49
Shasta	0	0	1	1	1	0	0	1	0	0	4	0.22
Sierra	0	0	0	0	1	0	0	0	0	0	1	3.11
Siskiyou	0	0	0	0	1	1	0	2	1	0	5	1.12
Solano	0	0	0	0	0	0	0	1	3	1	5	0.12
Sonoma	10	9	6	6	12	7	11	12	10	9	92	1.87
Stanislaus	1	1	0	0	0	0	0	1	1	1	5	0.09
Sutter	0	0	0	0	0	0	0	3	0	0	3	0.31
Tehama	0	0	0	0	1	0	0	0	5	1	7	1.10
Trinity	0	0	0	2	1	0	1	1	0	0	5	3.64
Tulare	0	0	0	0	1	0	0	1	1	2	5	0.11
Tuolumne	0	0	0	0	0	0	0	1	1	0	2	0.36
Ventura	2	0	1	0	3	2	0	0	3	2	13	0.15
Yolo	0	0	0	0	1	1	0	1	1	1	5	0.24
Yuba	0	0	1	0	2	0	1	0	0	0	4	0.55
TOTAL	**75**	**56**	**75**	**87**	**82**	**102**	**80**	**133**	**125**	**86**	**901**	**0.24**

CDPH-VBDS and Marin-Sonoma MVCD conducted tick surveillance in Marin County as follow-up to two historically confirmed human cases exposed in the area; all associated ticks were negative. Reported to CDPH-VBDS in 2017, San Mateo MVCD collected and tested 3,051 adult western blacklegged ticks in 1,084 pools from 15 parks. Minimum infection prevalence (MIP) - defined as the number of positive pools divided by the number of ticks pooled multiplied by 100 - was reported from these locations: Thornewood Open Space Preserve (1.8%), Los Trancos Open Space Preserve (1.7%), Huddard Park (0.5%), Portola Valley Ranch (0.7%), Laurelwood Park (1.2%), and Big Canyon Park (0.5%). Statewide minimum infection prevalence of *A. phagocytophilum* in adult *I. pacificus* was 0.5% and nymphal prevalence was 2.7% (Table 3.2).

Francisella tularensis

In 2017, San Diego Vector Control Program reported to CDPH-VBDS that 2,074 Pacific Coast adult ticks (*Dermacentor occidentalis*) in 272 pools, and 83 American dog tick adults (*Dermacentor variabilis*) in 17 pools, tested negative for *Francisella tularensis*.

Rickettsia philipii

In 2017, CDPH-VBDS tested one nymphal and 608 adult Pacific Coast ticks for *Rickettsia philipii*, the agent of Pacific Coast tick fever, from Alameda, Colusa, El Dorado, Inyo, Madera, Mariposa, Monterey, Orange, San Bernardino, Santa Clara, Santa Cruz, Sierra, Solano, Stanislaus, Sutter, Tuolumne, Ventura, and Yuba counties. Tick collections were often conducted in collaboration with the local vector control agency. All ticks were tested by RT-PCR at CDPH-Viral and Rickettsia Disease Laboratory (VRDL). Seven (1.2%) adult Pacific Coast ticks tested positive for *R. philipii* from Colusa (3/48=6.3%) and Orange (4/115=3.5%) counties.

Rickettsia rickettsii

CDPH-VBDS, in collaboration with Imperial County Public Health Department, Division of Environmental Health, conducted tick surveillance in response to a probable Rocky Mountain spotted fever (RMSF) case in Imperial County. Brown dog ticks (*Rhipicephalus sanguineus*) were collected and tested for *Rickettsia rickettsii* from dogs on the property. All 165 ticks tested negative. Additionally reported to CDPH-VBDS in 2017, Orange County MVCD collected and tested 290 adult Pacific Coast ticks in 69 pools, and 607 adult brown dog ticks in 122 pools, for spotted fever group *Rickettsia*. All ticks tested negative.

Borrelia spirochetes

Borrelia burgdorferi sensu lato

In 2017, local, state, and federal agencies in collaboration with CDPH-VBDS collected 14,077 adult, 860 nymphal, and 231 larval western blacklegged ticks from 29 counties to test for *Borrelia 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. From the 24 counties where ticks were tested individually, the overall prevalence of *B. burgdorferi* sensu lato was 0.8% in adult ticks and 4.8% in nymphal ticks (Table 3.3). Ticks tested by local vector control agencies in pools were tested by RT-PCR. In the 11 counties where adult ticks were tested in pools, the MIP was 1.0% (Table 3.4).

Borrelia miyamotoi

In 2017, 13,386 adult and 860 nymphal western blacklegged ticks were tested for *Borrelia miyamotoi*, a relapsing fever-type spirochete implicated in human disease in the eastern United States and

Table 3.2. Infection prevalence and minimum infection prevalence of *Anaplasma phagocytophilum* in *Ixodes pacificus* ticks, California, 2017

	No. Ticks Tested (pools)[a]			Positive *A. phagocytophilum*				
County	Adults	Nymphs	Larvae	Adults (IP/MIP)	Nymphs (IP)	Larvae (IP)	Collected by	Laboratory
Humboldt	79	5	2 (1)				CDPH, VBDS	CDPH, VBDS
Marin		6	3 (1)				CDPH, VBDS; Marin-Sonoma MVCD	CDPH, VBDS
Napa	114	147			5 (4.4)		CDPH, VBDS; Napa MAD	CDPH, VBDS
San Mateo	3,051 (1,084)			15 (0.5)[b]			San Mateo MVCD	San Mateo MVCD
Sonoma	62	66	66 (4)	1 (1.6)	1 (1.5)		CDPH, VBDS; Marin-Sonoma MVCD	CDPH, VBDS
Total	**3,306 (1,339)**	**224**	**71 (6)**	**16 (0.5)[b]**	**6 (2.7)**	**0**		

[a] if no pools listed then ticks were tested individually.

[b] Minimum infection prevalance is the number of positive pools divided by the number of ticks tested multiplied by 100.

Abbreviations:

IP, Infection prevalence; MIP, Minimum infection prevalence; CDPH-VBDS, California Department of Public Health, Vector-Borne Disease; MAD, Mosquito Abatement District Laboratory; MVCD, Mosquito and Vector Control District

Europe. Of the 2,650 individually tested adults and 860 individually tested nymphs, 19 (0.7%) and 10 (1.2%), respectively, tested positive (Table 3.3). Of the 10,736 adult ticks tested in 3,242 pools, 74 (0.7% MIP) tested positive (Table 3.4).

Mammal Surveillance

Francisella tularensis

CDPH-VBDS collaborates with CDPH-Microbial Disease Laboratory (MDL) 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 2017, all mammals tested from El Dorado (4), Nevada (3), and Solano counties were negative for *F. tularensis*.

Borrelia hermsii

CDPH-VBDS conducted environmental assessments in response to reported human cases of tick-borne relapsing fever. In 2017, one soft tick (*Ornithodoros hermsi*) recovered from a cabin located in Huntington Lake, Sierra National Forest, Fresno County, was negative. In response to a human case located in Mammoth Lakes, Mono County, 6 (55%) of 11 chipmunks were positive, while 10 golden mantled ground squirrels tested negative for *Borrelia hermsii*.

