Vector-Borne Disease Section

Annual Report

2023

California Department of PublicHealth

2023

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

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Preface

I am pleased to present to you the 2023 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 2023.

In 2023, West Nile virus (WNV) activity was elevated and widespread, with activity reported from 43 (74%) of 58 counties. Of the 433 human cases reported from 34 counties, 77% were the severe neuroinvasive form of the disease and there were 20 fatalities. The number of human cases was more than double the preceding five-year average and the highest reported since 2017; numbers of WNV positive mosquitoes, dead birds, and horses also well exceeded preceding years. West Nile virus continues to pose the greatest vector-borne disease threat in California, with over 8,000 cases (367 fatal) reported since 2003. In addition to WNV activity, St. Louis encephalitis virus (SLEV) activity was detected in 18 counties and there were 19 human cases, the highest number reported since the reemergence of SLEV in 2015.

Two locally transmitted cases of dengue were identified in Los Angeles County in 2023. These marked the first locally acquired cases of dengue detected in California. Travel-associated human cases of dengue (250), chikungunya (23), and Zika (3) were also reported in 2023. *Aedes aegypti* (yellow fever mosquito), the primary vector of dengue, Zika, and chikungunya viruses, is now well established in 24 California counties, and *Aedes albopictus* (Asian tiger mosquito) a secondary vector of these viruses, is found in five counties. With *Aedes aegypti* established throughout most of southern California and the Central Valley, as far north as Shasta County, there is the ongoing threat of local virus transmission in some regions of the state.

In 2023, 180 human cases of flea-borne typhus, caused by *Rickettsia typhi*, were reported; 86% of the case-patients required hospitalization. Typhus is considered endemic in parts of southern California. Plague activity was detected in rodents or carnivores from five counties (El Dorado, Lassen, Mariposa, Mono, and Nevada) and in one cat (Sierra County) in 2023, prompting enhanced outreach. This was the first confirmed case of feline plague in California since 2011. Since 1980, hantavirus infection has been diagnosed in 91 California residents, with most cases exposed to Sin Nombre virus (SNV) in the interior mountain ranges of the state or eastern Sierra Nevada. There was one human case reported in 2023 with likely exposure in the Sierra Nevada region, and SNV antibody-positive deer mice were found in 8 of 12 counties sampled.

Human cases of six tick-borne diseases were reported in California in 2023. Reports of Lyme disease (123) increased slightly relative to 2022. Although Lyme disease is the most commonly reported tick-borne disease in California, there were also cases of anaplasmosis (21), tick-borne relapsing fever (5), Rocky Mountain spotted fever (RMSF) (9), and babesiosis (10). Of the nine RMSF cases, five were associated with travel or residence in Tecate, Mexico. Three of these cases were fatal, highlighting the importance of early recognition and rapid treatment for this increasingly important bi-national tick-borne disease. In 2023, VBDS and collaborating agencies collected and tested thousands of ticks throughout California, including over 15,000 *Ixodes pacificus* (western blacklegged tick) from 37 counties, to aid in identifying areas at highest risk of tick-borne disease transmission.

In 2023, VBDS continued to expand public education through social media, digital and print materials, and the development of new web-based toolkits 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
Vector-Borne Disease Section

Acknowledgements

The California Department of Public Health, Vector-Borne Disease Section works with numerous local, state, and federal agencies, private and commercial organizations, and members of the medical community in its efforts to monitor, prevent, and control vector-borne diseases in California. Some of the Section's key collaborators in 2023 are listed here.

Rodent-borne Diseases

Alameda County Vector Control Services District (VCSD); Museum of Vertebrate Zoology at University of California Berkeley; California Department of Parks and Recreation; County of San Diego Vector Control Program (VCP); El Dorado County VCP; National Park Service (NPS); Orange County Mosquito and Vector Control District (MVCD); San Bernardino County VCP; 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; California Department of Fish and Wildlife (CDFW); County of Los Angeles Agricultural Commissioner; El Dorado County VCP; Los Angeles County Vector Management Program; NPS; 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.

Tick-borne Diseases

Alameda County VCSD; Butte County MVCD; CDFW; Contra Costa MVCD; University of California Davis Arbovirus Research and Training (DART) Laboratory; Delta MVCD; Imperial County Public Health Department; Lake County VCD; Marin County Health and Human Services; Marin-Sonoma MVCD; Mosquito and Vector amanagement District of Santa Barbara County; Napa County Mosquito Abatement District; 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 Environmental Health Division.

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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Annual Report Cover Art and Maps
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Suggested Citations

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https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/VBDSAnnualReports.aspx

Chapters

Many staff from the Vector-Borne Disease Section contribute to each chapter of the Annual Report; 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, 2023. California Department of Public Health, Sacramento, California, 2024. pp 1-3.

2 Flea-borne Diseases
Hacker, G; Novak, M and Kjemtrup, A. Chapter 2: Flea-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2023. California Department of Public Health, Sacramento, California, 2024. pp 4-7.

3 Tick-borne Diseases
Saunders, M and Kjemtrup, A. Chapter 3: Tick-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2023. California Department of Public Health, Sacramento, California, 2024. pp 8-14.

