Vector-Borne Disease Section

Annual Report

2019

California Department of PublicHealth

2019

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

INFECTIOUS DISEASES BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CENTER FOR INFECTIOUS DISEASES

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

Gavin Newsom
Governor
State of California

CHHS
California Health & Human Services Agency

California Department of PublicHealth

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Preface

I am pleased to present to you the 2019 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 2019.

In 2019, West Nile virus (WNV) activity was similar to 2018 with elevated activity reported from some Central Valley counties, such as Fresno and Tulare. Of the 225 human cases reported, 65% were the severe neuroinvasive form of the disease, and there were nine fatalities. West Nile virus continues to pose the greatest vector-borne disease threat in California, with over 7,000 cases (309 fatal) reported since 2003.
In addition to WNV activity, St. Louis encephalitis virus activity was detected in mosquitoes or sentinel chickens in 12 counties, and there were six human cases.

The number of travel-associated human cases of dengue (265) increased in California relative to 2018 (107 cases), commensurate with the increase in dengue activity worldwide. Zika (41) and chikungunya (35) case numbers were similar to 2018. The *Aedes* mosquito vectors of dengue, Zika, and chikungunya continued to expand their range in California in 2019. *Aedes aegypti* (yellow fever mosquito) infestations were found in four additional counties, with detections expanding from 236 cities/census designated places in 2018 to 266 in 2019. The range of *Aedes albopictus* (Asian tiger mosquito) increased in southern California, but they were not detected in new counties. With the establishment of these vector species in 16 counties, there is the ongoing threat of local virus transmission in some regions of the state.

Flea-borne typhus is endemic in parts of southern California, with 141 cases detected in 2019; 82% of these cases required hospitalization. In 2019, three cases of hantavirus were reported, including one fatality; all were residents of Mono County. Overall, 15.5% of deer mice tested from 19 counties were seropositive to Sin Nombre virus, the causative agent of hantavirus. There was evidence of plague activity in 5 of the 29 counties where surveillance was conducted, but no human cases were identified.

Human cases of six tick-borne diseases were reported in California in 2019, including 144 cases of Lyme disease. Four cases of Pacific Coast tick fever, transmitted by *Dermacentor occidentalis*, were reported; these were the first cases identified since 2015. There were seven cases of tick-borne relapsing fever (TBRF) in 2019, several requiring a follow-up environmental investigation to reduce exposure risk to future occupants of these primarily rural, high-elevation cabins and facilities.

VBDS activities in 2019 included expanding public education through social media, digital and print materials, and interactive maps. 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
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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 2019 are listed here.

Rodent-borne Diseases

Alameda County Vector Control Services District (VCSD); County of San Diego Vector Control Program (VCP); Mono County Environmental Health Services; Napa County Mosquito Abatement District (MAD); National Park Service (NPS); Orange County Mosquito and Vector Control District (MVCD); Riverside County Department of Environmental Health 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

Alameda County VCSD; Army Corps of Engineers; California Department of Fish and Wildlife (CDFW); County of Los Angeles Agricultural Commissioner; El Dorado County VCP; Los Angeles County Vector Management Program; Mono County Environmental Health Services; Mosquito and Vector Management District (MVMD) of Santa Barbara County; NPS; Placer County MVCD; Riverside County VCP; San Bernardino County VCP; San Diego County VCP; San Mateo County MVCD; Sierra County Environmental Health Department; United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service, Wildlife Services; USFS; Ventura County Environmental Health Division (EHD).

Tick-borne Diseases

Alameda County VCSD; Butte County MVCD; CDFW; University of California Davis Arbovirus Research and Training (DART) Laboratory; Imperial County Public Health Department; Marin County Health and Human Services; Marin-Sonoma MVCD; MVMD of Santa Barbara County; Napa County MAD; NPS; Nevada County Environmental Health; 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; Ventura County EHD.

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 and Kjemtrup, A. Chapter 1: Rodent-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2019. California Department of Public Health, Sacramento, California, 2020. pp 1-3.

2 Flea-borne Diseases
Novak, M; Hacker, G and Porse, C. Chapter 2: Flea-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2019. California Department of Public Health, Sacramento, California, 2020. pp 4-6.

3 Tick-borne Diseases
Saunders, M and Kjemtrup, A. Chapter 3: Tick-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2019. California Department of Public Health, Sacramento, California, 2020. 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, 2019. California Department of Public Health, Sacramento, California, 2020. 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, 2019. California Department of Public Health, Sacramento, California, 2020. 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, 2019. California Department of Public Health, Sacramento, California, 2020. pp 25-26.

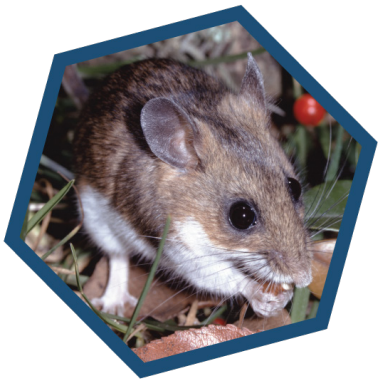
7 Public Information Materials, Publications
Nicolici, A. Chapter 7: Public Information Materials, Publications. In: Vector-Borne Disease Section Annual Report, 2019. California Department of Public Health, Sacramento, California, 2020. pp 27-28.

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, 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 vectors and vector- borne diseases, such as West Nile virus, Zika, chikungunya, dengue, and invasive *Aedes* mosquitoes
- Provide laboratory 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

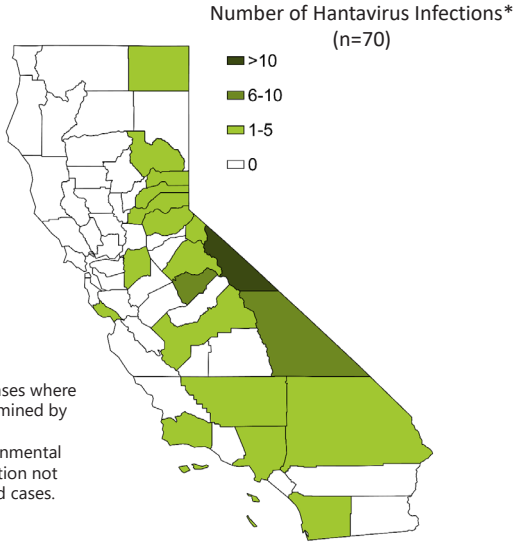
Human cases of hantavirus infection, which includes both hantavirus pulmonary syndrome (HPS) and non-pulmonary syndrome, are reported to the California Department of Public Health (CDPH) and are usually confirmed serologically and molecularly by the CDPH Viral and Rickettsial Disease Laboratory (CDPH-VRDL). When necessary, the CDPH Vector-Borne Disease Section (CDPH-VBDS) follows up human cases with environmental investigations, which may include trapping rodents and collaborating with CDPH-VRDL for testing for Sin Nombre virus (SNV), the usual cause of HPS and non-pulmonary hantavirus, to evaluate exposure or potential for additional exposure.

In 2019, three cases of HPS caused by SNV were reported in residents of Mono County, California. One case was fatal. Two cases were female, and median age for all cases was 32 years old (range, 28 to 66 years old). Months of illness onset were February, May, and November. Environmental investigations were conducted for two of the cases. Antibodies to SNV were not detected in eleven deer mice (*Peromyscus maniculatus*) collected from the case-patients' residences where exposure likely occurred. Also in 2019, environmental investigation of possible exposure sites of a fatal hantavirus case identified in late 2018 from San Joaquin County yielded four deer mice collected from near the case-patient's place of employment, which tested negative for SNV.

Since 1980, hantavirus infection has been diagnosed in 87 California residents, with the majority of cases exposed to SNV in the interior mountain ranges of the state or eastern Sierra (Figure 1.1). One case of hemorrhagic fever with renal syndrome caused by Puumala virus, a hantavirus endemic to northern Europe, was identified in a case-patient with travel history to Russia where Puumala virus activity had been reported.

Rodent surveillance

In 2019, 1,544 rodents (Genera: *Microtus*, *Neotoma*, *Peromyscus*, and *Reithrodontomys*) were tested for antibodies to SNV (Table 1.1). Of 1,374 *Peromyscus* spp. sampled, 113 (8.2%) were positive for SNV antibodies. Seroprevalence in deer mice, the primary reservoir for SNV, was 15.5% (Table 1.1). At least one deer mouse was SNV antibody-positive in 15 of 19 counties sampled in 2019 (Table 1.2). SNV antibody has been detected in deer mice from 26 of 42 counties sampled in the last 10 years; prevalence ranged from 2.3% to 36.1% (average 11.4%) over that period (Table 1.2).



*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 – 2019)

Table 1.1. Serologic evidence of hantavirus (Sin Nombre) infection in California rodents, 2010 - 2019

		2019			2010-2019		
Species	Common name	No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
Peromyscus boylii	brush mouse	149	3	2.0	641	5	0.8
Peromyscus californicus	California mouse	170	0		1,453	20	1.4
Peromyscus crinitus	canyon mouse	0	0		54	2	3.7
Peromyscus eremicus	cactus mouse	322	3	0.9	1,502	51	3.4
Peromyscus fraterculus	northern Baja mouse	8	0		1,443	13	0.9
Peromyscus maniculatus	deer mouse	692	107	15.5	5,246	599	11.4
Peromyscus truei	piñon mouse	33	0		401	3	0.7
Peromyscus sp.	unspeciated *Peromyscus*				2	0	
Peromyscus spp. subtotal		1,374	113	8.2	10,742	693	6.5
Reithrodontomys megalotis	western harvest mouse	132	20	15.2	1,020	116	11.4
Neotoma spp.	woodrats	29	0		193	1	0.5
Microtus spp.	voles	9	3	33.3	159	28	17.6

Additionally, 20 (15.2%) of 132 western harvest mice (*Reithrodontomys megalotis*) and 3 (33.3%) of 9 (*Microtus* spp.) demonstrated reactivity to SNV (Table 1.1). None of 29 woodrats (*Neotoma* spp.) demonstrated reactivity to SNV (Table 1.1). Seropositivity in these rodents may represent spillover of SNV from deer mice or infection with other hantaviruses (e.g. El Moro Canyon or Isla Vista), which cross react to the SNV assay. In California, no hantaviruses in wild rodents, other than SNV, have been shown to be pathogenic to humans.

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 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 2019 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 2019, deer mouse surveillance was conducted in three areas of the park. In Yosemite Valley, 3 (10.7%) of 28 deer mice were positive for SNV antibodies, as were 5 (10.6%) of 47 deer mice trapped in Tuolumne Meadows. Seven deer mice captured around employee housing in the Hodgdon Meadow area all tested negative. A total of 70 buildings were evaluated for rodent-borne disease risks. HH staff provided hantavirus prevention recommendations to YOSE and its associated partners based on surveillance results and facility evaluations.

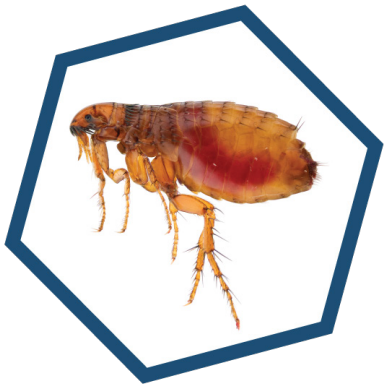
In May 2014, the National Park Service and HH entered into a master agreement which allows park units within California to obtain vector-borne disease related services from HH and CDPH. Lassen Volcanic National Park (LAVO) initiated a task agreement in 2019 for services that included hantavirus risk reduction, including facility evaluations and deer mouse surveillance to estimate rodent abundance and SNV prevalence. In 2019, deer mouse surveillance was conducted in two areas of LAVO. At Drakesbad Guest Ranch and nearby Warner Valley Campground, 11 (34.4%) of 32 deer mice tested positive for SNV antibodies, while 1 (16.7%) of 6 deer mice at Butte Lake Campground were positive. In addition, two buildings in LAVO were evaluated for vector-borne disease risks. HH staff provided hantavirus prevention recommendations to LAVO based on surveillance results and facility evaluations.