Table 3.3. Infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* spirochetes in *Ixodes pacificus* ticks, California, 2017

County	Adults	Nymphs	(IP)[a]	(IP)	(IP)	(IP)	Collected by	Laboratory
Alameda	171		1 (0.6)		2 (1.2)		CDPH, VBDS	CDPH, VBDS
Colusa	79	7					CDPH, VBDS	CDPH, VBDS
El Dorado	214	304	2 (0.9)	26 (8.6)	6 (2.8)	5 (1.7)	CDPH, VBDS	CDPH, VBDS
Humboldt	79	5			2 (2.5)		CDPH, VBDS	CDPH, VBDS
Los Angeles	47						CDPH, VBDS	CDPH, VBDS
Madera	9						CDPH, VBDS	CDPH, VBDS
Marin	11	281		10 (3.6)		2 (0.7)	CDPH, VBDS; Marin-Sonoma MVCD	CDPH, VBDS; Marin-Sonoma MVCD
Mariposa	1						CDPH, VBDS	CDPH, VBDS
Monterey	6						CDPH, VBDS	CDPH, VBDS
Napa	114	147	1 (0.9)	2 (1.4)	6 (5.3)	2 (1.4)	CDPH, VBDS; Napa MAD	CDPH, VBDS
Orange	31						CDPH, VBDS	CDPH, VBDS
Placer	90	1	1 (1.1)		1 (1.1)		CDPH, VBDS	CDPH, VBDS
San Bernardino	183						CDPH, VBDS	CDPH, VBDS
San Mateo	573		2 (0.4)				San Mateo MVCD	San Mateo MVCD
Santa Clara	1						CDPH, VBDS	CDPH, VBDS
Santa Cruz	486		4 (0.8)				Santa Cruz MVCD	CDPH, VBDS
Sierra	11		1 (9.1)				CDPH, VBDS	CDPH, VBDS
Solano	20				2 (10.0)		CDPH, VBDS	CDPH, VBDS
Sonoma	67	113	2 (3.0)	3 (2.7)		1 (0.9)	CDPH, VBDS; Marin-Sonoma MVCD	CDPH, VBDS
Stanislaus	94	2					CDPH, VBDS	CDPH, VBDS
Sutter	21						CDPH, VBDS	CDPH, VBDS
Tuolumne	1						CDPH, VBDS	CDPH, VBDS
Ventura	120						CDPH, VBDS	CDPH, VBDS
Yuba	221		7 (3.2)				CDPH, VBDS	CDPH, VBDS
Total	**2,650**	**860**	**21 (0.8)**	**41 (4.8)**	**19 (0.7)**	**10 (1.2)**		

Borrelia. Positive DFA ticks are subject to step 2. Step 2: multiplex real-time polymerase chain reaction (RT-PCR) for *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi*.

[a] IP - Measure of prevalence. IP (infection prevalence) is equal to the number of positive ticks divided by the number of ticks tested multiplied by 100.

Abbreviations:
CDPH-VBDS, California Department of Public Health, Vector-Borne Disease; MAD, Mosquito Abatement District Laboratory; MVCD, Mosquito and Vector Control District

Table 3.4. Minimum infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* in *Ixodes pacificus* ticks, California, 2017

County	Adults (pools)	(MIP)[b]	(MIP)[b]	Collected by	Laboratory
Butte	1,499 (301)	25 (1.7)	10 (0.7)	Butte MVCD	Placer MCVD
Marin	164 (38)	1 (0.6)	4 (2.4)	Marin Sonoma MVCD	Marin Sonoma MVCD
Orange[a]	71 (22)	0	n/a	Orange MVCD	Orange MVCD
Placer	1,866 (417)	39 (2.1)	14 (0.8)	Placer MVCD	Placer MVCD
Sacramento[a]	528 (130)	11 (2.1)	n/a	Sacramento Yolo MVCD	Sacramento Yolo MVCD
San Diego	418 (83)	0	0	San Diego VCP	San Diego VCP
San Mateo	2,478 (511)	19 (0.8)	15 (0.6)	San Mateo MVCD	San Mateo MVCD
Santa Clara	3,205 (1,642)	11 (0.3)	21 (0.7)	Santa Clara MVCD	Santa Clara MVCD; San Mateo MVCD
Shasta	976 (217)	4 (0.4)	10 (1.0)	Shasta MVCD	Placer MVCD
Sonoma	130 (33)	2 (1.5)	0	Marin Sonoma MVCD	Marin Sonoma MVCD
Yolo[a]	92 (23)	0	n/a	Sacramento Yolo MVCD	Sacramento Yolo MVCD
Total	**11,427 (3,417)**	**112 (1.0)**	**74 (0.7)**		

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

[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 100.

[c] 10,736 (3,242) adult ticks tested for *Borrelia miyamotoi.*

Abbreviations:
MVCD, Mosquito and Vector Control District; VCP, Vector Control Program

4 Mosquito-borne Diseases

Mosquito-borne diseases under surveillance in California include the endemic arboviral diseases caused by West Nile virus, St. Louis encephalitis virus, and western equine 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. The Vector-Borne Disease Section provides surveillance and testing for pesticide resistance in mosquitoes.

Human disease surveillance

West Nile virus

Serologic 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), 9 local county public health laboratories, and over 75 commercial laboratories. Local county laboratories tested for WNV using an IgM enzyme immunoassay (EIA) and/or an IgM immunofluorescence assay (IFA). Specimens with inconclusive results were forwarded to the CDPH-VRDL for further testing with a plaque reduction neutralization test (PRNT). Additional WNV infections were identified through nucleic acid test screening performed by blood donation centers.

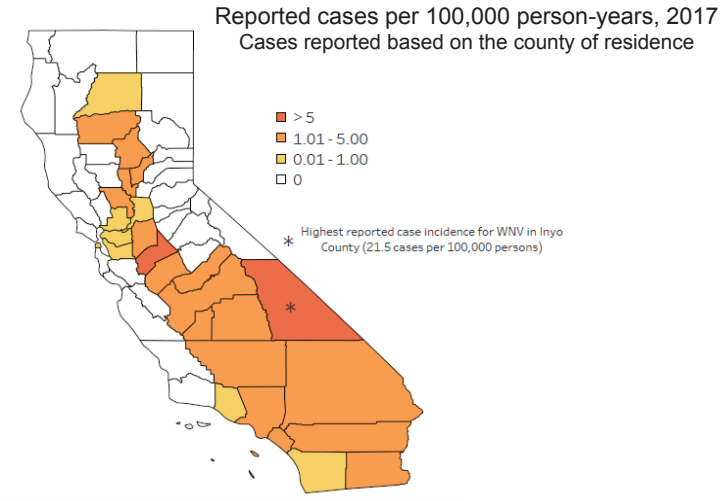


Figure 4.1. Incidence of reported human cases of West Nile virus, by county, California, 2017

In 2017, a total of 553 symptomatic and 47 asymptomatic WNV infections were identified, a 24.2% increase in infections compared to 2016 (Table 4.1). Of the 553 clinical cases, 401 (73%) were classified as West Nile neuroinvasive disease (e.g., encephalitis, meningitis, acute flaccid paralysis) and 152 (27%) were classified as non-neuroineuroivasive disease. A total of 44 fatalities were reported. Case-patients were residents of 27 counties and 358 (65%) were male. Incidence was highest (21.5 cases per 100,000 persons) in Inyo County (Table 4.1, Figure 4.1). The median age for West Nile neuroinvasive cases was 62 years (range, 6 to 96 years) and 51 years (range, 4 to 93 years) for non-neuroinvasive cases. The median age of the 44 WNV-associated fatalities was 76 years (range, 50 to 96 years). Dates of symptom onset for all reported cases ranged from March 16 to December 24, 2017.