4 Mosquito-borne Diseases
Romo, H; Danforth, ME and Metzger, M. Chapter 4: Mosquito-borne Diseases. In: Vector-Borne Disease Section Annual Report, 2023. California Department of Public Health, Sacramento, California, 2024. pp 15-22.

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, 2023. California Department of Public Health, Sacramento, California, 2024. pp 23-26.

6 Vector Control Technician Certification Program
Niemela, M. Chapter 6: Vector Control Technician Certification Program. In: Vector-Borne Disease Section Annual Report, 2023. California Department of Public Health, Sacramento, California, 2024. pp 27-28.

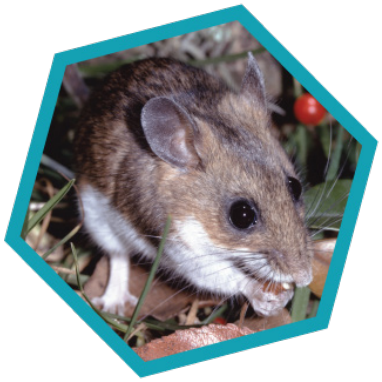
7 Public Information, Scientific Publications
Nicolici, A and Kjemtrup, A. Chapter 7: Public Information, Scientific Publications. In: Vector-Borne Disease Section Annual Report, 2023. California Department of Public Health, Sacramento, California, 2024. pp 29-33.

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; 116130; and 116180]. CDPH-VBDS provides leadership, information, and consultation on vector-borne diseases and vectors to the public and agencies engaged in disease prevention and vector control. CDPH-VBDS staff, located in three regional offices and headquartered in Sacramento, provide the following services:

- Develop and implement statewide vector-borne disease prevention, surveillance, and control programs
- Design and conduct scientific investigations to further knowledge of vector-borne diseases in California
- Coordinate preparedness activities for detection and response to introduced vector-borne diseases and vectors, such as West Nile virus, Zika, chikungunya, dengue, and invasive *Aedes* mosquitoes
- Conduct or coordinate emergency vector control when disease outbreaks occur
- Provide laboratory testing for vector-borne disease agents in arthropods and vertebrates
- Advise local agencies on public health issues related to vector-borne diseases
- Advise local agencies on regulatory issues pertaining to mosquito and other vector control
- Provide information, training, and educational materials to governmental agencies, the medical community, and the public
- Oversee a Cooperative Agreement (HSC 116180) between CDPH and local vector control agencies for pesticide applications
- Oversee the Vector Control Technician Certification and Continuing Education programs (HSC 116110(d))
- Provide consultation on issues related to the management of ticks, 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 for restricted-use 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 public.

Human disease surveillance

Human cases of hantavirus infection, which include both hantavirus pulmonary syndrome 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 causative agent of hantavirus infection, to evaluate unusual exposure circumstances or potential for additional exposures. In 2023, one case of hantavirus pulmonary syndrome was reported from a resident of Monterey County, California, who survived. Illness onset was in August. Exposure likely occurred while patient travelled in the Sierra Nevada. Genetic sequencing results of the patient's sample matched SNV sequences from deer mice (*Peromyscus maniculatus*) from the Sierra Nevada. SNV antibodies were detected in 3 (30%) of 10 deer mice collected from the California Sierra Nevada travel location. Since 1980, hantavirus infection has been diagnosed in 91 California residents, with the majority exposed to SNV in the interior mountain ranges of the state or eastern Sierra Nevada (Figure 1.1).

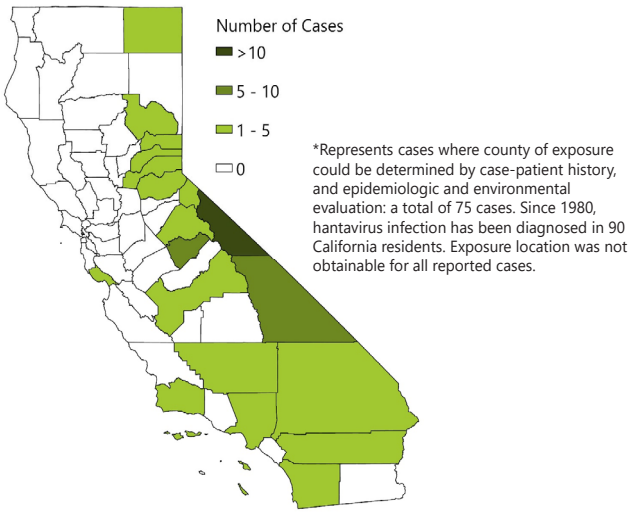


Figure 1.1. Likely county of exposure for reported hantavirus infections, California (1980 – 2023)*

Rodent surveillance

In 2023, 977 rodents (Genera: *Microtus*, *Neotoma*, *Peromyscus*, and *Reithrodontomys*) were tested for antibodies to SNV (Table 1.1). Of 926 *Peromyscus* spp. sampled, 26 (2.8%) were positive for SNV antibodies. Seroprevalence in deer mice, the primary reservoir for SNV, was 6.3% (Tables 1.1, 1.2). At least one deer mouse was SNV antibody-positive in 8 (67%) of 12 counties sampled in 2023 (Table 1.2). SNV antibody has been detected in deer mice from 24 (56%) of 43 counties sampled in the last 10 years; prevalence ranged from 1.5% to 45.5% (mean 12.5%) over that period (Table 1.2).