Table 1.2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus* in California, 2010-2019

	2019			2010-2019		
County	No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
Alameda	4	0	0.0	102	0	0.0
Alpine				9	2	22.2
Amador				8	0	0.0
Butte				6	0	0.0
Calaveras				4	1	25.0
Colusa				2	0	0.0
Contra Costa				13	0	0.0
Del Norte				1	0	0.0
El Dorado	18	6	33.3	261	51	19.5
Fresno				8	0	0.0
Glenn	5	1	20.0	10	1	10.0
Humboldt				26	0	0.0
Inyo				26	8	30.8
Kern				25	1	4.0
Lassen	11	2	18.2	88	12	13.6
Los Angeles				26	0	0.0
Marin				16	0	0.0
Mariposa	28	3	10.7	304	29	9.5
Modoc	22	1	4.5	61	10	16.4
Mono	112	47	42.0	399	144	36.1
Napa	5	1	20.0	17	3	17.6
Nevada	21	2	9.5	90	15	16.7
Orange	7	4	57.1	343	40	11.7
Placer				91	4	4.4
Plumas	32	11	34.4	116	29	25.0
Riverside	17	3	17.6	421	35	8.3
San Bernardino	13	0	0.0	219	5	2.3
San Diego	293	15	5.1	1,677	74	4.4
San Joaquin	4	0	0.0	4	0	0.0
San Mateo	15	4	26.7	173	33	19.1
Santa Barbara	7	0	0.0	10	0	0.0
Santa Clara				10	0	0.0
Santa Cruz				32	5	15.6
Shasta	24	1	4.2	116	19	16.4
Sierra				33	1	3.0
Siskiyou				85	20	23.5
Sutter				9	0	0.0
Tehama				86	18	20.9
Trinity				3	0	0.0
Tulare				15	0	0.0
Tuolumne	54	6	11.1	298	38	12.8
Ventura				3	1	33.3
Total	**692**	**107**	**15.5**	**5,246**	**599**	**11.4**

2 Flea-borne Diseases

Flea-borne typhus and plague 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

Flea-borne typhus

Human testing for *Rickettsia typhi,* causative agent of flea-borne typhus, is principally performed at commercial laboratories. The California Department of Public Health (CDPH) Viral and Rickettsial Disease Laboratory performs serology or PCR for samples requiring additional confirmation. One hundred forty-one cases of typhus fever were reported to CDPH in 2019. Seventy-seven (55%) of these were classified as confirmed cases according to CDPH working surveillance definition and 64 (45%) were probable. One hundred fifteen (82%) of the case-patients required hospitalization. Case-patients were residents of Los Angeles (115), Orange (18), San Bernardino (2), Contra Costa (1), Imperial (1), Placer (1), San Diego (1), and Ventura (2) counties. Typhus is considered endemic in parts of Orange and Los Angeles counties. The case-patients from Contra Costa, Imperial, and Placer counties reported travel outside the United States during the incubation period.

Plague

No cases of plague in humans were reported in 2019.

Animal disease surveillance (Plague)

Domestic pets

No cases of plague in domestic pets were reported in 2019.

Wild animals

The CDPH Vector-Borne Disease Section (CDPH-VBDS) plague surveillance program tested 554 wild rodents and 99 carnivores and other mammals from 29 California counties in 2019 (Figure 2.1, Table 2.1). Serum antibodies to *Yersinia pestis* were observed in 15 rodents and 1 carnivore from five counties (Figure 2.1, Table 2.1). The 551 rodents tested for plague antibodies included: 320 chipmunks (*Tamias* spp.), 130 California ground squirrels (*Otospermophilus beecheyi*), 58 golden-mantled ground squirrels (*Callospermophilus lateralis*), 16 Belding's ground squirrels (*Urocitellus beldingi*), 13 mice and voles (*Peromyscus* spp. and *Microtus* spp.), 9 wood rats (*Neotoma* spp.), and 5 Douglas squirrels (*Tamiasciurus douglasii*). Antibodies to *Y. pestis* were detected in seven yellow pine chipmunks (*Tamias amoenus*) from Nevada and Mono counties, three lodgepole chipmunks (*Tamias speciosus*) from Mono and Inyo counties, two shadow chipmunks (*Tamias senex*) from El Dorado and Plumas counties, one least chipmunk (*Tamias minimus*) from Mono County, one Uinta chipmunk (*Tamias umbrinus*) from Inyo County, and one California ground squirrel from Nevada County (Table 2.1). Three rodent carcasses that were submitted from two counties and tested by the CDPH Microbial Disease Laboratory's reference bacteriology unit were negative (Table 2.1).

The 99 wild carnivores and other mammals tested for plague antibodies included; 88 coyotes (*Canis latrans*), 3 black bears (*Ursus americanus*), 3 mountain lions (*Puma concolor*), 2 bobcats (*Lynx rufus*), 1 badger (*Taxidea taxus*), 1 feral pig (*Sus scrofa*), and 1 short-tailed weasel (*Mustela erminea*). One coyote from Plumas County was positive for *Y. pestis* antibodies (Table 2.1).

Independent county-wide plague surveillance programs included the San Diego County

Department of Environmental Health - Vector Control Program and Los Angeles County Department of Public Health - Vector Management Program. None of 417 rodents tested by San Diego County were positive for antibodies to *Y. pestis*. Los Angeles County tested 23 rodents, and none were positive. Data from these programs are not included in Table 2.1.

Rodent flea testing

A total of 353 fleas collected from sylvatic rodents or their burrows from five counties were identified to species, combined into 135 pools, and tested for the presence of *Yersinia pestis* bacteria. One flea pool tested PCR-positive for *Y. pestis*. The positive pool consisted of two *Eumolpianus eumolpi* collected from a yellow-pine chipmunk from Nevada County in August.

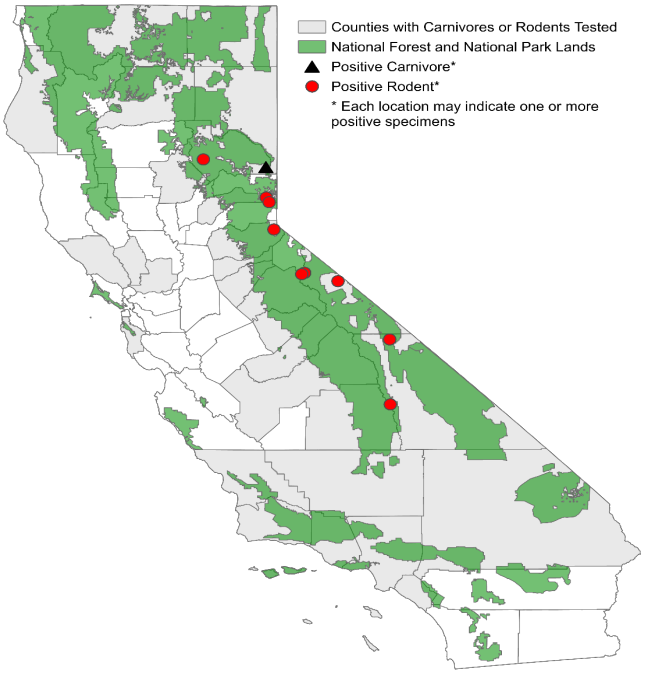


Figure 2.1. Approximate locations of carnivores or rodents that tested positive for serum antibodies to *Yersinia pestis*, California, 2019

Table 2.1. CDPH-VBDS plague surveillance results in wild rodents and carnivores by location, California, 2019

County / Location	Rodents tested by serology	Rodent carcasses tested by culture	Carnivores tested for serology	Antibody positive specimens: Species	Titer	Month
Amador	**0**		**6**			
Butte	**0**		**2**			
Calaveras	**0**		**10**			
El Dorado	**15**	**2**	**0**			
LTBMU, Taylor Creek Visitor Center				*Tamias senex*	1:64	October
Fresno	**22**		**0**			
Humboldt		**1**	**0**			
Inyo	**78**		**0**			
Horseshoe Meadow / Cottonwood Lakes CG, Inyo NF				*Tamias speciosus*	1:64	June
Schulman Grove Visitor Center, Inyo NF				*Tamias umbrinus*	1:64	August
Kern	**11**		**10**			
Lassen	**43**		**0**			
Los Angeles	**5**		**12**			
Madera	**0**		**21**			
Mariposa	**0**		**2**			
Modoc	**11**		**13**			
Mono	**149**		**1**			
Leavitt Meadow, Humboldt Toiyabe NF				*Tamias amoenus*	1:128	June
Sardine Creek				*Tamias amoenus*	1:256	June
Sardine Creek				*Tamias speciosus*	1:256	June
Bodie State Historic Park				*Tamias minimus*	1:32	September
Sardine Creek				*Tamias speciosus*	1:64	August
Napa	**0**		**1**			
Nevada	**69**		**1**			
Martis Creek Rec Area				*Tamias amoenus*	1:64	August
Prosser Reservoir, Tahoe NF				*Tamias amoenus*	1:1024	August
Prosser Reservoir, Tahoe NF				*Tamias amoenus*	1:128	August
Prosser Reservoir, Tahoe NF				*Tamias amoenus*	1:512	August
Prosser Reservoir, Tahoe NF				*Tamias amoenus*	1:128	August
Donner Memorial State Park				*Otospermophilus beecheyi*	1:128	October
Orange	**6**		**0**			
Plumas	**31**		**2**			
Vinton				*Canis latrans*	1:32	January
Plumas NF, Bucks Lake				*Tamias senex*	1:512	August
San Bernardino	**18**		**0**			
San Luis Obispo	**5**		**0**			
San Mateo	**1**		**0**			
Santa Barbara	**16**		**8**			
Shasta	**0**		**1**			
Siskiyou	**0**		**3**			
Solano	**0**		**2**			
Sonoma	**0**		**4**			
Tulare	**26**		**0**			
Tuolumne	**25**		**0**			
Ventura	**20**		**0**			
Total	**551**	**3**	**99**			

CG: Campground
LTBMU: Lake Tahoe Basin Management Unit
NF: National Forest

3 Tick-borne Diseases

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

Testing for human cases of tick-borne diseases is performed at commercial laboratories. Confirmation of some anaplasmosis and spotted fever group *Rickettsia* spp. may be performed at the California Department of Public Health (CDPH) Viral and Rickettsial Disease Laboratory (VRDL).

Anaplasmosis

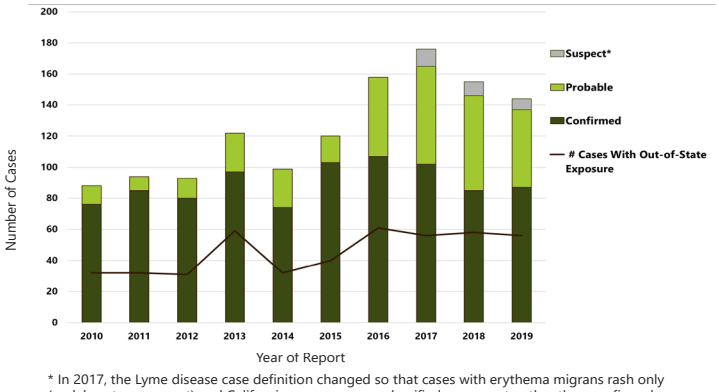
In 2019, eight cases of anaplasmosis caused by *Anaplasma phagocytophilum* were reported to CDPH: five met national surveillance criteria for a confirmed case and three met the criteria for a probable case. Case-patients were residents of Alameda, Contra Costa, Humboldt, Mendocino (2), Santa Barbara (2), and Ventura counties. Median age was 65 (range, 30 to 72 years) and six (75%) were male. Five case-patients (63%) reported out-of-state travel within the incubation period to the northeastern United States, which is a region endemic for *Anaplasma phagocytophilum*.

Babesiosis

Two cases of babesiosis caused by *Babesia microti* were reported to CDPH in 2019. Both met national surveillance criteria for a confirmed case with *Babesia microti* DNA identified by PCR. Case-patients were 60 and 71 years old and were residents of Contra Costa and Alameda counties. Both cases reported travel within the incubation period to the northeastern United States where *B. microti* is endemic.