St. Louis encephalitis virus

Four symptomatic cases of St. Louis encephalitis virus (SLEV) infection were identified in 2017. Case-patients were residents of four counties (Butte, Kern, Stanislaus, and Ventura) (Table 4.5), and three (75%) were male. The median age was 61 years (range 56-73 years) and dates of symptom onset ranged from July 24 to October 3, 2017.

Malaria

In 2017, 133 confirmed cases of malaria were reported to CDPH. Case-patients were residents of 23 California counties and 86 (65%) were male. The median age was 36 years (range, 0 to 74 years). Of the 81 cases for which the *Plasmodium* species was determined, 73 were *P. falciparum,* 32 *P. vivax*,

Table 4.1. Reported WNV human cases by county of residence, California, 2008-2017

County	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2017 incidence per 100,000 person-years	10 year incidence per 100,000 person-years
Alameda	1	0	1	0	2	0	1	0	0	1	0.06	0.04
Alpine	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Amador	0	0	0	1	0	0	0	0	1	0	0.00	0.52
Butte	6	2	1	3	10	24	24	53	21	4	1.77	6.54
Calaveras	1	0	0	0	0	0	0	0	0	0	0.00	0.22
Colusa	1	0	0	0	3	2	3	1	2	0	0.00	5.44
Contra Costa	4	5	4	3	4	5	5	1	4	4	0.35	0.34
Del Norte	0	0	0	0	0	0	0	0	0	0	0.00	0.00
El Dorado	1	1	0	1	0	1	0	0	1	0	0.00	0.27
Fresno	3	13	23	9	24	8	43	8	14	13	1.31	1.59
Glenn	1	0	2	1	7	9	10	19	6	0	0.00	19.14
Humboldt	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Imperial	0	0	0	0	1	0	1	1	0	3	1.59	0.32
Inyo	0	0	0	0	0	0	0	0	0	4	21.48	2.15
Kern	2	18	15	18	25	25	11	11	17	30	3.35	1.92
Kings	2	3	1	1	3	1	4	0	8	5	3.34	1.87
Lake	0	0	0	0	1	0	1	2	1	0	0.00	0.77
Lassen	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Los Angeles	156	20	4	58	163	151	253	286	151	277	2.70	1.48
Madera	0	1	7	2	3	3	3	4	6	2	1.28	1.98
Marin	0	0	0	0	0	2	0	1	0	0	0.00	0.11
Mariposa	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Mendocino	0	0	0	0	0	0	1	2	0	0	0.00	0.34
Merced	1	4	1	1	13	0	1	1	0	10	3.64	1.17
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	1	0	0	1	0	0	0	1	0	0.00	0.07
Napa	0	0	0	0	0	1	0	0	0	0	0.00	0.07
Nevada	0	0	0	0	0	0	0	2	0	0	0.00	0.20
Orange	71	4	1	10	42	10	263	92	32	33	1.03	1.75
Placer	6	0	3	1	12	6	7	0	7	0	0.00	1.10
Plumas	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Riverside	62	3	0	7	19	35	14	127	11	32	1.34	1.30
Sacramento	13	0	12	4	29	11	10	4	25	6	0.40	0.75
San Benito	0	0	0	0	0	0	0	0	0	0	0.00	0.00
San Bernardino	36	2	5	4	33	13	21	54	8	57	2.64	1.08
San Diego	35	4	0	0	1	0	11	42	20	2	0.06	0.35
San Francisco	0	0	1	0	1	1	0	0	0	1	0.11	0.05
San Joaquin	12	10	6	5	13	8	9	2	13	14	1.87	1.23
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	1	0	0	1	0	1	0	0	0	0	0.00	0.07
Santa Clara	1	0	0	1	0	2	10	8	1	0	0.00	0.12
Santa Cruz	0	0	0	1	0	0	0	0	0	0	0.00	0.04
Shasta	1	0	0	0	1	1	2	3	1	1	0.56	0.56
Sierra	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Siskiyou	0	0	0	0	0	0	0	1	0	0	0.00	0.22
Solano	1	0	0	0	2	1	5	1	4	1	0.23	0.34
Sonoma	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Stanislaus	17	14	12	11	26	17	33	13	26	28	5.11	3.59
Sutter	0	0	0	0	8	10	8	2	12	3	3.09	4.44
Tehama	4	0	0	1	4	5	4	5	5	2	3.13	4.69
Trinity	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Tulare	5	4	12	11	7	5	21	13	10	12	2.54	2.12
Tuolumne	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Ventura	0	0	0	0	7	2	1	6	7	1	0.12	0.28
Yolo	1	2	0	0	10	6	15	8	16	6	2.74	2.92
Yuba	0	1	0	3	4	13	6	10	11	1	1.34	6.57
Total WNV disease	**445**	**112**	**111**	**158**	**479**	**379**	**801**	**783**	**442**	**553**	**1.40**	**1.08**
Asymptomatic Infections[a]	53	17	20	18	48	54	91	77	41	47		
Total WNV infections	**498**	**129**	**131**	**176**	**527**	**433**	**892**	**860**	**483**	**600**	**1.52**	**1.20**

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

8 *P. ovale*, and 6 *P. malariae*. One hundred-thirty case-patients reported compatible travel history to malaria-endemic areas including Africa (98), Asia (16), India (12), South America (3), and Central America (2). Exposure information for two case-patients was not available.

Dengue

In 2017, 132 cases of dengue were reported to CDPH; 39 of these met the criteria for a confirmed case and 93 were probable (Table 4.2). Case-patients were residents of 28 California counties, 67 (51%) were female, and the median age was 37 (range, 0 to 77 years). No locally acquired cases were reported. Travel region history included India (50), Southeast Asia (46), North America (Mexico [16]), South Pacific (10), Central America (4), Caribbean (2), South America, and Africa. Exposure region was not available for two case-patients.

Chikungunya

Thirty-two cases of chikungunya were reported to CDPH in 2017; 7 of these met the criteria for a confirmed case and 25 were probable (Table 4.2). Case-patients were residents of 9 California counties, 19 (59%) were female and the median age was 48 (range, 5 to 76 years). No locally acquired cases were reported. All case-patients reported travel to chikungunya-endemic or outbreak areas including India (15), Southeast Asia (10), South America (3), and one each from Central America, North America (Mexico), Asia, and Africa. Exposure region was not available for three travel-associated case-patients.