Additionally, 9 (19.1%) of 47 western harvest mice (*Reithrodontomys megalotis*) demonstrated reactivity to SNV (Table 1.1). None of two voles (*Microtus* spp.) and two 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, which cross react to the Sin Nombre virus assay. In California, no hantaviruses other than SNV have been shown to be pathogenic to humans.

Table 1.1 Serologic evidence of hantavirus (Sin Nombre) infection in California rodents, 2014 - 2023

		2023			2014-2023		
Species	Common name	No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
Peromyscus boylii	brush mouse	46	0		713	5	0.7
Peromyscus californicus	California mouse	280	2	0.7	1,467	14	1.0
Peromyscus crinitus	canyon mouse	1	0		32	2	6.3
Peromyscus eremicus	cactus mouse	151	0		1,996	13	0.7
Peromyscus maniculatus	deer mouse	381	24	6.3	4,261	531	12.5
Peromyscus truei	piñon mouse	66	0		453	4	0.9
Peromyscus spp.	unspeciated *Peromyscus*	1	0		2	0	
Peromyscus spp. subtotal		926	26	2.8	8,924	569	6.4
Reithrodontomys megalotis	western harvest mouse	47	9	19.1	609	76	12.5
Neotoma spp.	woodrats	2	0		220	0	
Microtus spp.	voles	2	0		59	8	13.6

National Park hantavirus prevention

In May 2013, Yosemite National Park (YOSE) of the National Park Service (NPS) and Heluna Health (HH, formerly Public Health Foundation Enterprises) began a cooperative agreement to decrease the risk of contracting vector-borne diseases through increased health education, vector surveillance, and public health research. CDPH-VBDS and HH worked with YOSE staff in 2023 on hantavirus prevention activities including rodent surveillance to estimate deer mouse abundance and SNV prevalence, facility evaluations, and improving employee training and public education. Deer mouse surveillance was conducted in developed areas of Yosemite Valley, Tuolumne Meadows, and Crane Flat. The deer mouse trap success rate (10.9%) at Yosemite Valley locations in 2023 was similar to the overall Valley trap success rate (11.1%) for surveillance conducted from 2012 to 2022. Three (8.3%) of 36 deer mice collected from Yosemite Valley locations tested positive for SNV antibodies in 2023, compared to 6.9% (24 of 349) of deer mice sampled from 2012 to 2022. The 25.2% trap success rate for deer mice in Tuolumne Meadows was slightly higher than the overall trap success rate of 23.1% for surveillance events in this area from 2012 to 2022. However, the SNV seroprevalence of 3.4% (1 of 29) was lower than the overall SNV seroprevalence (11.9%, 93 of 783) for deer mice sampled in Tuolumne Meadows from 2012 to 2022. Only three deer mice were captured at Crane Flat, one (33%) of which was seropositive for SNV antibodies. Similarly, 35.7% (5 of 14) of deer mice previously tested from this area, between 2015 and 2022, were seropositive. In addition to rodent surveillance and SNV testing, over 100 structures were evaluated for rodent-borne disease risks. CDPH-VBDS and HH staff provided hantavirus prevention recommendations to YOSE and its associated partners based on the rodent surveillance results and facility evaluations.

Lassen Volcanic National Park (LAVO) renewed a cooperative agreement with HH and CDPH-VBDS in 2023 for services that included facility evaluations and deer mouse surveillance to estimate rodent abundance and SNV prevalence. Deer mouse surveillance was conducted in three developed areas of LAVO and two (33%) of six deer mice tested seropositive for SNV antibodies. The seropositive mice were collected at Lake Helen Picnic Area and Volcano Adventure Campground, while two deer mice captured at Lost Creek Campground tested negative. For comparison, 21.7% (55 of 254) of deer mice in LAVO tested positive for SNV antibodies from 2014 to 2022. In addition, four buildings in LAVO were evaluated for hantavirus or other vector-borne disease risks. HH staff provided hantavirus prevention recommendations to LAVO based on the surveillance results and facility evaluations.