Lyme disease

A total of 144 cases of Lyme disease caused by *Borrelia burgdorferi* were reported in 2019; 87 of these met the surveillance case definition criteria for a confirmed case, 50 were probable, and 7 were suspect cases with erythema migrans rash with exposure in California (Figure 3.1). Of the 87 confirmed cases, case-patients were residents of 27 counties, with Santa Cruz County reporting the largest number of cases (14) (Table 3.1). The median age of confirmed Lyme disease case-patients was 47 (range, 4 to 77 years) and 49 (56%) were male. Of the 46 confirmed case-patients for whom race was reported, 41 (89%) self-identified as white, 3 (7%) as Asian, and 2 (4%) as other. Erythema migrans (EM) was identified in 29 (33%) confirmed case-patients, 23 (79%) of whom had onset of EM noted between May and September. Between 2010 and 2019, the highest incidence of Lyme disease was in northern and central coastal counties and some inland counties along the western slope of the Sierra Nevada (Figure 3.2). Of the 45 (52%) confirmed case-patients reporting travel history within the incubation period, 37 (82%) reported exposure outside of California, most commonly in the northeastern United States.



* In 2017, the Lyme disease case definition changed so that cases with erythema migrans rash only (no laboratory support) and California exposure were classified as suspect, rather than confirmed.

Figure 3.1. Confirmed and probable Lyme disease cases, including cases reporting travel within incubation period, by report year 2010 - 2019

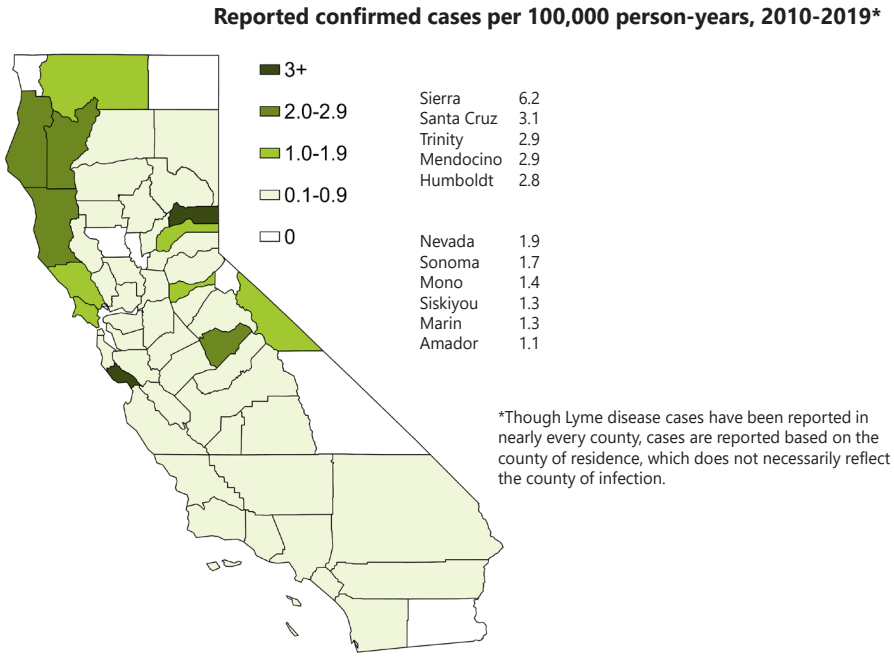


Figure 3.2. Incidence of reported confirmed Lyme disease, by county, California, 2010-2019

Spotted fever group rickettsiosis

Eight cases of Rocky Mountain spotted fever (RMSF) caused by *Rickettsia rickettsii* were reported to CDPH in 2019; all met the surveillance criteria for probable cases. Case-patients were residents of eight counties: Imperial, Los Angeles, Marin, Mendocino, Orange, San Bernardino, San Diego, and San Luis Obispo. Five (63%) case-patients were male, and median age was 67 years (range, 9 to 72 years). Four (50%) reported possible exposure outside their county of residence including to counties in California (Riverside) or to Nevada and Mexico (2). Two probable cases of African tick-bite fever caused by *R. africae* were identified in travelers returning from Africa; one probable case of Indian tick-typhus caused by *R. conorii* was reported in a traveler returning from India.

One confirmed and three probable cases of Pacific Coast tick fever (PCTF) caused by the *Rickettsia philipii* 364D were reported to CDPH in 2019. Three (75%) case-patients were male and median age was 51.5 (range, 6 to 65 years). Case-patients were residents of three counties including Alameda (2), Contra Costa, and Monterey; no case-patients reported travel outside of their county of residence. Months of onset were April and July (3). Three case-patients recalled tick-bites and an eschar was observed in all cases.

Pacific Coast tick fever is transmitted by *Dermacentor occidentalis* ticks, primarily the nymphal stage. Since 2008, 16 confirmed and 7 probable cases have been reported to CDPH. PCTF cases reported in 2019 were the first cases reported since 2015.

Tick-borne relapsing fever

Seven cases of tick-borne relapsing fever (TBRF), caused by *Borrelia hermsii*, were reported to CDPH in 2019; six (86%) of these met CDPH working surveillance case definition criteria for a confirmed case, and one (14%) was probable. Median age of confirmed case-patients was 29 years (range, 9 to 45 years) and four (57%) were female. Case-patients were residents of nine counties: Alameda, Marin, Mono (3), San Francisco, and Santa Clara. States or California counties where case-patients (confirmed and probable) were likely exposed in the three weeks prior to illness onset included the counties of El Dorado, Mono (3), Nevada, and the states of Idaho and Nevada.

Table 3.1. Reported confirmed Lyme disease cases by county of residence, California, 2010-2019

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	TOTAL	Incidence per 100,000 person-years
Alameda	2	2	4	0	3	11	8	12	4	7	53	0.33
Alpine	0	0	0	0	0	0	0	0	0	0	0	0.00
Amador	1	0	0	1	0	2	0	0	0	0	4	1.06
Butte	0	0	0	0	1	0	2	0	0	1	4	0.18
Calaveras	0	0	0	0	0	1	0	1	0	1	3	0.66
Colusa	0	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	1	1	4	5	2	4	6	12	10	2	47	0.43
Del Norte	0	0	0	0	0	0	0	0	0	0	0	0.00
El Dorado	2	0	2	0	2	2	1	2	0	0	11	0.60
Fresno	1	1	4	0	1	1	1	0	1	1	11	0.11
Glenn	0	0	0	0	1	0	0	0	0	1	2	0.70
Humboldt	7	5	4	4	4	6	4	3	1	0	38	2.81
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	0	0	0	0	1	1	0	0	1	5	0.06
Kings	0	0	0	1	0	0	1	0	0	0	2	0.13
Lake	0	0	0	0	0	1	1	0	0	3	5	0.77
Lassen	0	0	0	0	0	0	1	0	0	0	1	0.31
Los Angeles	6	8	2	17	6	6	1	3	2	3	54	0.05
Madera	0	1	0	0	0	0	0	0	0	0	1	0.07
Marin	3	1	3	6	5	5	3	0	1	8	35	1.35
Mariposa	0	0	1	1	1	1	0	0	0	0	4	2.20
Mendocino	6	3	4	0	1	0	1	1	1	9	26	2.94
Merced	0	1	0	0	0	0	0	0	0	0	1	0.04
Modoc	0	0	0	0	0	0	0	0	0	0	0	0.00
Mono	1	0	0	1	0	0	0	0	0	0	2	1.43
Monterey	1	1	1	1	0	0	1	0	0	1	6	0.14
Napa	0	1	1	0	2	2	2	0	1	0	9	0.64
Nevada	3	6	2	1	1	1	2	0	2	1	19	1.93
Orange	5	6	0	0	0	0	1	0	0	0	12	0.04
Placer	0	1	2	1	0	0	2	3	0	0	9	0.24
Plumas	0	0	0	0	1	0	0	0	0	0	1	0.50
Riverside	0	4	0	2	1	1	3	1	1	1	14	0.06
Sacramento	0	1	2	0	0	0	1	1	3	2	10	0.07
San Benito	0	0	0	0	0	1	0	0	0	0	1	0.18
San Bernardino	0	2	0	1	0	1	0	0	0	2	6	0.03
San Diego	6	8	7	8	8	9	7	1	8	0	62	0.19
San Francisco	2	1	2	5	0	0	0	11	14	10	45	0.53
San Joaquin	0	0	1	0	1	0	1	0	1	3	7	0.10
San Luis Obispo	0	0	1	4	3	3	1	1	1	3	17	0.62
San Mateo	3	0	1	3	6	5	5	4	0	2	29	0.39
Santa Barbara	1	3	0	6	0	4	8	3	3	2	30	0.68
Santa Clara	5	11	4	13	5	10	11	7	5	2	73	0.39
Santa Cruz	9	8	5	5	6	8	7	15	10	11	84	3.10
Shasta	1	1	1	0	0	0	0	0	0	0	3	0.17
Sierra	0	0	1	0	0	0	0	0	1	0	2	6.22
Siskiyou	0	0	1	1	0	1	1	1	1	0	6	1.34
Solano	0	0	0	0	0	0	3	2	2	0	7	0.16
Sonoma	6	6	12	7	11	12	11	8	8	5	86	1.74
Stanislaus	0	0	0	0	0	1	1	3	2	0	7	0.13
Sutter	0	0	0	0	0	0	0	0	0	0	0	0.00
Tehama	0	0	0	0	0	0	3	1	0	0	4	0.63
Trinity	0	2	1	0	1	0	0	0	0	0	4	2.92
Tulare	0	0	1	0	0	1	1	0	0	2	5	0.11
Tuolumne	0	0	0	0	0	1	0	0	0	1	2	0.36
Ventura	1	0	3	2	0	0	3	3	2	2	16	0.19
Yolo	0	0	1	1	0	1	1	3	0	0	7	0.33
Yuba	1	0	2	0	1	0	0	0	0	0	4	0.54
TOTAL	**76**	**85**	**80**	**97**	**74**	**103**	**107**	**102**	**85**	**87**	**896**	**0.23**

Tick surveillance

Anaplasma phagocytophilum

In 2019, CDPH Vector-Borne Disease Section (CDPH-VBDS) tested 470 adult, 329 nymphal, and 108 larval western blacklegged ticks (*Ixodes pacificus*) from Alameda, Marin, Mendocino, and Napa counties for the presence of *A. phagocytophilum*; ticks were collected by CDPH-VBDS, Napa County Mosquito Abatement District and Marin-Sonoma Mosquito and Vector Control District (MVCD). Two (0.4%) adult and six (1.8%) nymphal western blacklegged ticks tested positive by real-time polymerase chain reaction (RT-PCR) at CDPH-VBDS laboratory (Table 3.2). Two positive adults and one positive nymph were collected from Bothe-Napa Valley State Park, Napa County, and five positive nymphs were collected from China Camp State Park, Marin County. San Mateo MVCD reported to CDPH-VBDS that in 2019, their agency collected and tested 2,349 adult western blacklegged ticks in 497 pools from 17 parks, and 459 nymphal western blacklegged ticks in 233 pools from 11 parks. Positive adult tick pools were collected from Coal Creek Open Space Preserve (OSP) (0.6%), Hillsborough (North) (1.1%), Los Trancos OSP (1.0%), Montara Mountain (0.5%), Purisima Creek OSP (0.8%), and San Pedro Valley Park (0.7%). Statewide minimum infection prevalence (defined as the number of positive pools dived by the number of ticks tested multiplied by 100) of *A. phagocytophilum* in adult and nymphal *I. pacificus* were 0.4% and 0.7%, respectively (Table 3.2).