Zika

In 2017,126 infections of Zika virus were reported to CDPH; 69 of these met the criteria for a confirmed infection and 57 were probable infections. Infected persons were residents of 22 counties (Table 4.2), 97 (77%) were female, and the median age was 31 years (range, 0 to 84 years). All infections were travel related. Reported travel by 113 infected individuals was to Zika-endemic or outbreak areas including North America (Mexico [53]), Central America (26), Southeast Asia (12), the Caribbean (7), South America (4), Pacific Islands (4), and Africa (1). Exposure region was not available for one infected person. Four individuals were infected through sexual contact with an infected returned

Table 4.2: Reported *Aedes* transmitted diseases in humans by county, California, 2017

County	Chikungunya	Dengue	Zika	TOTAL
Alameda	3	19	10	32
Alpine	0	0	0	0
Amador	0	0	0	0
Butte	0	1	0	1
Calaveras	0	0	0	0
Colusa	0	0	0	0
Contra Costa	3	4	4	11
Del Norte	0	0	0	0
El Dorado	0	2	0	2
Fresno	0	2	1	3
Glenn	0	0	0	0
Humboldt	0	1	0	1
Imperial	0	0	1	1
Inyo	0	0	0	0
Kern	0	0	1	1
Kings	0	0	0	0
Lake	0	0	0	0
Lassen	0	0	0	0
Los Angeles	9	20	22	51
Madera	0	0	0	0
Marin	0	2	2	4
Mariposa	0	0	0	0
Mendocino	0	0	1	1
Merced	0	0	0	0
Modoc	0	0	0	0
Mono	0	0	0	0
Monterey	0	3	1	4
Napa	0	0	0	0
Nevada	0	1	0	1
Orange	2	10	12	24
Placer	0	1	0	1
Plumas	0	0	0	0
Riverside	0	1	4	5
Sacramento	1	6	0	7
San Benito	0	0	0	0
San Bernardino	0	3	7	10
San Diego	2	8	20	30
San Francisco	0	4	11	15
San Joaquin	1	2	1	4
San Luis Obispo	0	1	0	1
San Mateo	1	3	2	6
Santa Barbara	0	1	2	3
Santa Clara	10	24	14	48
Santa Cruz	0	2	0	2
Shasta	0	0	0	0
Sierra	0	0	0	0
Siskiyou	0	0	0	0
Solano	0	4	2	6
Sonoma	0	1	5	6
Stanislaus	0	2	0	2
Sutter	0	0	0	0
Tehama	0	0	0	0
Trinity	0	0	0	0
Tulare	0	0	2	2
Tuolumne	0	0	0	0
Ventura	0	3	0	3
Yolo	0	1	1	2
Yuba	0	0	0	0
TOTAL	**32**	**132**	**126**	**290**

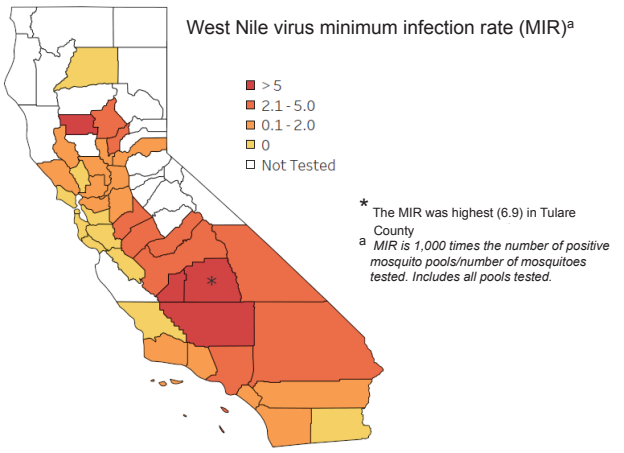


Figure 4.2. West Nile Virus minimum infection rate of *Culex* spp. mosquitoes, by county, California, 2017

traveler, and nine infants were congenital infections. Sixty-seven infected women were pregnant at time of diagnosis.

Mosquito surveillance

In 2017, a total of 1,259,491 mosquitoes (46,193 pools) collected in 38 counties were tested at the University of California, Davis Arbovirus Research and Training (DART) laboratory or at one of 13 local agencies by a real-time (TaqMan) reverse transcriptase-polymerase chain reaction (RT-qPCR) for SLEV, WEEV, and/or WNV viral RNA (Table 4.3).

West Nile virus was detected in 3,371 mosquito pools from 27 counties and SLEV was detected in 179 mosquito pools from 14 counties (Tables 4.3, 4.5, 4.8,). Statewide, the 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 was 2.7; the MIR was highest (6.9) in Tulare County (Table 4.3, Figure 4.2). 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 six *Culex* species (*Cx. erythrothorax, Cx. pipiens, Cx. quinquefasciatus, Cx. stigmatosoma*, *Cx. tarsalis, and Cx. thriambus*) and three other species (*Aedes aegypti, Culiseta incidens*, and *Cs. inornata*) (Table 4.4). St. Louis encephalitis virus was identified from four *Culex* species (*Cx. pipiens, Cx. quinquefasciatus, Cx. stigmatosoma,* and *Cx. tarsalis*). In 2017, the first detection of WNV in mosquitoes was

Table 4.3. West Nile Virus (WNV) positive mosquito pools and minimum infection rate, by county, California, 2017

County	No. mosquitoes tested[a]	No. mosquito pools tested	WNV positive pools[a]	WNV Minimum Infection Rate[b]
Alameda	5,985	480	0	0.0
Alpine	0			
Amador	0			
Butte	20,732	442	47	2.3
Calaveras	0			
Colusa	0			
Contra Costa	16,496	552	9	0.5
Del Norte	0			
El Dorado	0			
Fresno	43,286	1,387	167	3.9
Glenn	2,254	47	12	5.3
Humboldt	0			
Imperial	7,307	671	0	0.0
Inyo	4,403	94	9	2.0
Kern	29,626	725	152	5.1
Kings	14,894	452	79	5.3
Lake	21,775	749	17	0.8
Lassen	0			
Los Angeles	118,172	4,302	582	4.9
Madera	16,309	446	62	3.8
Marin	1,363	100	0	0.0
Mariposa	0			
Mendocino	0			
Merced	9,200	376	40	4.3
Modoc	0			
Mono	0			
Monterey	0			
Napa	3,887	139	0	0.0
Nevada	0			
Orange	156,448	5,750	280	1.8
Placer	37,284	2,359	59	1.6
Plumas	0			
Riverside	187,677	5,716	196	1.0
Sacramento	93,209	4,908	153	1.6
San Benito	216	6	0	0.0
San Bernardino	72,451	3,896	295	4.1
San Diego	10,818	691	9	0.8
San Francisco	324	20	0	0.0
San Joaquin	121,632	2,929	242	2.0
San Luis Obispo	1,796	47	0	0.0
San Mateo	6	4	0	0.0
Santa Barbara	6,396	174	1	0.2
Santa Clara	1,421	134	0	0.0
Santa Cruz	2,166	206	0	0.0
Shasta	15,628	544	0	0.0
Sierra	0			
Siskiyou	0			
Solano	10,715	302	9	0.8
Sonoma	12,954	535	1	0.1
Stanislaus	54,460	1,400	196	3.6
Sutter	9,127	255	16	1.8
Tehama	0			
Trinity	0			
Tulare	91,203	3,080	630	6.9
Tuolumne	0			
Ventura	2,847	60	3	1.1
Yolo	48,362	2,022	87	1.8
Yuba	6,662	193	18	2.7
Total	**1,259,491**	**46,193**	**3,371**	**2.7**

[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

Table 4.4. West Nile virus (WNV) positive mosquito pools and minimum infection rate, by mosquito species, California, 2017