Table 1.2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus* in California, 2014-2023

	2023			2014-2023		
County	No. tested	No. reactive	Percent	No. tested	No. reactive	Percent
Alameda	14	0	0.0	87	0	0.0
Alpine				9	2	22.2
Amador				8	0	0.0
Butte				6	0	0.0
Calaveras				4	1	25.0
Contra Costa				12	0	0.0
Del Norte				1	0	0.0
El Dorado	63	6	9.5	305	66	21.6
Fresno				8	0	0.0
Glenn				5	1	20.0
Humboldt				69	0	0.0
Inyo				11	5	45.5
Kern	26	1	3.8	66	1	1.5
Lassen				26	8	30.8
Los Angeles	8	0	0.0	33	0	0.0
Marin				43	0	0.0
Mariposa	39	4	10.3	362	28	7.7
Modoc				38	3	7.9
Mono				356	135	37.9
Monterey	9	0	0.0	10	0	0.0
Napa				5	1	20.0
Nevada	21	2	9.5	106	17	16.0
Orange				0	0	0.0
Placer				32	2	6.3
Plumas	7	2	28.6	115	25	21.7
Riverside				149	26	17.4
San Bernardino				118	0	0.0
San Diego	153	6	3.9	1,298	58	4.5
San Joaquin				4	0	0.0
San Mateo				173	33	19.1
Santa Barbara				12	0	0.0
Santa Clara				1	0	0.0
Santa Cruz				18	5	27.8
Shasta	4	2	50.0	114	19	16.7
Sierra				22	0	0.0
Siskiyou	1	0	0.0	81	22	27.2
Sonoma				46	0	0.0
Sutter				9	0	0.0
Tehama				99	20	20.2
Trinity				3	0	0.0
Tulare				32	2	6.3
Tuolumne	36	1	2.8	330	50	15.2
Ventura				35	1	2.9
Total	**381**	**24**	**6.3**	**4,261**	**531**	**12.5**

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*, the 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 eighty cases of flea-borne typhus were reported to CDPH in 2023. Thirty-six (20%) of these were classified as confirmed cases according to CDPH working surveillance definition and 135 (75%) were probable. Median age was 43 years (range 0 to 86 years); 97 (54%) were male, and 83 (46%) were female. One hundred fifty-five (86%) of the case-patients required hospitalization. Case-patients were residents of Los Angeles (144, 80%), Orange (19, 11%), Riverside (7, 4%), San Bernardino (5, 2.5%), Contra Costa (1, 0.5%), El Dorado (1, 0.5%), Monterey (1, 0.5%), San Diego (1, 0.5%), and Santa Clara (1, 0.5%) counties. Typhus is considered endemic in Southern California.

Plague

Human cases of plague are reportable to CDPH by local health jurisdictions. Presumptive positive test results for reported cases are typically confirmed by either the CDPH Microbial Diseases Laboratory (CDPH-MDL) or the U.S. Centers for Disease Control and Prevention. Environmental investigation in response to a human case of plague typically includes an evaluation and risk assessment of all potential exposure sites.

There were no human cases of plague reported to CDPH in 2023.

Animal disease surveillance (plague)

Rodent and flea surveillance is conducted to test for antibodies to *Yersinia pestis* in rodents and the presence of *Y. pestis* in fleas, which provides evidence of *Y. pestis* transmission in local rodent populations. Reported rodent carcasses are submitted to CDPH and tested for *Y. pestis* when plague infection is suspected. Recreational area closures for flea control may be initiated depending on surveillance findings and estimated plague transmission risks. Domestic pet plague cases and *Y. pestis* antibody presence in carnivores are used as indicators of regional plague activity and positive results are typically followed by local rodent and flea surveillance.

Domestic pets

One case of plague in a domestic feline was reported in December 2023 from Sierra County. This was the first confirmed case of feline plague in California since 2011. An evaluation of the potential exposure location and follow-up rodent surveillance is planned for 2024.

This is the first known case of feline plague in California in 12 years. Felines are typically exposed by hunting rodents and can result in increased human exposure risk.

Wild animals

The CDPH Vector-Borne Disease Section (CDPH-VBDS) plague surveillance program tested blood samples from 616 wild rodents and 261 carnivores and feral pigs sampled from 28 California counties in 2023 (Figure 2.1, Table 2.1). Serum antibodies to *Y. pestis* were observed in nine (1.5%) rodents from four counties (Figure 2.1, Table 2.1). The 616 rodents tested for plague antibodies included: 186 deer mice (*Peromyscus maniculatus*), 180 chipmunks (*Tamias* spp.), 148 California ground squirrels (*Otospermophilus beecheyi*), 34 golden-mantled ground squirrels (*Callospermophilus lateralis*), 26 other *Peromyscus* spp., 23 woodrats (*Neotoma* spp.), 9 Douglas squirrels (Tamiasciurus douglasii), 8 Belding's ground squirrels (*Urocitellus beldingi*), 1 California vole (*Microtus californicus*), and 1 Great Basin pocket mouse (*Perognathus parvus*).

Table 2.1. CDPH-VBDS *Yersinia pestis* test results for wild rodents and carnivores sampled in 2023