Francisella tularensis

In 2019, CDPH-VBDS tested a total of 605 adult and 1 nymphal Pacific coast ticks (*Dermacentor occidentalis*), and 3 American dog tick (*Dermacentor variabilis*) adults from Los Angeles, Nevada, and San Diego counties for *Francisella tularensis*, the causative agent of tularemia. One *Haemaphysalis leporispalustris* adult and one *Ixodes spinipalpis* nymph, both from San Mateo County, were also tested for *F. tularensis* by CDPH-VBDS. All ticks tested negative. Reported to CDPH-VBDS, San Diego Vector Control Program tested 2,264 Pacific coast tick adults in 263 pools, one *H. leporispalustris* adult, and 18 unidentified adult ticks in eight pools for *Francisella tularensis*. All ticks tested negative.

Spotted fever group rickettsiosis

In 2019, CDPH-VBDS tested 576 adult, 1 nymphal, and 21 larval Pacific coast ticks from Marin, Orange, San Diego, and Sonoma counties, and 2 adult American dog ticks from San Diego County for spotted fever group *Rickettsia* (SFGR), including *R. philipii* 364D, causative agent of Pacific coast tick fever. All ticks were tested by RT-PCR by CDPH-VBDS and CDPH-VRDL. Twenty-one (3.7%) adult Pacific coast ticks positive for *R. philipii* 364D were detected in Orange (20/516=3.9%), and San Diego (1/60=1.7%) counties. A single Pacific coast nymphal tick collected from Sonoma county tested positive for *R. philipii* 364D. Sixty-six adult Pacific coast ticks tested positive for *Rickettsia rhipicephali*, a SFGR with no known human pathogenicity, from Orange (65/516=12.6%), and San Diego (1/60=1.7%) counties. Ten (1.9%) additional Pacific coast tick adults from Orange County tested positive for SFGR of unknown species.

Borrelia spirochetes

Borrelia burgdorferi sensu lato

In 2019, local, state, and federal agencies, in collaboration with CDPH-VBDS, collected 17,758 adult, 2,556 nymphal, and 108 larval western

Table 3.2. Infection prevalence and minimum infection prevalence of *Anaplasma phagocytophilum* in *Ixodes pacificus* ticks, California, 2019

	No. Ticks Tested (pools)[a]			Positive *A. phagocytophilum*				
County	Adults	Nymphs	Larvae	Adults (IP/MIP[b])	Nymphs (IP/MIP)	Larvae (IP/MIP)	Collected by	Laboratory
Alameda	1	0	0	0	0	0	CDPH, VBDS	CDPH, VBDS
Marin	71 (16)	206	7 (1)	0	5 (2.43)	0	CDPH, VBDS; Marin-Sonoma MVCD	CDPH, VBDS
Mendocino	0	17	22 (2)	0	0	0	CDPH, VBDS	CDPH, VBDS
Napa	398	106	79	2 (0.5)	1 (0.94)	0	CDPH, VBDS; Napa MAD	CDPH, VBDS
San Mateo	2349 (497)	459 (233)	0	11 (0.47)	0	0	San Mateo MVCD	San Mateo MVCD
Total	**2,819 (912)**	**788 (562)**	**108 (82)**	**12 (0.4)**	**6 (0.7)**	**0**		

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

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

[b] Infection prevalance is the number of individually tested ticks positive divided by the number of ticks tested; minimum infection prevalance is the number of positive pools divided by the number of ticks tested multiplied by 100.

blacklegged ticks from 33 counties to test for *Borrelia burgdorferi*, the agent of Lyme disease. Collection and testing data for western blacklegged ticks are collated by CDPH-VBDS. From the 24 counties where ticks were tested individually, the overall prevalence of *B. burgdorferi* sensu lato was 0.5% in adult ticks and 5.0% in nymphal ticks (Table 3.3). Ticks were tested individually either by RT-PCR only or by direct fluorescent antibody (DFA) followed by RT-PCR. Ticks tested by local vector control agencies in pools were tested by RT-PCR. In the 10 counties where ticks were tested in pools, the adult MIP was 0.6% and nymphal MIP was 2.4% (Table 3.4). All larval ticks tested negative.

Borrelia miyamotoi

In 2019, of the western blacklegged ticks collected, 16,212 adult, 2,556 nymphal, and 108 larval ticks were tested for *Borrelia miyamotoi*, a relapsing fever-type spirochete implicated in human disease in the eastern United States and Europe. Of the 5,745 individually tested adults and 1,373 individually tested nymphs, 62 (1.1%) and 26 (1.9%), respectively, tested positive (Table 3.3). Of the 10,477 adult ticks tested in 2,064 pools and 1,183 nymphs tested in 377 pools, 70 (0.7% MIP) and 10 (0.9% MIP), respectively, tested positive (Table 3.4).

Of the 5,745 individually tested ticks, one (0.02%) *I. pacificus* adult from Placer County tested positive for both *B. burgdorferi* sensu lato and *B. miyamotoi* by RT-PCR at CDPH-VBDS. (Table 3.3).

Table 3.3. Infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* spirochetes in *Ixodes pacificus* ticks, California, 2019

	No. Ticks Tested			Positive *B. burgdorferi*		Positive *B. miyamotoi*		Positive Coinfection		
County	Adults	Nymphs	Larvae*	Adults (IP)[a]	Nymphs (IP)	Adults (IP)	Nymphs (IP)	Adults (IP)	Collected by	Laboratory
Alameda	1								CDPH, VBDS	CDPH, VBDS
Butte	30	82			2 (2.4)				CDPH, VBDS	CDPH, VBDS
El Dorado	89	180			15 (8.3)	1 (1.1)	4 (2.2)		CDPH, VBDS	CDPH, VBDS
Los Angeles	697	1							CDPH, VBDS	CDPH, VBDS
Marin	1	288	7		22 (7.6)		5 (1.7)		CDPH, VBDS; Marin Sonoma MVCD	CDPH, VBDS; Marin Sonoma MVCD
Mendocino	85	17	22						CDPH, VBDS	CDPH, VBDS
Napa	398	106	79	3 (0.8)	4 (3.8)	14 (3.5)	2 (1.9)		CDPH, VBDS; Napa MAD	CDPH, VBDS
Nevada	565	451		14 (2.5)	16 (3.6)	7 (1.2)	10 (2.2)		CDPH, VBDS	CDPH, VBDS
Orange	91	0			0				CDPH, VBDS	CDPH, VBDS
Placer	108	92			2 (2.2)		1 (1.1)	1 (0.9)	CDPH, VBDS	CDPH, VBDS
Riverside	83								CDPH, VBDS	CDPH, VBDS
San Bernardino	138								CDPH, VBDS	CDPH, VBDS
San Diego	316								CDPH, VBDS	CDPH, VBDS
San Luis Obispo	253								CDPH, VBDS	CDPH, VBDS
Santa Barbara	42								CDPH, VBDS	CDPH, VBDS
Santa Clara	2354			11 (0.5)		37 (1.6)			Santa Clara MVCD	Santa Clara MVCD
Santa Cruz	150								Santa Cruz MVCD	CDPH, VBDS
Shasta	48			1 (2.1)		2 (4.2)			CDPH, VBDS	CDPH, VBDS
Sierra	65			1 (1.5)		1 (1.5)			CDPH, VBDS	CDPH, VBDS
Solano	3								CDPH, VBDS	CDPH, VBDS
Sonoma	4	151			8 (5.3)		4 (2.7)		Marin Sonoma MVCD	Marin Sonoma MVCD
Stanislaus	81								CDPH, VBDS	CDPH, VBDS
Ventura	25								CDPH, VBDS; Ventura MVCD	CDPH, VBDS
Yuba	118	5		1 (0.8)					CDPH, VBDS	CDPH, VBDS
Total	**5,745**	**1,373**	**108**	**31 (0.5)**	**69 (5.0)**	**62 (1.1)**	**26 (1.9)**	**1 (0.02)**		

All *Ixodes pacificus* ticks tested at CDPH-VBDS are subject to a two step process, unless otherwise noted. Step 1: direct fluorescent antibody test (DFA) for genus *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.

* No larvae tested positive for *B. burgdorferi* sensu lato or *Borrelia miyamotoi*, so IP was not calculated.

Abbreviations:

CDPH-VBDS, California Department of Public Health, Vector-Borne Disease Section; 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, 2019

County	No. Ticks Tested		Positive *B. burgdorferi*		Positive *B. miyamotoi*[c]		Collected by	Laboratory
	adults	nymphs	adults (MIP)[b]	nymphs (MIP)[b]	adults (MIP)[b]	nymphs (MIP)[b]		
Alameda	438 (100)	724 (144)	11 (2.5)	22 (3.0)	4 (0.9)	7 (1.0)	Alameda County VCSD	Alameda County VCSD
Butte	1675 (335)		4 (0.2)		17 (1.0)		Butte MVCD	Placer MCVD
Marin	514 (108)		4 (0.8)		5 (1.0)		Marin Sonoma MVCD	Marin Sonoma MVCD
Placer	2647 (574)		13 (0.5)		17 (0.6)		Placer MVCD	Placer MVCD
Sacramento[a]	1085 (260)		20 (1.8)		n/a		Sacramento Yolo MVCD	Sacramento Yolo MVCD
San Diego	2206 (315)		0		0		San Diego VCP	San Diego VCP
San Mateo	2349 (497)	459 (233)	11 (0.5)	6 (1.3)	22 (0.9)	3 (0.7)	San Mateo MVCD	San Mateo MVCD
Santa Cruz	58 (12)		1(1.7)		1(1.7)		Santa Cruz MVCD	Santa Cruz MVCD
Sonoma	590 (123)		9 (1.5)		4 (0.7)		Marin Sonoma MVCD	Marin Sonoma MVCD
Yolo[a]	451 (98)		1 (0.2)		n/a		Sacramento Yolo MVCD	Sacramento Yolo MVCD
Total	**12,013 (2,422)**	**1,183 (377)**	**74 (0.6)**	**28 (2.4)**	**70 (0.7)**	**10 (0.9)**		

[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] 10,477 (2,064) adult ticks tested for *Borrelia miyamotoi.*

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

Mammal Surveillance

Francisella tularensis

CDPH-VBDS collaborates with CDPH Microbial Disease Laboratory to test mammals for *Francisella tularensis*, the agent of tularemia, by serology (performed by CDPH-VBDS laboratory), 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 2019, small mammals were tested from El Dorado (2), Humboldt (1), and San Mateo (18) counties. All mammals tested negative.

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.

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 (CDPH) Viral and Rickettsial Disease Laboratory (VRDL), seven 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 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.

West Nile virus remains the greatest vector-borne disease threat in California, with over 7,000 cases (309 fatal) reported since 2003. *Culex pipiens, Cx. quinquefasciatus,* and *Cx. tarsalis* are the most widespread and common vectors of this virus in California.

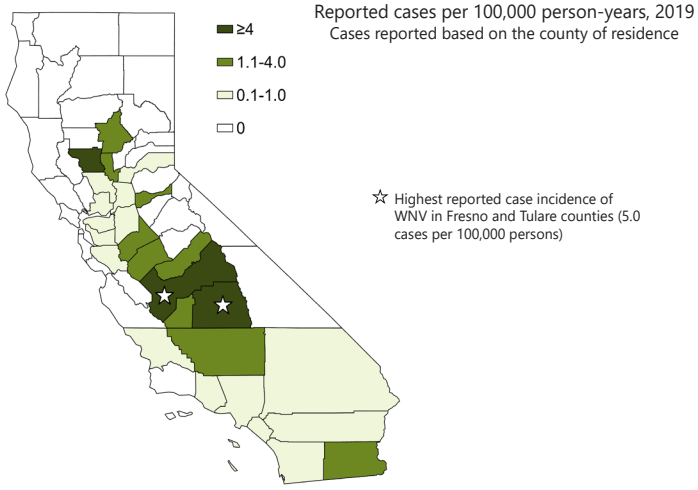


Figure 4.1. Incidence of reported human cases of West Nile virus, by county, California, 2019

In 2019, a total of 225 symptomatic and 18 asymptomatic infections with WNV were identified; the same number of total infections (243) was also reported in 2018 (Table 4.1). Of the 225 clinical cases, 79 (35%) were classified as West Nile non-neuroinvasive disease and 146 (65%) were classified as West Nile neuroinvasive disease (e.g., encephalitis, meningitis, or other neurologic dysfunction). Case-patients were residents of 27 counties and 136 (60%) were male. Incidence was highest (5.0 cases per 100,000 persons) in Fresno and Tulare counties (Table 4.1, Figure 4.1). The median age for West Nile fever cases was 57 years (range, 19 to 86 years), and neuroinvasive cases was 59.5 years (range, 10 to 93 years). The median age of the six WNV-associated fatalities was 77.5 years (range, 67 to 85 years). Dates of symptom onset for all reported cases ranged from May 12 to November 19, 2019.