Mosquito Species	No. Pools Tested	No. Mosquitoes	WNV +	Minimum Infection Rate[a]
***Culex* species**				
Cx. erraticus	1	6	0	0.0
Cx. erythrothorax	1,483	55,486	6	0.1
Cx. pipiens	7,905	165,399	287	1.7
Cx. quinquefasciatus	17,455	481,221	1,935	4.0
Cx. stigmatosoma	1,175	13,612	53	3.9
Cx. tarsalis	15,593	511,349	1,085	2.1
Cx. thriambus	139	752	1	1.3
All *Culex*	**43,751**	**1,227,825**	**3,367**	**2.7**
***Anopheles* species**				
An. franciscanus	15	136	0	0.0
An. freeborni	3	8	0	0.0
An. hermsi	39	352	0	0.0
All *Anopheles*	**57**	**496**	**0**	**0.0**
***Aedes* species**				
Ae. aegypti	1569	12,301	2	0.2
Ae. albopictus	90	774	0	0.0
Ae. dorsalis	1	3	0	0.0
Ae. melanimon	1	2	0	0.0
Ae. nigromaculis	2	58	0	0.0
Ae. notoscriptus	1	1	0	0.0
Ae. squamiger	8	108	0	0.0
Ae. taeniorhynchus	1	50	0	0.0
Ae. vexans	41	1,923	0	0.0
Ae. washinoi	18	828	0	0.0
All *Aedes*	**1,732**	**16,048**	**2**	**0.1**
Other species				
Culiseta incidens	361	6,848	1	0.1
Culiseta inornata	107	656	1	1.5
Culiseta particeps	26	403	0	0.0
Unknown	159	7,215	0	0.0
All other	**653**	**15,122**	**2**	**0.1**

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

from a *Cx. tarsalis* pool collected in San Diego County on March 22. The last detection of WNV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in Los Angeles County on November 28. The first and last detection of SLEV in mosquitoes were from *Cx. quinquefasciatus* and *Cx. tarsalis* pools collected in Fresno County on June 9 and October 12, respectively.

Animal surveillance

Chicken serosurveillance

In 2017, 29 local mosquito and vector control agencies in 25 counties maintained 139 sentinel chicken flocks (Table 4.6). Blood samples were collected from chickens every other week and tested for antibodies to WNV, SLEV, 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 10,689 chicken blood samples tested, 305 seroconversions to WNV were detected among 75 flocks in 18 counties (Tables 4.6, 4.8). In addition, nine SLEV seroconversions were detected among four flocks in three counties (Table 4.5). Statewide, 29% 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 2017, the first and last WNV seroconversions were detected in Los Angeles County on June 15 and November 14, respectively. The first SLEV seroconversion was detected in Merced County on July 14 and the last seroconversion was detected in Los Angeles County on September 27.

Table 4.5. Infections with St. Louis encephalitis virus in humans, mosquito pools, and sentinel chickens, by county, California, 2017

County	Humans	Mosquito Pools[1]	Sentinel Chickens
Butte	1	1	0
Fresno	0	63	NT
Imperial	0	3	NT
Kern	1	18	NT
Kings	0	21	NT
Los Angeles	0	1	2
Madera	0	10	NT
Merced	0	2	1
Placer	0	1	0
Riverside	0	23	NT
San Bernardino	0	2	6
Stanislaus	1	27	NT
Tulare	0	6	NT
Ventura	1	0	0
Yuba	0	1	0
State Totals	**4**	**179**	**9**

NT= no samples tested

[1]Positive mosquito pools included *Culex tarsalis* (111 pools), *Cx. quinquefasciatus* (60 pools), *Cx. pipiens* (7 pools), and *Cx. stigmatosoma* (1 pool)

In 2017, SLEV was detected for the first time in more than 40 years in five northern California counties: Butte, Merced, Placer, Stanislaus, and Yuba.

Table 4.6. Results of testing sentinel chickens for West Nile (WNV) virus, by county, California, 2017

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	31
Calaveras	1	10	1	1
Colusa	1	10	0	0
Contra Costa	5	50	2	7
Del Norte	0			
El Dorado	0			
Fresno	0			
Glenn	1	7	1	1
Humboldt	0			
Imperial	0			
Inyo	0			
Kern	0			
Kings	0			
Lake	2	12	1	2
Lassen	0			
Los Angeles	48	318	36	145
Madera	0			
Marin	0			
Mariposa	0			
Mendocino	0			
Merced	8	48	6	19
Modoc	0			
Mono	0			
Monterey	0			
Napa	0			
Nevada	4	24	0	0
Orange	0			
Placer	2	12	1	5
Plumas	0			
Riverside	0			
Sacramento	2	12	1	2
San Benito	1	10	1	1
San Bernardino	9	72	6	36
San Diego	0			
San Francisco	0			
San Joaquin	0			
San Luis Obispo	0			
San Mateo	3	30	0	0
Santa Barbara	5	50	1	4
Santa Clara	8	56	0	0
Santa Cruz	2	20	0	0
Shasta	7	54	1	4
Sierra	0			
Siskiyou	0			
Solano	3	36	2	11
Sonoma	0			
Stanislaus	0			
Sutter	6	42	4	22
Tehama	3	30	1	4
Trinity	0			
Tulare	0			
Tuolumne	0			
Ventura	5	54	0	0
Yolo	2	12	1	2
Yuba	2	14	2	8
Total	**139**	**1,035**	**75**	**305**

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

Dead bird surveillance for West Nile virus

In 2017, the WNV hotline and website received 7,745 dead bird reports from the public in 55 counties (Table 4.7). Oral swabs from dead bird carcasses were tested either at the DART laboratory or at one of 13 local agencies by RT-qPCR. Of the 2,058 carcasses deemed suitable for testing, WNV was detected in 510 (25%) carcasses from 39 counties (Tables 4.7, 4.8, Figure 4.3). Since 2003, the prevalence of WNV positive dead birds has ranged from a low of 5% (2003) to a high of 60% (2014). In 2017, the first WNV positive dead bird was an American crow reported from Orange County on January 5, and the last WNV positive dead bird was an American crow reported from Santa Clara County on December 29.

Horses

Serum or brain tissue specimens from horses displaying neurological symptoms were tested for WNV at the California Animal Health and Food Safety Laboratory. In 2017, West Nile virus infection was detected in 21 horses from 13 counties (Table 4.8). Eight of the horses died or were euthanized as a result of their infection.