County Location	Rodent blood tested by serology	Rodent carcasses tested by culture	Carnivore blood tested by serology	Positive Specimens	
				Species	Month
Alameda	**25**		**41**		
Butte	**0**		**15**		
Calaveras	**0**		**2**		
Contra Costa	**0**		**21**		
El Dorado	**53**	**1**	**27**		
LTBMU: Tallac Historical Site				*Tamias amoenus*	June
Ed Z'berg Sugar Pine Point State Park: General Creek CG				*Otospermophilus beecheyi*	October
Kern	**40**		**27**		
Kings	**0**		**1**		
Lassen	**58**		**13**		
Lassen NF: Eagle Lake CG				*Tamias amoenus*	July
Lassen NP: Butte Lake CG				*Tamias speciosus*	August
Los Angeles	**15**		**8**		
Madera	**0**		**4**		
Mariposa	**11**		**24**		
Yosemite NP				*Pekania pennanti*	January
Yosemite NP				*Pekania pennanti*	January
Yosemite NP				*Ursus americanus*	July
Yosemite NP				*Pekania pennanti*	November
Yosemite NP				*Pekania pennanti*	November
Yosemite NP				*Pekania pennanti*	November
Yosemite NP				*Pekania pennanti*	December
Modoc	**0**		**34**		
Mono	**56**		**0**		
Inyo NF: Oh Ridge CG				*Tamias umbrinus*	July
Inyo NF: Twin Lakes				*Tamias speciosus*	July
Inyo NF: Twin Lakes				*Tamias speciosus*	July
Inyo NF: Twin Lakes				*Tamias speciosus*	July
Napa	**0**		**11**		
Nevada	**61**		**0**		
Donner Memorial SP				*Tamiasciurus douglasii*	September
Placer	**0**		**1**		
Plumas	**42**		**0**		
Sacramento	**0**		**5**		
San Bernardino	**12**		**0**		
San Diego	**112**		**0**		
San Joaquin	**0**		**2**		
San Luis Obispo	**0**		**4**		
San Mateo	**40**		**0**		
Shasta	**34**		**0**		
Trinity	**0**		**1**		
Tulare	**3**		**0**		
Tuolumne	**44**		**20**		
Ventura	**10**		**0**		
Total	**616**	**1**	**261**		

CG: Campground; LTBMU: Lake Tahoe Basin Management Unit; NF: National Forest; NP: National Park; SP: State Park

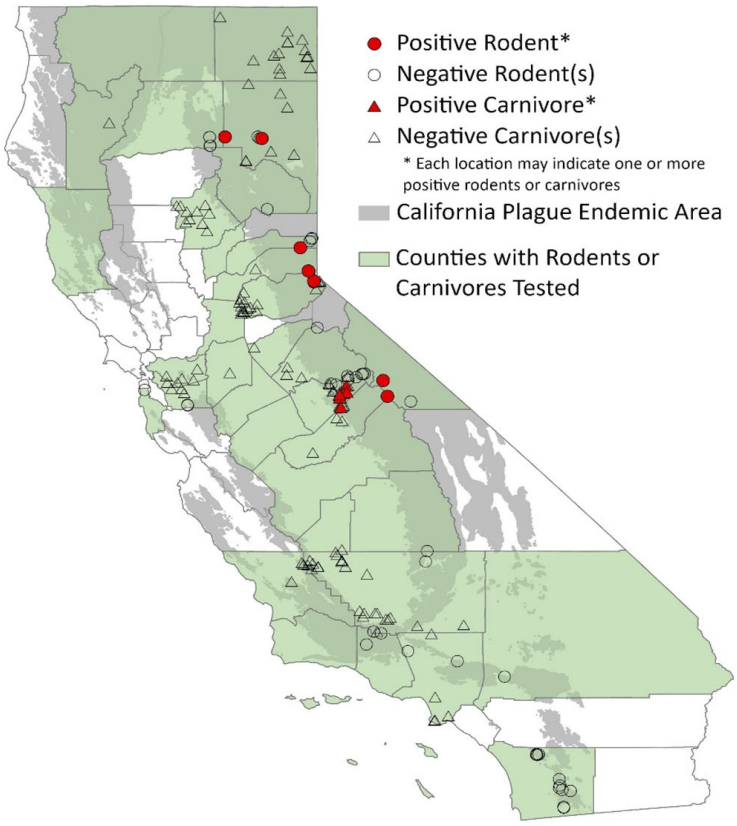


Figure 2.1. Approximate locations of carnivores or rodents collected in 2023 that were tested by serology or culture for *Yersinia pestis*.

Antibodies to *Y. pestis* were detected in 3 lodgepole chipmunks (*Tamias speciosus*) from Mono County, 1 lodgepole chipmunk from Lassen County, 2 yellow-pine chipmunks (*Tamias amoenus*) from El Dorado and Lassen counties, 1 Uinta chipmunk (*Tamias umbrinus*) from Mono County, 1 California ground squirrel from El Dorado County, and 1 Douglas squirrel (*Tamiasciurus douglasii*) from Nevada County (Table 2.1). One rodent carcass from El Dorado County tested negative for *Y. pestis* by the CDPH-MDL reference bacteriology unit (Table 2.1). The 261 wild carnivore (and feral pig) samples included: 112 coyotes (*Canis latrans*), 83 feral pigs (*Sus scrofa*), 17 fishers (*Pekania pennanti*),15 black bears (*Ursus americanus*), 13 raccoons (*Procyon lotor*), 9 gray foxes (*Urocyon cinereoargenteus*), 7 striped skunks (*Mephitis mephitis*), 3 bobcats (*Lynx rufus*), 1 mountain lion (*Puma concolor*), and 1 red fox (*Vulpes vulpes*). Serum antibodies to *Y. pestis* were detected in seven wild carnivores from Mariposa County for an overall seroprevalence of 2.7%. Positive samples included six fishers and one black bear (Table 2.1). Additional carnivore samples from 2023 likely will be tested and reported in 2024.