Table 4.1. Reported WNV human cases by county of residence, California, 2010-2019

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2019 incidence per 100,000 person-years	10 year incidence per 100,000 person-years
Alameda	1	0	2	0	1	0	0	1	0	1	0.06	0.04
Alpine	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Amador	0	1	0	0	0	0	1	0	1	1	2.61	1.04
Butte	1	3	10	24	24	53	21	4	12	5	2.21	6.93
Calaveras	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Colusa	0	0	3	2	3	1	2	0	0	1	4.52	5.43
Contra Costa	4	3	4	5	5	1	4	4	4	1	0.09	0.30
Del Norte	0	0	0	0	0	0	0	0	0	0	0.00	0.00
El Dorado	0	1	0	1	0	0	1	0	0	0	0.00	0.16
Fresno	23	9	24	8	43	8	14	13	14	51	5.01	2.03
Glenn	2	1	7	9	10	19	6	0	2	0	0.00	19.22
Humboldt	0	0	0	0	0	0	0	0	1	0	0.00	0.07
Imperial	0	0	1	0	1	1	0	3	0	3	1.58	0.47
Inyo	0	0	0	0	0	0	0	4	0	0	0.00	2.15
Kern	15	18	25	25	11	11	17	30	13	28	3.06	2.11
Kings	1	1	3	1	4	0	8	5	0	3	1.95	1.69
Lake	0	0	1	0	1	2	1	0	1	0	0.00	0.92
Lassen	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Los Angeles	4	58	163	151	253	286	151	277	43	31	0.30	1.38
Madera	7	2	3	3	3	4	6	2	4	3	1.88	2.32
Marin	0	0	0	2	0	1	0	0	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	1	2	0	0	0	0	0.00	0.34
Merced	1	1	13	0	1	1	0	10	2	10	3.53	1.38
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	0	1	0	1	0	0.00	0.07
Napa	0	0	0	1	0	0	0	0	1	0	0.00	0.14
Nevada	0	0	0	0	0	2	0	0	1	0	0.00	0.30
Orange	1	10	42	10	263	92	32	33	9	5	0.16	1.54
Placer	3	1	12	6	7	0	7	0	9	1	0.25	1.16
Plumas	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Riverside	0	7	19	35	14	127	11	32	15	12	0.49	1.11
Sacramento	12	4	29	11	10	4	25	6	15	4	0.26	0.78
San Benito	0	0	0	0	0	0	0	0	0	0	0.00	0.00
San Bernardino	5	4	33	13	21	54	8	57	9	7	0.32	0.96
San Diego	0	0	1	0	11	42	20	2	2	3	0.09	0.24
San Francisco	1	0	1	1	0	0	0	1	0	0	0.00	0.05
San Joaquin	6	5	13	8	9	2	13	14	14	7	0.91	1.18
San Luis Obispo	0	0	0	0	0	0	0	0	0	2	0.71	0.07
San Mateo	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Santa Barbara	0	1	0	1	0	0	0	0	0	0	0.00	0.04
Santa Clara	0	1	0	2	10	8	1	0	1	1	0.05	0.12
Santa Cruz	0	1	0	0	0	0	0	0	0	0	0.00	0.04
Shasta	0	0	1	1	2	3	1	1	1	0	0.00	0.56
Sierra	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Siskiyou	0	0	0	0	0	1	0	0	0	0	0.00	0.22
Solano	0	0	2	1	5	1	4	1	0	1	0.23	0.34
Sonoma	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Stanislaus	12	11	26	17	33	13	26	28	15	16	2.86	3.52
Sutter	0	0	8	10	8	2	12	3	1	1	1.03	4.62
Tehama	0	1	4	5	4	5	5	2	2	0	0.00	4.35
Trinity	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Tulare	12	11	7	5	21	13	10	12	8	24	5.01	2.57
Tuolumne	0	0	0	0	0	0	0	0	1	0	0.00	0.18
Ventura	0	0	7	2	1	6	7	1	2	2	0.23	0.33
Yolo	0	0	10	6	15	8	16	6	11	1	0.45	3.28
Yuba	0	3	4	13	6	10	11	1	2	0	0.00	6.42
Total WNV disease	**111**	**158**	**479**	**379**	**801**	**783**	**442**	**553**	**217**	**225**	**0.56**	**1.04**
Asymptomatic Infections[a]	20	18	48	54	91	77	41	47	26	18		
Total WNV infections	**131**	**176**	**527**	**433**	**892**	**860**	**483**	**600**	**243**	**243**	**0.61**	**1.15**

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

St. Louis encephalitis virus

Six symptomatic cases of St. Louis encephalitis virus (SLEV) infection were identified in 2019. Case-patients were residents of four counties (Table 4.5) and four were male. The median age was 64 years and dates of symptom onset ranged from July 14 to September 13, 2019.

Malaria

In 2019, 106 confirmed cases of malaria were reported to CDPH. Case-patients were residents of 23 California counties and 64 (60%) were male. The median age was 39 years (range, 2 to 83 years). Of the 95 cases for which the *Plasmodium* species was determined, 77 were *P. falciparum*, 12 *P. vivax*, 3 *P. ovale*, and 3 *P. malariae*. One hundred three case-patients reported compatible travel history to malaria-endemic areas including Africa (87), Asia (10), India (3), Mexico (2), and South America (1). Exposure information for 3 case-patients was not available.

Chikungunya

Thirty-five cases of chikungunya were reported to CDPH in 2019; two of these met the criteria for a confirmed case and 33 were probable (Table 4.2). Case-patients were residents of 15 California counties, 17 (49%) were female, and the median age was 46 (range 0 to 69 years). No locally acquired cases were reported. All case-patients reported travel to chikungunya-endemic or outbreak areas including India (14), South East Asia (9), Central America (4), North America (Mexico [5]), Caribbean (2), and South America (1).

Dengue

In 2019, 265 cases of dengue were reported to CDPH; 83 of these met the criteria for a confirmed case, and 182 were probable (Table 4.2). Case-patients were residents of 29 California counties, 144 (54%) were female, and the median age was 43 (range 3 to 96 years). No locally acquired cases were reported. Travel region history included North America (Mexico [91]), South East Asia (60), India (46), Central America (36), South Pacific (9), Caribbean (8), South America (4), and Africa (1). Exposure region was not available for ten infected persons.

Table 4.2. Reported confirmed and probable *Aedes*-transmitted diseases in humans by county, California, 2019

County	Chikungunya	Dengue	Zika	TOTAL
Alameda	5	23	2	30
Alpine	0	0	0	0
Amador	0	0	0	0
Butte	0	2	0	2
Calaveras	0	0	0	0
Colusa	0	0	0	0
Contra Costa	1	16	2	19
Del Norte	0	0	0	0
El Dorado	0	1	0	1
Fresno	0	2	0	2
Glenn	0	0	0	0
Humboldt	0	0	0	0
Imperial	0	0	0	0
Inyo	0	0	0	0
Kern	1	3	0	4
Kings	0	0	0	0
Lake	0	0	0	0
Lassen	0	0	0	0
Los Angeles	2	55	6	63
Madera	0	1	0	1
Marin	1	3	0	4
Mariposa	0	0	0	0
Mendocino	0	0	0	0
Merced	0	1	0	1
Modoc	0	0	0	0
Mono	0	0	0	0
Monterey	0	1	0	1
Napa	0	0	0	0
Nevada	1	0	0	1
Orange	2	20	5	27
Placer	0	3	0	3
Plumas	0	0	0	0
Riverside	2	5	2	9
Sacramento	1	10	2	13
San Benito	0	0	0	0
San Bernardino	0	6	3	9
San Diego	3	26	7	36
San Francisco	3	14	4	21
San Joaquin	0	1	0	1
San Luis Obispo	2	5	0	7
San Mateo	1	8	2	11
Santa Barbara	1	0	0	1
Santa Clara	9	41	3	53
Santa Cruz	0	1	0	1
Shasta	0	0	0	0
Sierra	0	0	0	0
Siskiyou	0	0	0	0
Solano	0	2	1	3
Sonoma	0	4	1	5
Stanislaus	0	0	0	0
Sutter	0	0	0	0
Tehama	0	0	0	0
Trinity	0	0	0	0
Tulare	0	0	0	0
Tuolumne	0	1	0	1
Ventura	0	6	1	7
Yolo	0	4	0	4
Yuba	0	0	0	0
TOTAL	**35**	**265**	**41**	**341**

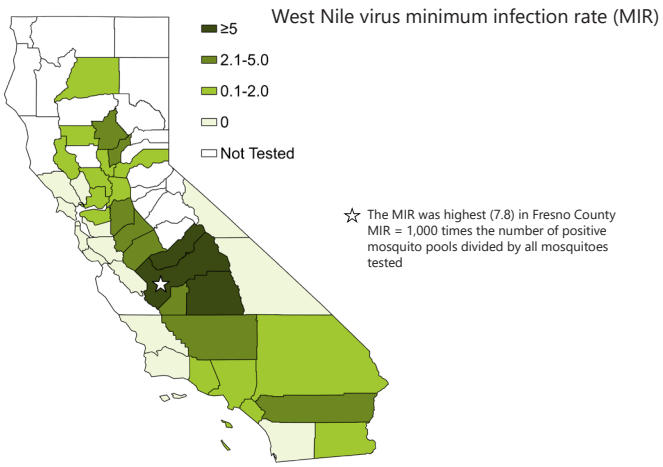


Figure 4.2. West Nile virus minimum infection rate of *Culex* spp. mosquitoes, by county, California, 2019

Table 4.3. West Nile Virus (WNV) positive mosquito pools and minimum infection rate, by county, California, 2019

County	No. mosquitoes tested[a]	No. mosquito pools tested	WNV positive pools[a]	WNV Minimum Infection Rate[b]
Alameda	18,086	1,438	0	0.0
Alpine	0			
Amador	0			
Butte	19,350	400	44	2.3
Calaveras	0			
Colusa	0			
Contra Costa	15,468	456	1	0.1
Del Norte	0			
El Dorado	0			
Fresno	63,386	2,001	495	7.8
Glenn	1,248	27	1	0.8
Humboldt	0			
Imperial	1,016	33	2	2.0
Inyo	1,618	38	0	0.0
Kern	37,095	878	129	3.5
Kings	16,725	518	63	3.8
Lake	18,651	715	6	0.3
Lassen	0			
Los Angeles	162,733	4,586	94	0.6
Madera	13,620	344	85	6.2
Marin	3,100	184	0	0.0
Mariposa	0			
Mendocino	0			
Merced	19,832	840	48	2.4
Modoc	0			
Mono	50	1	0	0.0
Monterey	0			
Napa	4,793	139	0	0.0
Nevada	0			
Orange	126,251	5,512	208	1.6
Placer	47,019	2,785	53	1.1
Plumas	0			
Riverside	253,055	7,027	524	2.1
Sacramento	61,215	4,578	74	1.2
San Benito	300	21	0	0.0
San Bernardino	80,642	3,744	52	0.6
San Diego	36,556	2,592	0	0.0
San Francisco	102	10	0	0.0
San Joaquin	85,500	2,667	288	3.4
San Luis Obispo	2,263	62	0	0.0
San Mateo	3,852	118	0	0.0
Santa Barbara	8,094	182	0	0.0
Santa Clara	1,579	134	0	0.0
Santa Cruz	3,682	263	0	0.0
Shasta	11,192	442	3	0.3
Sierra	0			
Siskiyou	0			
Solano	19,684	833	5	0.3
Sonoma	15,422	586	0	0.0
Stanislaus	62,378	1,685	203	3.3
Sutter	8,281	252	15	1.8
Tehama	0			
Trinity	0			
Tulare	116,628	3,915	813	7.0
Tuolumne	0			
Ventura	2,757	62	1	0.4
Yolo	44,762	1,970	59	1.3
Yuba	6,405	195	22	3.4
Total	**1,394,390**	**52,233**	**3,288**	**2.4**

[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

Zika

In 2019, 41 infections of Zika virus were reported to CDPH; eight of these met the criteria for a confirmed infection and 33 were probable infections. Infected persons were residents of 14 counties (Table 4.2), 33 (80%) were female, and the median age was 31 years (range, 10 to 69 years). All infections were travel related. Reported travel by 29 infected individuals was to Zika-endemic or outbreak areas including South East Asia (12), Central America (9), North America (Mexico [7]), and India (1). Exposure region was not available for 12 infected persons.