Invasive mosquito surveillance

Invasive *Aedes* mosquitoes have been detected in California since 2011 when *Ae. albopictus*, also known as the Asian tiger mosquito, was re-discovered in Los Angeles County. *Aedes aegypti*, also known as the yellow fever mosquito, was later detected in Fresno, Madera, and San Mateo counties in 2013, followed in 2014 by *Ae. notoscriptus*, native to Australia, in

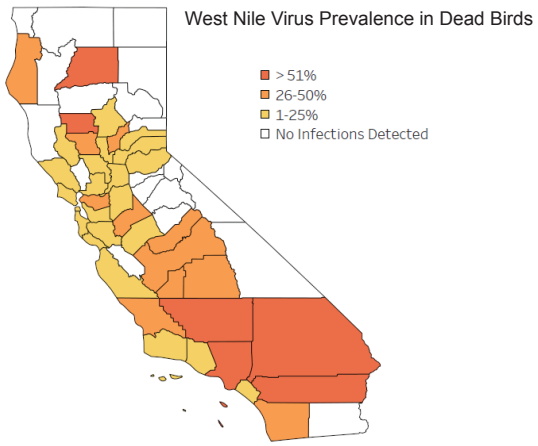


Figure 4.3. Prevalence of West Nile virus infection in dead birds, California, 2017

Table 4.7. Dead birds reported, tested[a], and positive for West Nile virus, by county, California, 2017

County	Reported	Tested	Positive	(%)
Alameda	276	39	2	(5.1)
Alpine	1	0		
Amador	11	0		
Butte	98	24	5	(20.8)
Calaveras	8	0		
Colusa	10	2	1	(50.0)
Contra Costa	695	44	19	(44.2)
Del Norte	0			
El Dorado	72	18	2	(11.1)
Fresno	168	11	5	(45.5)
Glenn	6	2	2	(100)
Humboldt	12	2	1	(50.0)
Imperial	3	0		
Inyo	12	0		
Kern	76	3	3	(100)
Kings	28	3	1	(33.3)
Lake	40	25	5	(20.0)
Lassen	0			
Los Angeles	889	160	101	(63.1)
Madera	27	3	1	(33.3)
Marin	64	9	1	(11.1)
Mariposa	4	0		
Mendocino	11	0		
Merced	64	7	1	(14.3)
Modoc	0			
Mono	2	0		
Monterey	34	4	1	(25.0)
Napa	39	5	0	(0)
Nevada	25	8	1	(12.5)
Orange	674	477	57	(11.9)
Placer	250	123	4	(3.3)
Plumas	1	0		
Riverside	289	68	41	(60.3)
Sacramento	945	358	86	(24.0)
San Benito	9	1	0	(0)
San Bernardino	258	59	45	(76.3)
San Diego	246	109	43	(39.4)
San Francisco	55	11	1	(9.1)
San Joaquin	233	40	7	(17.5)
San Luis Obispo	59	13	6	(46.2)
San Mateo	404	94	1	(1.1)
Santa Barbara	37	6	1	(16.7)
Santa Clara	515	107	15	(14.0)
Santa Cruz	80	18	1	(5.6)
Shasta	47	3	2	(66.7)
Sierra	1	0		
Siskiyou	1	0		
Solano	104	21	4	(19.0)
Sonoma	130	26	5	(19.2)
Stanislaus	217	22	6	(27.3)
Sutter	58	22	3	(13.6)
Tehama	9	0		
Trinity	1	1	0	(0)
Tulare	82	16	8	(50.0)
Tuolumne	7	1	0	(0)
Ventura	119	16	2	(12.5)
Yolo	195	61	14	(23.0)
Yuba	44	16	6	(37.5)
Totals	**7,745**	**2,058**	**510**	**(24.7)**

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

Table 4.8. Infections with West Nile virus in humans, horses, dead birds, mosquito pools, and sentinel chickens, by county, California, 2017

County	Humans[a]	Horses	Dead Birds	Mosquito Pools	Sentinel Chickens
Alameda	1	0	2	0	0
Alpine	0	0	NT	NT	NT
Amador	0	0	NT	NT	NT
Butte	3	0	5	47	31
Calaveras	0	0	NT	NT	1
Colusa	0	0	1	NT	0
Contra Costa	4	1	19	9	7
Del Norte	0	0	NT	NT	NT
El Dorado	0	0	2	NT	NT
Fresno	11	1	5	167	NT
Glenn	0	2	2	12	1
Humboldt	1	0	1	NT	NT
Imperial	3	0	NT	0	NT
Inyo	4	0	NT	9	NT
Kern	31	2	3	152	NT
Kings	4	0	1	79	NT
Lake	0	0	5	17	2
Lassen	0	3	NT	NT	NT
Los Angeles	287	1	101	582	145
Madera	2	0	1	62	NT
Marin	0	0	1	0	NT
Mariposa	0	0	NT	NT	NT
Mendocino	0	0	NT	NT	NT
Merced	9	0	1	40	19
Modoc	0	0	NT	NT	NT
Mono	0	0	NT	NT	NT
Monterey	0	0	1	NT	NT
Napa	0	0	0	0	NT
Nevada	0	0	1	NT	0
Orange	41	0	57	280	NT
Placer	2	0	4	59	5
Plumas	0	1	NT	NT	NT
Riverside	30	4	41	196	NT
Sacramento	7	1	86	153	2
San Benito	0	0	0	0	1
San Bernardino	62	0	45	295	36
San Diego	2	1	43	9	NT
San Francisco	1	0	1	0	NT
San Joaquin	14	2	7	242	NT
San Luis Obispo	0	0	6	0	NT
San Mateo	0	0	1	0	0
Santa Barbara	0	0	1	1	4
Santa Clara	0	0	15	0	0
Santa Cruz	0	0	1	0	0
Shasta	1	0	2	0	4
Sierra	0	0	NT	NT	NT
Siskiyou	0	0	NT	NT	NT
Solano	1	0	4	9	11
Sonoma	0	0	5	1	NT
Stanislaus	31	0	6	196	NT
Sutter	2	0	3	16	22
Tehama	2	1	NT	NT	4
Trinity	0	0	0	NT	NT
Tulare	13	0	8	630	NT
Tuolumne	0	1	0	NT	NT
Ventura	1	0	2	3	0
Yolo	6	0	14	87	2
Yuba	1	0	6	18	8
State Totals	**577**	**21**	**510**	**3,371**	**305**

[a]Includes asymptomatic infections detected through blood bank screening

NT= no samples tested

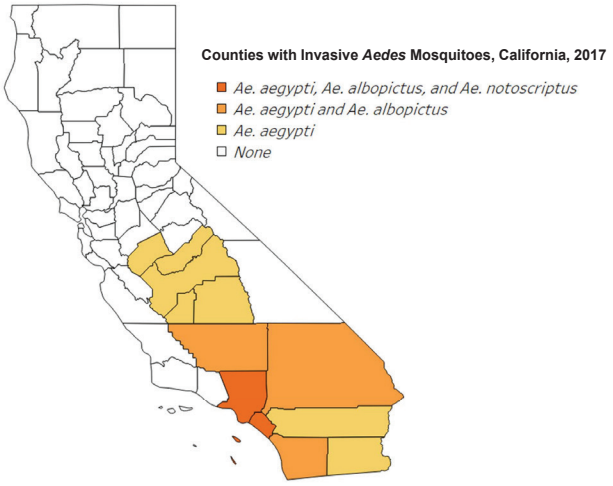


Figure 4.4. Invasive *Aedes* Mosquito Detections, by County, California, 2017

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.

Since 2011, local vector control agencies have detected invasive *Aedes* mosquitoes in 197 cities or census-designated places (CDP) in 14 counties; populations are considered established in 12 counties (Figure 4.4). In 2017, *Ae. aegypti* and *Ae. albopictus* were discovered in 73 and 62 new cities and CDPs, respectively. *Aedes notoscriptus* was discovered in Orange County for the first time. Local vector control agencies with invasive *Aedes* have incorporated *Aedes*-specific traps such as ovicups, Biogents Sentinel traps, and autocidal gravid ovitraps into surveillance programs. Agencies prepared for and responded to travel-associated human cases of *Aedes*-borne arboviruses such as Zika to minimize the potential for local transmission in areas with established populations of *Ae. aegypti* or *Ae. albopictus*. Education and outreach programs have been intensified with emphasis on the public's role in helping minimize invasive *Aedes* habitat on private property and personal protection measures against mosquito bites. In 2017, a total of 12,359 *Ae. aegypti* and 916 *Ae. albopictus* tested negative for dengue, chikungunya, and Zika. Two *Ae. aegypti* pools were positive for WNV (Table 4.4).