In 2023, the San Diego County Department of Environmental Health-Vector Control Program conducted independent, county-wide surveillance and testing for plague in rodents. None of 173 rodents tested was positive for antibodies to *Y. pestis* via a hemagglutination assay. Of those 173 rodents, 112 were sent to CDPH for secondary testing and none were positive (Table 2.1).

Table 2.2. CDPH-VBDS *Yersinia pestis* test results for wild rodents and carnivores sampled from 2021 to 2022 and tested in 2023

County Location	Rodent blood tested by serology	Rodent carcasses tested by culture	Carnivore blood tested by serology	Positive specimens		
				Species	Collection Month	Collection Year
Butte	**1**		**1**			
El Dorado	**0**		**2**			
Kern	**0**		**19**			
Los Angeles	**0**		**1**			
Madera	**0**		**6**			
Mariposa	**0**		**12**			
El Portal				*Pekania pennanti*	December	2022
Mendocino	**0**		**2**			
Modoc	**0**		**5**			
Mono	**0**	**1**	**0**			
Napa	**0**		**1**			
Placer	**0**		**1**			
San Luis Obispo	**0**		**11**			
Santa Barbara	**0**		**5**			
Siskiyou	**0**		**2***			
Stanislaus	**0**		**2***			
Tulare	**0**		**1**			
Yuba	**0**		**1**			
Total	**1**	**1**	**72**			

* Both samples from Siskiyou and one sample from Stanislaus were collected in 2021. All other samples were collected in 2022.

In addition to the samples collected and tested in 2023, CDPH-VBDS conducted serologic testng on one rodent and 72 carnivore samples that were collected in 2021 (three carnivore samples) or 2022 (one rodent and 69 carnivore samples) but were not submitted for testing until 2023 (Table 2.2). One fisher sampled from Mariposa County in 2022 tested positive for antibodies to *Y. pestis*. These results from 2021 to 2022 are reported here to provide a complete accounting of plague samples tested but not previously reported.

Rodent flea testing

A total of 716 fleas collected in 2023 from sylvatic rodents from ten counties were identified to 12 different species (Tables 2.3, 2.4). They were combined into 283 pools and tested for the presence of *Y. pestis*. No flea pools tested PCR-positive for *Y. pestis* (Table 2.4).

Table 2.3. CDPH-VBDS *Yersinia pestis* test results in rodent fleas by county, 2023

County	Flea Pools (Total # Fleas) Tested by PCR	Number Positive Pools
El Dorado	**31 (99)**	**0**
Kern	**7 (16)**	**0**
Lassen	**41 (102)**	**0**
Mariposa	**5 (6)**	**0**
Mono	**30 (48)**	**0**
Nevada	**59 (138)**	**0**
Plumas	**45 (116)**	**0**
Shasta	**34 (80)**	**0**
Tuolumne	**16 (19)**	**0**
Ventura	**15 (92)**	**0**
Total	**283 (716)**	**0**

PCR: Polymerase Chain Reaction

Table 2.4. CDPH-VBDS *Yersinia pestis* test results in rodent fleas by flea species, 2023

Flea Species	Flea Pools (Total # Fleas) Tested by PCR	Number Positive Pools
Atheca wagneri	**40 (85)**	**0**
Ceratophyllus ciliatus	**84 (193)**	**0**
Eumolpianus eumolpi	**23 (47)**	**0**
Eumolpianus eutamiadis	**21 (26)**	**0**
Hoplopsyllus anomalus	**3 (4)**	**0**
Opisodasys keeni	**3 (3)**	**0**
Orchopeas agilis	**3 (22)**	**0**
Orchopeas nepos	**5 (5)**	**0**
Orchopeas sexdentatus	**1 (1)**	**0**
Oropsylla idahoensis	**26 (53)**	**0**
Oropsylla montana	**59 (257)**	**0**
Peromyscopsylla hesperomys adelpha	**15 (20)**	**0**
Total	**283 (716)**	**0**

PCR: Polymerase Chain Reaction

3 Tick-borne Diseases

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

Human disease surveillance

Anaplasmosis

In 2023, 21 cases of anaplasmosis caused by *Anaplasma phagocytophilum* were reported to the California Department of Public Health (CDPH): seventeen (81%) met national surveillance criteria for a confirmed case and four (19%) met the criteria for a probable case. Median age was 61 years (range, 30 to 82 years), 11 (52%) were male and ten (48%) were female. Of those self-reporting race and ethnicity, 17 (81%) were White, and 4 (19%) were Unknown. None identified as Hispanic or Latino. Case-patients were residents of Humboldt, Kern, Los Angeles (8), Marin (3), Sacramento, San Diego, San Mateo (2), Santa Barbara, Santa Clara, Sonoma, and Ventura counties. Four (19%) patients reported exposure within California, including Humbolt, Marin (2), and Sonoma counties, 16 (76%) reported exposure in the northeast or upper Midwest of the United States, and for one (5%) exposure could not be determined (Figure 3.1).