Mosquito surveillance

In 2019, a total of 1,394,390 mosquitoes (52,233 pools) collected in 39 counties were tested at the University of California, Davis Arbovirus Research and Training (DART) Laboratory or at one of 12 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).

WNV was detected in 3,288 mosquito pools from 25 counties and SLEV was detected in 356 mosquito pools from 12 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 2.4; the MIR was highest (7.8) in Fresno 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). WNV was identified from five *Culex* species (*Cx. erythrothorax*,

Table 4.4. West Nile virus (WNV) positive mosquito pools and minimum infection rate, by mosquito species, California, 2019

Mosquito Species	No. Pools Tested	No. Mosquitoes	WNV +	Minimum Infection Rate[a]
***Culex* species**				
Cx. erythrothorax	2,900	95,552	2	0.02
Cx. pipiens	8,937	171,772	373	2.2
Cx. quinquefasciatus	20,092	582,174	1,954	3.4
Cx. restuans	2	3	0	0.0
Cx. stigmatosoma	1,317	15,461	28	1.8
Cx. tarsalis	17,387	512,586	929	1.8
Cx. thriambus	179	519	0	0.0
Culex species	33	127	0	0.0
All *Culex*	**50,847**	**1,378,194**	**3,286**	**2.4**
***Anopheles* species**				
An. franciscanus	12	89	0	0.0
An. freeborni	8	72	0	0.0
An. hermsi	15	236	0	0.0
All *Anopheles*	**35**	**397**	**0**	**0.0**
***Aedes* species**				
Ae. aegypti	767	6,540	1	0.2
Ae. albopictus	5	74	0	0.0
Ae. nigromaculis	2	43	0	0.0
Ae. notoscriptus	2	4	0	0.0
Ae. sierrensis	1	3	0	0.0
Ae. squamiger	1	19	0	0.0
Ae. taeniorhynchus	7	303	0	0.0
Ae. vexans	3	94	0	0.0
Ae. washinoi	2	27	0	0.0
All *Aedes*	**790**	**7,107**	**1**	**0.1**
Other species				
Culiseta incidens	448	6,852	1	0.1
Culiseta inornata	78	408	0	0.0
Culiseta particeps	13	381	0	0.0
Unknown	22	1,051	0	0.0
All other	**561**	**8,692**	**1**	**0.1**

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

Cx. pipiens, *Cx. quinquefasciatus*, *Cx. stigmatosoma*, and *Cx. tarsalis*), *Aedes aegypti*, and *Culiseta incidens* (Table 4.4). SLEV was identified from four *Culex* species (*Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. stigmatosoma*, and *Cx. tarsalis*). In 2019, the first and last detections of WNV in mosquitoes were from *Cx. quinquefasciatus* pools collected in Orange County on January 29 and November 19, respectively. The first detection of SLEV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in Tulare County on May 24, whereas the last detection was from a *Cx. tarsalis* pool collected in Riverside County on November 13.

Animal surveillance

Chicken serosurveillance

In 2019, 27 local mosquito and vector control agencies in 25 counties maintained 108 sentinel chicken flocks (Table 4.6). Blood samples were collected from chickens every other week and tested for antibodies to SLEV, WNV, and WEEV by an EIA at the CDPH Vector-Borne Disease Section (CDPH-VBDS) laboratory and one local agency. 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 9,160 chicken blood samples tested, 139 seroconversions to WNV were detected among 43 flocks in 17 counties (Tables 4.6, 4.8). Statewide, 17.4% 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 2019, the first and last WNV seroconversions were detected in Los Angeles County on July 25 and November 14, respectively. In addition, three SLEV seroconversions were detected among two flocks in Merced County between August 30 and September 13 (Table 4.5).

Table 4.5. Infections with St. Louis encephalitis virus in humans, mosquito pools, and sentinel chickens, by county, California, 2019

County	Humans	Mosquito Pools[1]	Sentinel Chickens
Fresno	2	58	NT
Imperial	2	5	NT
Kern	1	56	NT
Kings	0	4	NT
Los Angeles	0	2	0
Madera	0	5	NT
Merced	0	2	3
Orange	0	3	NT
Riverside	0	108	NT
San Bernardino	0	4	NT
Stanislaus	1	13	NT
Tulare	0	96	0
State Totals	**6**	**356**	**3**

NT= no samples tested

[1]Positive mosquito pools included *Cx. quinquefasciatus* (179 pools), *Culex tarsalis* (171 pools), *Cx. pipiens* (5 pools), and *Cx. stigmatosoma* (1 pool)

Table 4.6. Results of testing sentinel chickens for West Nile (WNV) virus, by county, California, 2019

County	No. flocks	No. chickens[a]	No. WNV positive flocks	WNV positive sera
Alameda	2	12	0	0
Alpine	0			
Amador	0			
Butte	7	45	7	34
Calaveras	1	10	0	0
Colusa	1	10	1	6
Contra Costa	5	50	1	2
Del Norte	0			
El Dorado	0			
Fresno	0			
Glenn	1	6	1	1
Humboldt	0			
Imperial	0			
Inyo	0			
Kern	0			
Kings	0			
Lake	2	11	0	0
Lassen	0			
Los Angeles	28	190	10	28
Madera	0			
Marin	0			
Mariposa	0			
Mendocino	0			
Merced	8	48	6	16
Modoc	0			
Mono	0			
Monterey	0			
Napa	0			
Nevada	2	12	0	0
Orange	0			
Placer	3	18	2	8
Plumas	0			
Riverside	0			
Sacramento	3	19	1	4
San Benito	1	10	1	1
San Bernardino	0			
San Diego	0			
San Francisco	0			
San Joaquin	0			
San Luis Obispo	0			
San Mateo	2	14	0	0
Santa Barbara	5	34	0	0
Santa Clara	8	56	0	0
Santa Cruz	2	20	0	0
Shasta	7	50	1	1
Sierra	0			
Siskiyou	0			
Solano	3	36	2	4
Sonoma	0			
Stanislaus	0			
Sutter	5	35	3	11
Tehama	3	29	2	4
Trinity	0			
Tulare	1	11	1	10
Tuolumne	0			
Ventura	5	54	2	3
Yolo	2	10	1	1
Yuba	1	7	1	5
Total	**108**	**797**	**43**	**139**

[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 2019, the WNV hotline and website received 5,681 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 or at one of 12 local agencies by RT-qPCR. Of the 1,927 carcasses deemed suitable for testing, WNV was detected in 226 (11.7%) carcasses from 21 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 2019, the first WNV positive dead bird was a Cooper's hawk reported from San Diego County on March 12, and the last WNV positive dead bird was a California gull reported from Los Angeles County on December 4.

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 2019, WNV infection was detected in 15 horses from 12 counties (Table 4.8). Three of the horses died or were euthanized as a result of their infection.

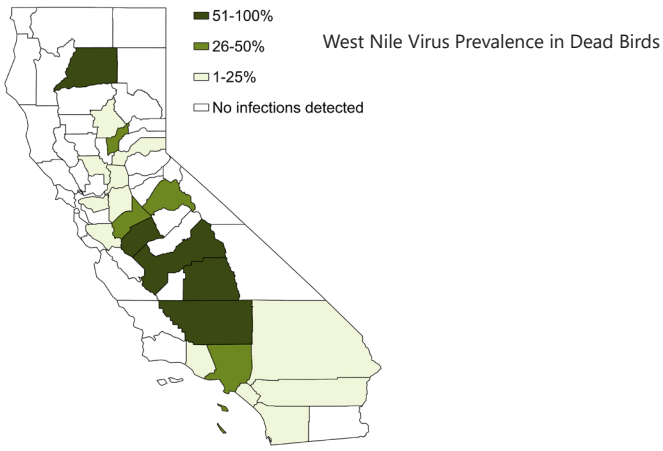


Figure 4.3. Prevalence of West Nile virus infection in dead birds, California, 2019

Table 4.7. Dead birds reported, tested, and positive for West Nile virus, by county, California, 2019

County	Reported	Tested[a]	Positive	%
Alameda	213	83	0	0
Alpine	0			
Amador	4	0		
Butte	67	21	1	4.8
Calaveras	8	0		
Colusa	7	1	0	0
Contra Costa	321	23	1	4.3
Del Norte	0			
El Dorado	47	14	0	0
Fresno	344	16	10	62.5
Glenn	3	0		
Humboldt	8	4	0	0
Imperial	1	0		
Inyo	14	0		
Kern	27	2	2	100
Kings	15	0		
Lake	12	2	0	0
Lassen	2	0		
Los Angeles	694	182	53	29.1
Madera	9	0		
Marin	53	5	0	0
Mariposa	1	0		
Mendocino	7	0		
Merced	40	5	3	60
Modoc	0			
Mono	1	0		
Monterey	21	5	0	0
Napa	25	1	0	0
Nevada	4	3	0	0
Orange	621	489	50	10.2
Placer	184	119	3	2.5
Plumas	2	0		
Riverside	116	40	5	12.5
Sacramento	738	317	44	13.9
San Benito	3	1	0	0
San Bernardino	105	20	4	20
San Diego	175	124	2	1.6
San Francisco	47	5	0	0
San Joaquin	137	33	5	15.2
San Luis Obispo	29	6	0	0
San Mateo	233	61	0	0
Santa Barbara	22	2	0	0
Santa Clara	442	151	8	5.3
Santa Cruz	94	22	0	0
Shasta	19	1	1	100
Sierra	0			
Siskiyou	1	0		
Solano	55	11	0	0
Sonoma	54	6	0	0
Stanislaus	142	15	4	26.7
Sutter	49	10	0	0
Tehama	6	0		
Trinity	0			
Tulare	135	31	17	54.8
Tuolumne	15	2	1	50
Ventura	92	18	2	11.1
Yolo	181	67	7	10.4
Yuba	36	9	3	33.3
Totals	**5,681**	**1,927**	**226**	**11.7**

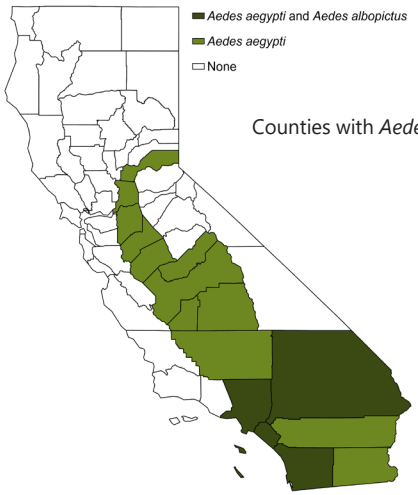
[a] Tested by the University of California Davis Arboviral Research and Training or local mosquito/vector control agency

Table 4.8. Infections with West Nile virus in humans, horses, dead birds, mosquito pools, and sentinel chickens, by county, California, 2019