In 2016, VBDS expanded laboratory capacity to include pesticide resistance testing for *Ae. aegypti* mosquitoes. Molecular assays, targeting two mutations at the 1016 and 1534 positions of the *Ae. aegypti* sodium channel gene, were optimized to detect genetic mutations that may confer resistance to commonly used pyrethroid and pyrethrin adulticides. In 2017, over 4,000 *Ae. aegypti* from 11 counties were received for resistance testing. Resistance profiles indicated that populations of *Ae. aegypti* in the Central Valley region had resistant gene profiles, whereas populations in southern California had combinations of both resistant and susceptible genes (Figure 4.5). Local vector control agencies may use these findings to assist with adulticide selection in the event of a situation requiring rapid knock-down of adult *Ae. aegypti*.

Two mutations at the 1016 and 1534 positions of the *Ae. aegypti* sodium channel gene used to demonstrate resistance and susceptibility to commonly used pyrethroid adulticides

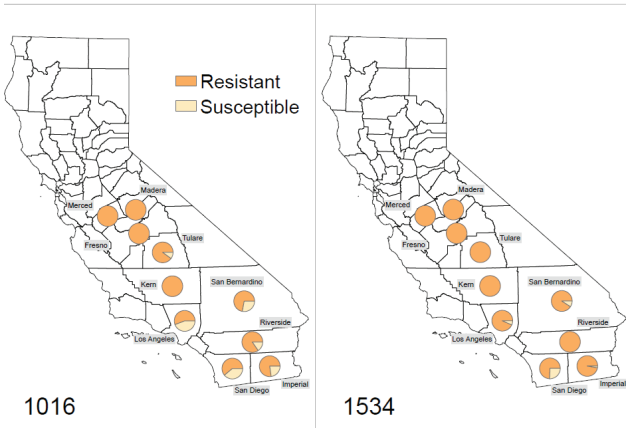


Figure 4.5. Pesticide resistance and susceptibility in *Aedes aegypti* mosquito populations, 2017

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
- Respond 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 2017. For each forest, activities and testing results for selected VBD are summarized in Tables 5.1 through 5.3, and highlights are described below.

2017 U.S. Forest Service Highlights

- Eastern Sierra tick collection from the Inyo National Forest is helping to provide evidence for the transmission cycle of *Babesia duncani,* an emerging but rare tick-borne disease.
- Exposure to hantavirus was detected in deer mice (*Peromyscus maniculatus*) from four US Forests (Eldorado, Inyo, Plumas, San Bernardino).
- No campground closures were required to interrupt plague transmission in 2017.
- Only 5 (<1%) of 636 rodents from USFS lands tested positive for exposure to plague, a significant decrease from 8.6% (56/648) in 2016.
- Seven (39%) of 18 R5 Forests had evidence of plague activity (Inyo, Klamath, LTBMU, Lassen, San Bernardino, Sequoia, and Stanislaus National Forests (Table 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, 2017

National Forest	Disease Risks Addressed	Facility Evaluation	Presentation Audiences	Forest Locations Visited[1]
Angeles	Plague			Jackson Lake Picnic Area; Jackson Lake, Oak Mountain, and Table Mountain campgrounds
Cleveland	Hantavirus; Plague; Tick-borne diseases	Pine Hills Fire Station, Palomar		Holy Jim Canyon, Silverado Canyon
Eldorado	Hantavirus; Plague	Leek Springs Fire Lookout, Lumberyard Fire Station	Lumberyard Fire Station, Dew Drop Fire Station	Amador Ranger Station; Pyramid Creek Trailhead; Pacific and Placerville Ranger Districts
Inyo	Hantavirus; Plague; Tick-borne diseases		Bishop All-Employee Safety Meeting, Forest Headquarters, Mt. Whitney Ranger District	Supervisor's Office; Clyde, Palisade Glacier, and Pine Glen group campgrounds; Coldwater, Ellery Camp, Four Jeffrey, Junction, Oh! Ridge, Saddlebag Lake, Sherwin Creek, Sage Flat, Old Shady Rest, Twin Lakes and Upper Gray's Meadow campgrounds; Long-term leased lands in and around Mammoth Lakes; Cottonwood Canyon; Sage Flat Trailhead
Klamath	Hantavirus; Plague			Ukonom Fire Lookout; Kangaroo Lake and Scott Mountain campgrounds
Lake Tahoe Basin Management Unit	Hantavirus; Plague		American Land and Leisure (concessionaire)	LTBMU Supervisors Office; Fallen Leaf, Kaspian and William Kent campgrounds
Lassen	Plague; Tick-borne diseases			Almanor District Office; Deer Creek Falls Trail
Los Padres	Plague; Tick-borne diseases			Mt. Pinos and Ojai Ranger District Offices; Chuchupate, Figueroa, Los Prietos, McGill, Mt. Pinos, Upper Oso, and Wheeler Gorge campgrounds; North Fork Matalija, Sisar Canyon trails
Mendocino	Plague; Tick-borne diseases	Genetic Resource and Conservation Facility		Genetic Resource and Conservation Facility; Mill Creek Campground; Letts Lake Rd.
Modoc	Hantavirus; Plague; Tick-borne diseases			Forest Supervisor's Office
Plumas	Hantavirus; Tick-borne diseases	Beckwourth Ranger District	Beckwourth Ranger District	Crocker, Gold Lake, Lake Davis, Sly Creek, and Strawberry campgrounds
San Bernardino	Hantavirus; Plague; Tick-borne diseases			Middle Fork Lytle Creek, Momyer-Alger Creek trails; Penstock Rd., San Sevaine Rd.; Apple White, Barton Flats, Boulder Basin, and Hanna Flat campgrounds
Sequoia	Hantavirus; Plague; Tick-borne diseases		Kern River Ranger District	Blackrock Information Station; Boulder Gulch, Fish Creek, Hospital Flat, Hungry Gulch, Pioneer Point, and Troy Meadow campgrounds
Shasta-Trinity	Tick-borne disease			McCloud Bridge Campground
Sierra	Plague; Tick-borne diseases			High Sierra District Office; Lewis Creek and Way of the Mono trails; Camp Edison, Dinky Creek, Dorabelle, and Rancheria campgrounds
Six Rivers	Hantavirus; Plague	Ukonom Fire Lookout		Forest Supervisor's and Gasquet District Offices; Ukonom Fire Lookout; Fish Lake Campground
Stanislaus	Plague		Calaveras Ranger District, Groveland Ranger District	Forest Supervisor's Office; Pacific and Pinecrest Ranger Stations; Big Meadow; New Spicer Reservoir; Stanislaus River, Clark Fork Horse, Sandy Flat, Peaceful Pines, and Sand Flat (Alp) campgrounds; Arnot Creek, Clark Fork, Disaster Creek, and Spicer Meadow trailheads
Tahoe	Hantavirus; Plague; Tick-borne diseases	Forest Supervisor's Office	American River Ranger District, Truckee Ranger District	Alder Creek, Berger Creek, Boca, Boca Springs, Bullards Bar Reservoir, Cold Creek, Cottonwood, Diablo, Goose Meadows, Granite Flat, Hampshire Rocks, Hobart Mills, Indian Springs, Sardine Lake, Silver Creek, Prosser, Prosser Hill OHV, and Prosser Ranch, Serene Lake, Six Mile Valley, Soda Springs, Sugar Bowl, Stampede Reservoir, Lower and Upper Little Truckee campgrounds; Packer Lake Picnic Area; Indian Valley, North Yuba, and Sagehen trails.