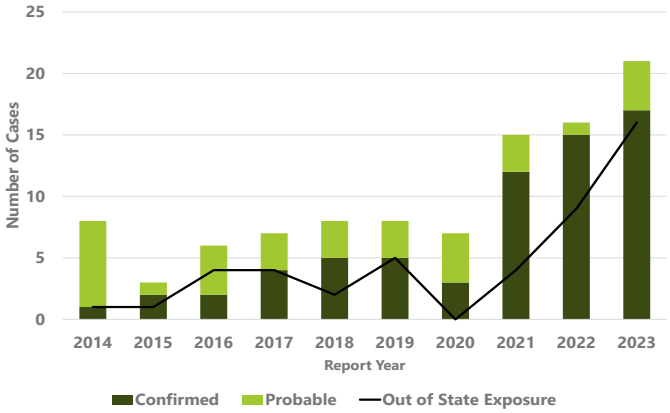


Figure 3.1. Confirmed and probable anaplasmosis cases, including cases reporting travel within incubation period, by report year 2014 - 2023

Since 2013, the median number of reported anaplasmosis cases in California has risen from one case per year to eight cases per year.

Babesiosis

In 2023, ten cases of babesiosis were reported to CDPH; nine (90%) met national surveillance criteria for confirmed for infection with *Babesia microti*; one (10%) was a probable case of *B. duncani*. Six (60%) were male; four (40%) were female. The median age was 67 years (range, 18 to 83 years). Self-reported race and ethnicity were White (7), Asian, or Unknown (2); none reported Hispanic or Latino ethnicity. One case was fatal. Case-patients were residents of Alameda, Contra Costa (2), Los Angeles (3), Marin, Orange, San Diego, and Sonoma counties. Exposures included blood transfusion, travel to eastern United States or Europe where *B. microti* is endemic (8), or unknown (*B. duncani*).

Ehrlichiosis

Three cases of ehrlichiosis were reported to CDPH in 2023; one (33%) met national surveillance criteria for confirmed case for infection with *Ehrlichia chaffeensis*; two (66%) were probable cases of *E. chaffeensis*. Two

cases had travel history to midwestern states where the Lone Star tick (*Amblyomma americanium*), the tick vector for *E. chaffeensis* is endemic; travel history was unknown for one.

Lyme disease

A total of 123 cases of Lyme disease caused by *Borrelia burgdorferi* were reported in 2023; 78 (63%) of these met the surveillance case definition criteria for a confirmed case, 37 (30%) were probable, and 8 (7%) were suspect cases with erythema migrans (EM) rash with exposure in California (Figure 3.2).

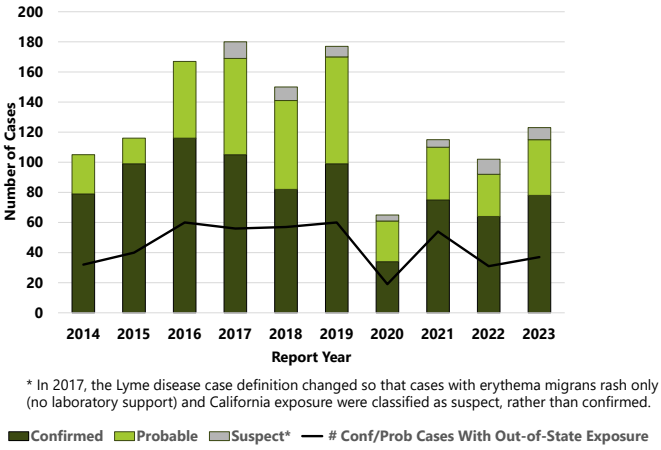
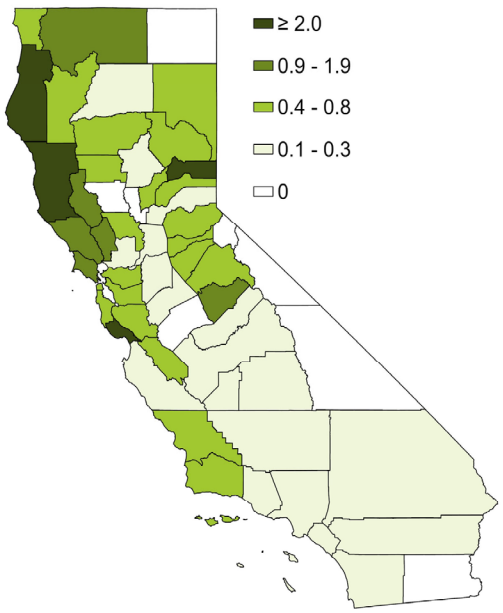


Figure 3.2. Confirmed, probable and suspect Lyme disease cases, including cases reporting travel within incubation period, by report year 2014 - 2023