County	Humans[a]	Horses	Dead Birds	Mosquito Pools	Sentinel Chickens
Alameda	1	0	0	0	0
Alpine	0	0	NT	NT	NT
Amador	1	0	NT	NT	NT
Butte	6	0	1	44	34
Calaveras	0	0	NT	NT	0
Colusa	1	0	0	NT	6
Contra Costa	1	0	1	1	2
Del Norte	0	0	NT	NT	NT
El Dorado	1	0	0	NT	NT
Fresno	51	2	10	495	NT
Glenn	0	0	NT	1	1
Humboldt	0	0	0	NT	NT
Imperial	3	0	NT	2	NT
Inyo	0	0	NT	0	NT
Kern	32	2	2	129	NT
Kings	3	0	NT	63	NT
Lake	0	0	0	6	0
Lassen	0	0	NT	NT	NT
Los Angeles	31	0	53	94	28
Madera	4	2	NT	85	NT
Marin	0	0	0	0	NT
Mariposa	0	0	NT	NT	NT
Mendocino	0	0	NT	NT	NT
Merced	11	1	3	48	16
Modoc	0	0	NT	NT	NT
Mono	0	0	NT	0	NT
Monterey	0	0	0	NT	NT
Napa	0	0	0	0	NT
Nevada	0	0	0	NT	0
Orange	7	0	50	208	NT
Placer	1	0	3	53	8
Plumas	0	0	NT	NT	NT
Riverside	12	1	5	524	NT
Sacramento	4	1	44	74	4
San Benito	0	0	0	0	1
San Bernardino	11	1	4	52	NT
San Diego	3	0	2	0	NT
San Francisco	0	0	0	0	NT
San Joaquin	8	1	5	288	NT
San Luis Obispo	2	0	0	0	NT
San Mateo	0	0	0	0	0
Santa Barbara	0	0	0	0	0
Santa Clara	1	0	8	0	0
Santa Cruz	0	0	0	0	0
Shasta	0	0	1	3	1
Sierra	0	0	NT	NT	NT
Siskiyou	0	0	NT	NT	NT
Solano	1	0	0	5	4
Sonoma	0	0	0	0	NT
Stanislaus	17	2	4	203	NT
Sutter	2	0	0	15	11
Tehama	0	0	NT	NT	4
Trinity	0	0	NT	NT	NT
Tulare	25	0	17	813	10
Tuolumne	0	1	1	NT	NT
Ventura	2	1	2	1	3
Yolo	1	0	7	59	1
Yuba	0	0	3	22	5
State Totals	**243**	**15**	**226**	**3,288**	**139**

[a]Includes asymptomatic infections detected through blood bank screening

NT= no samples tested



Counties with *Aedes* mosquitoes, California, 2019

Figure 4.4. Invasive *Aedes* mosquito detections, by county, California, 2019

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 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 and *Aedes albopictus* can serve as a vector of these arboviruses. In Australia, *Ae. notoscriptus* is an important urban vector of dog heartworm and has been found infected with Ross River and Barmah Forest viruses.

Since 2011, local vector control agencies have detected *Ae. aegypti* and *Ae. albopictus* mosquitoes in 285 cities or census-designated places (CDP) in 18 counties; populations of *Ae. aegypti* and *Ae. albopictus* are considered established in 16 and 4 counties, respectively. *Aedes notoscriptus* continued to be detected within parts of Los Angeles, Orange, and San Diego counties (Figure 4.4). In 2019, *Ae. aegypti* and *Ae. albopictus* were discovered in 30 CDPs and 2 new cities. *Ae. aegypti* were detected for the first time in four counties: Sacramento, San Joaquin, Stanislaus, and Placer. Local vector control agencies with invasive *Aedes* have incorporated *Aedes*-specific traps such as ovicups, Biogents Sentinel traps, and autocidal gravid ovitraps into standard surveillance programs. Agencies responded to travel-associated human cases of *Aedes*-borne arboviruses, such as Zika, following CDC recommended guidelines to minimize the potential for local transmission in areas with established populations of *Ae. aegypti* or *Ae. albopictus*. Education and outreach programs to the public 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 2019, one *Ae. aegypti* out of 6,540 tested was positive for WNV (MIR of 0.2) and 74 *Ae. albopictus* tested negative (Table 4.4). A total of 15,204 *Ae. aegypti* and 154 *Ae albopictus* were tested for chikungunya, dengue, and Zika viruses; all were negative.

VBDS performed additional pesticide resistance testing on *Ae. aegypti* mosquitoes during 2019. Microplate assays measure detoxification enzyme activity and target-site insensitivity associated with resistance to pyrethroids and organophophates. Approximately 2,300 wild-caught *Ae. aegypti* mosquitoes collected in 2017-2018 by 18 local vector control agencies in the Central Valley and southern California were tested by VBDS and compared to a known susceptible laboratory strain. Results found wild-caught mosquitoes had both elevated enzyme levels and target-site insensitivity suggesting that *Ae. aegypti* in California may have functional resistance pathways that could reduce the efficacy of currently available mosquito adulticides.

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
- Response 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 2019. 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.

2019 U.S. Forest Service Highlights

- CDPH-VBDS biologists conducted five formal facility evaluations for hantavirus risk in three Forests in 2019 (Table 5.1).
- Rodent trapping showed a high hantavirus seroprevalence, 34 (23%) of 145 deer mice from USFS lands, up from 15% in 2018 (Table 5.3).
- 44 (17.8%) of 247 *Dermacentor occidentalis* ticks tested positive for spotted fever group *Rickettsia,* of which 17 (6.9%) were positive for *R. phillipi* 364D, causative agent of Pacific Coast tick fever, in Cleveland National Forest; further study on this organism and ticks in the area may be warranted (Table 5.3).
- Four (31%) of 13 Forests where plague surveillance and testing occurred showed evidence of plague activity, up from 18% R5 Forests with plague activity in 2018 (Table 5.3).
- In Angeles National Forest, 503 *D. occidentalis* ticks were collected and tested in follow-up to a human tularemia case reported in 2018; all ticks tested negative.

Table 5.1. Summary of U.S. Forest Service Activities (Region 5) performed by the California Department of Public Health under the CDPH-VBDS Cost-Share Agreement, 2019

National Forest	Disease Risks Addressed	Facility Evaluation	Presentation Audiences	Forest Locations Visited/Contacted[1]
Angeles/ San Gabriel Mountain National Monument	Hantavirus; Plague; Tick-borne diseases			Supervisor's Office; Gateway and Mojave River Ranger District Offices; Chantry Flat Recreation Area, Chantry Flat Heliport Jupiter Mountain Loop Trail, Manzanita, South Fork, and Sturtevent Falls trails; Table Mountain Campground
Cleveland	Hantavirus; Plague; Tick-borne diseases			Supervisor's Office; Descanso, Palomar and Trabuco Ranger District Offices; Blue Jay and Dripping Springs campgrounds, Inaja Memorial Picnic Area, Wild Horse and Secret Canyon trails
Eldorado	Hantavirus; Plague; Tick-borne diseases			Supervisor's Office; Amador, Georgetown, Pacific, and Placerville Ranger District Offices; Sly Park Recreation Area; Fleming Meadow Trail, FS Road 11N65; Leek Springs Fire Lookout, Lumberyard Fire Station
Inyo	Hantavirus; Plague; Tick-borne diseases		Bishop All-Employee Appreciation Day; Concessionaire's meeting in Bishop Safety Meeting	Supervisor's Office; Lee Vining, Mammoth Lakes, Mt. Whitney, and White Mountain Ranger District Offices; Big Pine Creek Recreation Area, Cottonwood Lakes, Four Jeffrey, Grandview, Horseshoe Meadow, Lake Gregory, Lower Sage Flat, Sherwin Creek, Upper Gray's Meadow, and Upper Sage Flat campgrounds; Woods Lodge; Olancha Pass Trailhead; Crooked Creek Research Station; Horseshoe Meadow Pack Station; Schulman Grove Visitor Center; Lee Vining Ranger Station, Crestview Fire Station, and Mono Basin Visitor Center
Klamath	Hantavirus; Plague			Supervisor's Office; Goosenest Ranger District Office; Juanita Lake Campground; Oak Bottom Campground
Lake Tahoe Basin Management Unit	Hantavirus; Plague; Tick-borne diseases		California Land Management (concessionaire)	LTBMU Supervisors Office; Tallac Historical Site; Taylor Creek Visitor Center; Camp Richardson, Fallen Leaf, Kaspian and William Kent campgrounds
Lassen	Hantavirus; Plague			Supervisor's Office; Almanor and Eagle Lake Ranger District Offices; Almanor Group, Almanor Legacy Camp, Aspen Grove, Christie, Merrill, Rocky Knoll, Roxie Peconom, Silver Bowl, and West Eagle Group campgrounds
Los Padres	Hantavirus; Plague; Tick-borne diseases	Santa Barbara Ranger District Office		Supervisor's Office; Mt. Pinos, Ojai, Santa Barbara, and Santa Lucia Ranger District Offices; Cerro Alto, Chuchupate, Figueroa, Freemont, Los Prietos, Paradise, Sage Hill Group, Upper Oso, and Wheeler Gorge campgrounds; Falls, First Crossing, Live Oak, Lower Oso, and White Rock day use areas; Aliso, Cerro Alto, Potrero John, Rinconada Rose Valley Falls, Sisar Canyon, and Snyder trails
Mendocino	Hantavirus			Supervisors Office; Grindstone Ranger Distict Office; Alder Springs Fire Station
Modoc	Hantvirus; Plague	Buck Creek Guard Station		Supervisor's Office; Big Valley, Devil's Garden, and Warner Mountain Ranger Districts; Crowder Flat Guard Station, Jane's Reservoir, Lower Rush Creek, Upper Rush Creek, and Willow Creek campgrounds
Plumas	Hantavirus; Plague; Tick-borne diseases			Supervisor's Office; Beckwourth, Feather River, and Mt. Hough Ranger District Offices; Sly Creek, Big Cove, Bucks Lake, Chilcoot, Cottonwood Springs Group, Frenchman, Mill Creek, Spring Creek, and Snag Lake campgrounds; Smith Lake Trailhead; Laufman Ranger Station
San Bernardino	Plague; Tick-borne diseases			Supervisor's Office, Front Country, Mountaintop, and San Jacinto Ranger District Offices; Apple White and Holcomb Creek campgrounds; Kenworthy Ranger Station; Lake Hemet, Middle Fork Lytle Creek, South Fork and Momyer Creek trails; Penstock and San Sevaine Road
Sequoia	Hantavirus; Plague; Tick-borne diseases		Western Divide Ranger District Office	Supervisor's Office; Hume Lake, Kern River, and Western Divide Ranger District Offices; Fairview, Fish Creek, Headquarters, Limestone, and Tillie Creek, and Troy Meadow campgrounds, and recreation sites along the Kern River; Johnsondale Work Center; South Fork Wildlife Area
Shasta-Trinity	Tick-borne diseases			Supervisor's Office; Shasta Lake Ranger District; Hirz Bay Campground
Sierra	Plague			Supervisor's Office; Bass Lake Ranger District; Edison Campground
Six Rivers	Hantavirus; Plague			Supervisor's Office; Lower Trinity and Orleans Ranger District Offices; Smith River National Recreation Area Office
Stanislaus	Hantavirus; Plague; Tick-borne diseases		Camp Wolfboro, BSA	Supervisor's Office; Calaveras, Groveland, Mi-Wok, and Summit Ranger District Offices; Baker Historical Station (High Sierra Institute), Arnold Rim trail; Baker, Big Meadow, Eureka Valley, Boulder Flat, Brightman Flat, Camp Jack Hazard, Cascade Creek, Deadman, Eureka Valley, Meadowview, New Spicer Reservoir, Pigeon Flat, Pinecrest, Sandy Flat, and Stanislaus River campgrounds; Kennedy Meadows, and Spicer Meadow trailheads; Column of the Giants, Donnell Vista Point picnic area
Tahoe	Hantavirus; Plague; Tick-borne diseases	American Ranger District Office; Yuba River Ranger District Office; Duncan Peak Fire Lookout	American River, Sierraville, Truckee, and Yuba River Ranger Districts	Supervisor's Office; American River, Sierraville, Truckee, and Yuba River Ranger District Offices; Hobart Work Center; CSU Sand Francisco Field Campus; Berger Creek, Bocca Rest, Boca Springs, Boyington Mill, Bullards Bar Reservoir, Dark Day, Diablo, Fuller Lake, Goose Meadows, Granite Flat, Hampshire Rocks, Lakeside, Packsaddle, Prosser Ranch, Prosser Reservoir, Rucker Lake, Salmon Creek, Sardine Lake, Silver Creek, Skillman Horse, White Cloud campgrounds; Hobart Mills trailhead, Sand Pond Day Use; Packer Lake and Donner Camp picnic areas; Prosser Hill OHV area; Rock Creek Nature and Sagehen Creek trails; Yuba Pass