[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, 2017

National Forest	Unique Services/ Unusual Findings
Cleveland	Upon Forest Service staff request, conducted hantavirus risk facility assessments and rodent trapping at the Pine Hills Fire Station. Written recommendations were provided to the Forest Safety Officer and District Ranger.
Eldorado	Conducted plague and hantavirus surveillance at Leek Springs Lookout. All rodents were negative for serum antibodies to plague but 2 (10%) of 20 mice were positive for antibodies to Sin Nombre virus, causative agent of hantavirus pulmonary syndrome.
Inyo	Collected over 300 *Dermacentor albipictus* tick larvae from Upper Grays Meadow Campground. This single host tick is normally found on deer and is being investigated for its potential role in the transmission of *Babesia duncani,* a known human pathogen.
Lake Tahoe Basin Management Unit	Upon Forest Service staff request, provided the Acting Forest Safety Officer with information detailing VBDS activities on the Management Unit over the previous five years and a summary of the past >30 years of recreational area closures due to plague activity.
Lassen	Provided Almanor Ranger District with the VBDS protocol for dead rodent submission for plague testing after reports by USFS personnel of dead rodents in local campgrounds.
Los Padres	Conducted plague surveillance on all Ranger Districts. None of the 37 ground squirrels tested was positive for serum antibodies to *Y. pestis*, causative agent for plague.
Mendocino	Conducted hantavirus risk facility assessments and rodent trapping at the Genetic Resource and Conservation facility near Chico.
Plumas	Conducted hantavirus risk facility assessments and rodent trapping at the Beckwourth District Office. All three trapped deer mice tested positive for antibodies to SNV. Test results and recommendations were emailed to responsible parties at the District and Forest.
San Bernardino	Provided recommendations on plague risk at Boulder Basin Campground after two successive trapping events showed evidence of previous plague activity.
Sequoia	Follow-up plague surveillance at Troy Meadow Campground showed a greatly decreased seroprevalence for plague in the campground's rodent population. One (11%) of nine rodents was positive for antibodies to *Y. pestis.*
Sierra	VBDS biologists recovered and tested a soft tick, *Ornithodoros hermsi*, from a follow-up investigation to a tick-borne relapsing fever case on long-term leased lands.
Six Rivers	Visited the Forest Supervisors Office and discussed the Forest's need and priorities for hantavirus risk assessments and rodent surveillance.
Stanislaus	Gave vector-borne disease safety presentations to staff on the Calaveras and Groveland Ranger Districts.
Tahoe	Conducted a follow-up environmental investigation to a confirmed hantavirus case with probable exposure in the Truckee area. Evidence collected indicates a rare outdoor exposure due to unusual circumstances.
R5 (District Level)	Held annual meeting with Region 5 leadership. Reviewed Region 5 websites for presence of vector-borne disease safety information links. Updated spatial maps of hantavirus, plague, and tick surveillance on USFS lands. Provided pre-season letter for distribution throughout Region 5. Submitted pesticide use report on USFS lands. Provided hantavirus facility risk assessment reports.

Table 5.3. Testing results for selected vector-borne disease agents in U.S. National Forests, California, 2017

National Forest	Hantavirus		*Yersinia pestis*						*Borrelia* spp.[c]		*Borrelia hermsii*		*Rickettsia spp.*[d]	
	Peromyscus mice[a]		Rodents		Flea pools		Carnivores[b]		*Ixodes* ticks		Ornithodoros ticks		*Dermacentor* ticks	
	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested
Angeles			0	127			0	4						
Cleveland	0	12	0	29					0	8				
Eldorado	7	40	0	2										
Inyo	5	11	1	106					0	7				
Klamath	0	15	0	29			1	22						
Lake Tahoe BMU			1	22	0	12								
Lassen							2	14	0	28				
Los Padres			0	37			0	10	0	112			0	7
Mendocino	0	9					0	2	0	97				
Plumas	5	19					0	5	0	21				
San Bernardino	1	16	2	103										
Sequoia	0	29	1	71										
Shasta-Trinity							0	6						
Sierra	0	8	0	24	0	20			0	9	0	1		
Six Rivers	0	22	0	30										
Stanislaus							1	4						
Tahoe	0	23	0	56	0	37			8	232				
Total, all forests	**18**	**204**	**5**	**636**	**0**	**69**	**4**	**67**	**8**	**514**	**0**	**1**	**0**	**7**

[a] Deer mice (*Peromyscus maniculatus)* are the principal reservoir for hantavirus. Other species of *Peromyscus* tested because they may be reservoir competent in certain circumstances.

[b] 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.

[c] *Borrelia* spp. results do not differentiate *Borrelia burgodrferi,* causative agent for Lyme disease, and *Borrelia miyamotoi*, a relpsing fever-type spirochete.

[d] *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.

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 126 continuing education events in 2017. 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 2017, 1,304 Vector Control Technicians employed at 111 local public health agencies and the CDPH held 3,092 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 2017, 909 individuals employed at 76 agencies held full certification status. In addition, 395 employees from 58 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 2017

Exam section	No. Exams Given	No. Passed (%)
Core	170	126 (74)
Mosquito Control	173	104 (60)
Terrestrial Invertebrate Control	114	68 (60)
Vertebrate Vector Control	88	73 (83)
Totals	**545**	**371 (68)**

Table 6.2. Vector Control Technician certificates in effect as of December 2017

	No. Certificates		
Certification Category	Full Status	Limited Status	Total
Mosquito Control	891	253	1,144
Terrestrial Invertebrate Vector Control	702	218	920
Vertebrate Vector Control	720	308	1,028
Totals	**2,313**	**779**	**3,092**

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 2017

Vector-borne disease

- *Insect Repellent Fact Sheet* (English only)
- *Your Guide to Insect Repellents* (English/Spanish, web brochure and poster)

Mosquito-borne disease

- *Zika + Family Planning* (English/Spanish, toolkit)[1]
- *Insect Repellent: What Pregnant and Breastfeeding Women Need to Know* (English/Spanish, web poster)
- *Don't Bring Zika Home* (English/Spanish, posters and web graphics)[2]
- *Don't Bring Zika Home PSA Video* (English/Spanish)[2]
- *ZikaFreeCA.com* (website housing *Don't Bring Zika Home* materials)

[1]All Zika toolkits were co-created with the CDPH Maternal, Child, and Adolescent Health (MCAH) Program
[2]Designed and created by KP Public Affairs and Honey Agency under contract with the Zika Communications Team (including MCAH and VBDS members)

Publications*

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*Bolded names are members of VBDS staff

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VECTOR-BORNE
DISEASE SECTION
CALIFORNIA DEPARTMENT OF PUBLIC HEALTH