[1] Locations visited or contacted 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 U.S. Forest Service Activities (Region 5), CDPH-VBDS Cost-Share Agreement, 2019

National Forest	Unique Services/ Unusual Findings
Angeles / San Gabriel Mountain National Monument	Conducted tick collections at the Chantry Flat Recreation Area, a long-term tick surveillance and pathogen testing site for southern California. Collected and tested *Dermacentor occidentalis* ticks in response to a human tularemia case reported in 2018.
Cleveland	Detected a high seroprevalence of *Rickettsia phillipi* in *D. occidentalis* ticks collected from trails in the Trabuco Ranger District.
Eldorado	Five (50%) of 10 deer mice trapped at Leek Springs Fire Lookout were positive for antibodies to Sin Nombre virus (SNV), causative agent for hantavirus pulmonary syndrome (HPS). Communicated results to Forest leadership with a comparison to previous surveillance events and test results.
Inyo	Advised Forest leadership of continued high SNV seroprevalence in deer mice from Bodie State Historic Park. Kept the Forest leadership informed of hantavirus case investigations in Mono County and the need for personnel to inspect heating/cooling ducts for signs of rodent entry.
Lake Tahoe Basin Management Unit	Conducted plague surveillance at LTBMU campgrounds and recreation areas. One chipmunk was positive for antibodies to *Yersinia pestis.* Communicated test results and recommendations for continued sign postings to Management Unit leadership.
Lassen	One (25%) of four deer mice from Rocky Knoll Campground tested positive for antibodies to SNV, the causative agent for HPS.
Los Padres	Upon request, conducted hantavirus surveillance and facility evaluations at the Santa Barbara Ranger District. None of the seven captured rodents sampled was positive for SNV. Submitted a final report and recommendations to responsible parties at the District, Forest, and R5.
Mendocino	Conducted hantavirus surveillance and facility evaluations at the Alder Springs Fire Station and co-located Cal Fire Conservation Camp. The single *Peromyscus* sp. mouse from the USFS facility was negative for SNV antibodies, while one (20%) of five deer mice from the Cal Fire facility was positive for antibodies to SNV.
Modoc	Conducted hantavirus surveillance and a facility evaluation at Buck Creek Guard Station. None of 10 *P. maniculatus* was positive for antibodies to SNV. A report of findings was submitted to the District Ranger, Forest Safety Officer, and concerned parties at R5.
Plumas	Conducted plague surveillance in the Bucks Lake area. One shadow chipmunk tested positive for plague antibodies at Mill Creek Campground. This was the second consecutive year for a plague positive rodent at this site.
San Bernardino	Conducted adult tick surveillance in the Lytle Creek and San Jacinto Ranger Districts and found above average tick numbers present at the areas surveyed. None of the 180 *Ixodes pacificus* ticks submitted for testing was positive for *Borrelia* organisms.
Sequoia	None of the nine rodents sampled and tested from Troy Meadow Campground showed antibodies to *Y. pestis,* the causative agent for plague.
Sierra	All 22 rodents sampled and tested from Forest lands were negative for antibodies to *Y. pestis,* causative agent for plague.
Stanislaus	None of seven carnivores tested from lands adjacent to the Forest was positive for antibodies to *Y. pestis,* causative agent for plague.
Tahoe	Four (18%) chipmunks out of 22 sciurid rodents tested positive for antibodies to *Y. pestis* from Lakeside Campground. Communicated test results and recommendations to District and Forest leadership.
R5 (District Level)	Held annual meeting with Region 5 leadership. Provided pre-season letter for distribution throughout Region 5. Submitted pesticide use report on USFS lands. Provided hantavirus facility risk assessment reports and results of facility follow-up questionnaires. Overall Sin Nombre virus seroprevalence on USFS lands in California were significantly greater than the long-term statewide average (23% vs.10%).

Table 5.3. Testing results for selected vector-borne disease agents in U.S. National Forests, California, 2019

National Forest	Hantavirus		*Yersinia pestis*				*Borrelia spp.* [b]		*Rickettsia spp.* [c]	
	Peromyscus mice		rodents		carnivores [a]		*Ixodes* ticks		*Dermacentor* ticks	
	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested
Angeles[d]			0	5	0	5	0	229		
Cleveland			0	6			0	187	44	247
Eldorado	6	18	0	1			1	90		
Inyo	0	6	2	129						
Klamath					0	3				
Lake Tahoe BMU			1	16[e]						
Lassen	1	5	0	15	0	1				
Los Padres	0	16	0	25	0	3	0	154		
Mendocino	0	1								
Modoc	1	22	0	11	0	10				
Plumas			1	21[e]	1	3	0	24		
San Bernardino			0	16			0	180		
Sequoia			0	37						
Shasta-Trinity					0	2	3	48		
Sierra			0	22	0	7				
Stanislaus					0	7				
Tahoe	1	13	4	25[e]			2	188		
H-T (non-R5)[f]	25	52	4	16						
Total, all forests	**34**	**133**	**12**	**347**	**1**	**41**	**6**	**1100**	**44**	**247**

[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] Tests for *Borrelia burgdorferi* causative agent for Lyme disease, and *Borrelia miyamotoi* a recently recognized infectious agent for relapsing fever.

[c] Tests for *R. phillipi,* causative agent for Pacific Coast tick fever, and spotted fever group Rickettsae.

[d] 503 *Dermacentor occidentalis* ticks collected from Jupiter Mountain Loop Trail tested negative for tularemia

[e] Fifty-seven total flea pools from captured rodents tested negative for plague bacteria.

[f] Non-R5 specimens from the Humboldt-Toiyabe were collected and tested under a contract with the United States Marine Corps Mountain Warfare Training Center, and from a hantavirus case investigation on long-term lease lands near Twin Lakes.

6 Vector Control Technician Certification Program

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

To become certified in a control category, applicants must pass the Core section and at least one Specialty section of the examination. Each applicant to the examination pays a fee for each section requested on the application. The Core section consists of questions about the safe and effective use of pesticides. Specialty sections of the examination include the Biology and Control of Mosquitoes in California, Arthropods of Public Health Significance in California, and Vertebrates of Public Health Importance in California (Table 6.1). Successful examinees are issued a gold certification card that is valid for up to two years in the qualified categories specified on the card. To maintain full certification status in subsequent two-year cycles, Certified Technician employees must pay annual renewal fees and fulfill minimum continuing education requirements. The California Department of Public Health (CDPH) Vector-Borne Disease Section approved 104 continuing education events in 2019. 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 2019, 1,221 Vector Control Technicians employed at 104 local public health agencies and CDPH held 2,937 certificates (Table 6.2). The agencies include special districts, departments of county government, departments of city government, and CDPH. Of these agencies, 73 are signatory to a cooperative agreement with CDPH.

In 2019, 929 individuals employed at 74 agencies held full certification status. In addition, 292 employees from 52 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 2019

Exam section	No. Exams Given	No. Passed (%)
Core	164	125 (76)
Mosquito Control	169	120 (71)
Terrestrial Invertebrate Control	115	83 (72)
Vertebrate Vector Control	102	82 (80)
Totals	**550**	**410 (74)**

Table 6.2. Vector Control Technician certificates in effect as of December 2019

	No. Certificates		
Certification Category	Full Status	Limited Status	Total
Mosquito Control	915	212	1,127
Terrestrial Invertebrate Vector Control	720	163	883
Vertebrate Vector Control	728	199	927
Totals	**2,363**	**574**	**2,937**

7 Public Information Materials, Publications

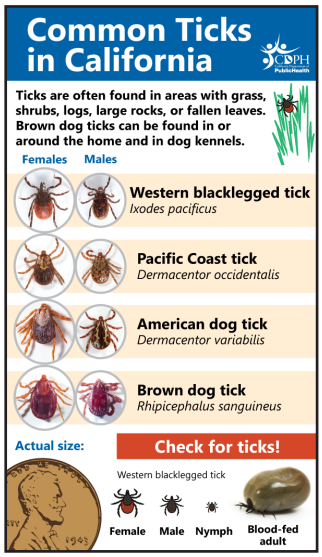
A goal of the California Department of Public Health, Vector-Borne Disease Section is to provide clear and effective information on disease prevention. This goal is pursued through approaches including presentations, development and distribution of printed and digital materials, and maintenance of websites 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 information materials in 2019

- *Flea-borne Typhus – What Californians Need to Know* (flier – English/Spanish)
- *Flea-borne Typhus* (social media messages)
- *Seasonal Risk of Exposure to Infected Western Blacklegged Ticks in California* (graphic)

Expanded resources in 2019

- *Common Ticks in California* (wallet card, new version – English/Spanish)
- *Conenose (Kissing) Bugs and Chagas Disease* (webpage)
- *Facts About Conenose Bugs in California* (fact sheet)
- *A Parent's Guide to Head Lice* (brochure – English/Spanish/Chinese/Farsi/Tagalog/Vietnamese)



Publications*

Backus, L; **Foss, L**; Tell, L. 2019. West Nile virus in hummingbirds in California, USA, 2005-2017. Journal of Wildlife Diseases. doi:10.7589/2018-10-241.

Feiszli, T; **Padgett, K**; **Snyder, R**; Fang, Y; Simpson, J; Barker, CM; **Foss, L**; Messenger, S; **Kramer, V**. Surveillance for mosquito-borne encephalitis virus activity in California, 2018. Proceedings and Papers of the 87th Annual Conference of the Mosquito and Vector Control Association of California, 2019 87: 12-19.

Karpathy, S; Espinosa, A; **Yoshimizu, M**; Hacker, J; **Padgett, K**; Paddock, CD. A novel TaqMan assay to detect *Rickettsia* 364D, the etiologic agent of Pacific Coast tick fever. Journal of Clinical Microbiology 2019 58(1). doi: 10.1128/JCM.01106-19

Kjemtrup, AM; Messenger, S; Meza, AM; **Feiszli, T**; **Yoshimizu, MH**; **Padgett, K**; Singh, S. New exposure location for hantavirus pulmonary syndrome case, California, USA, 2018. Emerging Infectious Diseases 2019 Oct;25(10):1962-1964. doi: 10.3201/eid2510.190058

Liebman, K; **Billeter, SA**; **Yoshimizu, M**; **Yang, F**; **Metzger, ME**; **Schildhauer, S**; **Payne, R**; **Pakingan, MJ**; **Hu, R**; **Kramer, V**; **Padgett, K**. Identification of molecular determinants of resistance to pyrethroid insecticides in *Aedes aegypti* (Diptera: Culicidae) populations in California, USA. Journal of Medical Entomology 2019 May; 56(5). doi: 10.1093/jme/tjz076

MacDonald, AJ; O'Neill, C; **Yoshimizu, M**; **Padgett, K**; Larsen, AE. Tracking seasonal activity of the western blacklegged tick across California. Journal of Applied Ecology 2019 August 56(11). doi: 10.1111/1365-2664.13490

Rose, I; **Yoshimizu, M**; Bonilla, D; Fedeova, N; Lane, RS; **Padgett, K**. Phylogeography of *Borrelia* spirochetes in *Ixodes pacificus* and *Ixodes spinipalpis* ticks highlights differential acarological risk of tick-borne disease transmission in northern versus southern California. PLoS ONE 2019. doi: 10.1371/journal.pone.0214726

Yoshimizu, M; **Padgett, K**; **Kramer, V**. Surveillance of a kdr resistance mutation in *Culex pipiens* (Diptera: Culicidae) and *Culex quinquefasciatus* in California. Journal of Medical Entomology 2019 57(2). doi: 10.1093/jme/tjz208

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VECTOR-BORNE
DISEASE SECTION
CALIFORNIA DEPARTMENT OF PUBLIC HEALTH