Of the 78 confirmed cases, patients were residents of 25 counties, with Santa Cruz County reporting the greatest number of cases (11) (Table 3.1). The median age of confirmed Lyme disease patients was 41.5 years (range, 0 to 85 years); 41 (53%) were female, 36 (46%) were male, and one (1%) was non-binary. Of the confirmed patients for whom race and ethnicity were reported, 45 (58%) self-identified as White, 2 (3%), Asian, 1 (1%), Multiple races, and 3 (4%) as Other. Seven (9%) self-identified as Hispanic or Latino. Erythema migrans was identified in 30 (38%) confirmed case-patients, with onset of EM noted mostly in summer months of June through August (17 or 57%). Between 2014 and 2023, the highest incidence of Lyme disease was in the north to central coastal counties and some northern counties with western-facing Sierra slopes (Figure 3.2). Of the 37 (32%) confirmed and probable patients reporting travel history outside of California one month prior to onset, the most common areas of exposure were the northeast or upper Midwest of the United States (33 or 89%) followed by Europe (3 or 8%), and one (3%) was described as other.



Reported confirmed Lyme disease cases per 100,000 person-years, 2014-2023*

Santa Cruz	3.4
Sierra	3.2
Humboldt	2.9
Mendocino	2.6
Sonoma	1.5
Siskiyou	1.4
Mariposa	1.2
Marin	1.2
Lake	0.9

* Reported by county of residence. Though Lyme disease cases have been reported in nearly every county, cases are reported based on the county of residence, which does not necessarily reflect the county of infection.

Figure 3.3. Incidence of reported confirmed Lyme disease, by county, California, 2014-2023

Table 3.1. Reported confirmed Lyme disease cases by county of residence, California, 2013-2022

County	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	TOTAL	Incidence per 100,000 person-years
Alameda	1	11	10	11	3	7	8	3	5	4	63	0.38
Alpine	0	0	0	0	0	0	0	0	0	0	0	0.00
Amador	0	1	1	0	0	0	0	0	0	0	2	0.50
Butte	1	0	2	0	0	1	0	0	1	1	6	0.29
Calaveras	0	1	0	1	0	1	0	0	0	0	3	0.67
Colusa	0	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	2	4	5	13	10	2	2	5	2	1	46	0.40
Del Norte	0	0	0	0	0	0	0	0	1	0	1	0.38
El Dorado	1	3	1	2	0	0	0	0	3	2	12	0.64
Fresno	0	1	1	0	1	1	0	1	1	0	6	0.06
Glenn	1	0	0	0	0	1	0	0	0	0	2	0.70
Humboldt	5	6	4	3	4	6	2	0	4	5	39	2.93
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	0	1	1	0	0	1	0	0	0	1	4	0.04
Kings	0	0	1	0	0	0	0	0	0	0	1	0.07
Lake	0	0	2	0	0	3	1	0	0	0	6	0.90
Lassen	0	0	1	0	0	0	0	0	0	0	1	0.35
Los Angeles	14	6	2	4	2	2	0	4	2	8	44	0.04
Madera	0	0	0	0	0	0	1	0	1	0	2	0.13
Marin	5	2	5	0	1	7	1	5	3	0	29	1.15
Mariposa	1	1	0	0	0	0	0	0	0	0	2	1.18
Mendocino	1	0	1	1	0	9	1	5	4	3	25	2.79
Merced	0	0	0	0	0	0	0	0	0	0	0	0.00
Modoc	0	0	0	0	0	0	0	0	0	0	0	0.00
Mono	0	0	0	0	0	0	0	0	0	0	0	0.00
Monterey	0	0	1	0	0	1	0	2	1	0	5	0.11
Napa	1	3	2	0	1	0	1	1	2	0	11	0.81
Nevada	0	2	2	0	1	2	0	0	0	1	8	0.80
Orange	0	0	1	0	0	0	0	0	0	0	1	0.00
Placer	0	0	2	3	0	0	0	0	1	1	7	0.17
Plumas	1	0	0	0	0	0	0	0	0	0	1	0.53
Riverside	1	1	3	1	1	2	2	2	0	3	16	0.07
Sacramento	0	0	1	1	3	4	0	3	2	5	19	0.12
San Benito	0	1	0	0	0	0	0	0	0	1	2	0.30
San Bernardino	0	1	0	0	0	2	0	3	0	0	6	0.03
San Diego	7	8	8	2	6	2	0	2	6	3	44	0.13
San Francisco	1	0	0	10	13	11	2	11	3	4	55	0.65
San Joaquin	1	0	1	0	1	3	0	0	0	1	7	0.09
San Luis Obispo	3	3	1	0	1	2	2	2	2	0	16	0.57
San Mateo	6	5	5	4	0	2	1	0	0	0	23	0.31
Santa Barbara	0	4	7	4	3	2	1	2	1	2	26	0.59
Santa Clara	7	9	11	8	5	2	3	4	5	9	63	0.33
Santa Cruz	7	7	9	15	10	11	3	11	5	11	89	3.39
Shasta	0	0	0	0	0	0	1	1	0	1	3	0.17
Sierra	0	0	0	0	1	0	0	0	0	0	1	3.15
Siskiyou	0	1	1	1	1	0	0	0	1	1	6	1.38
Solano	0	0	3	2	2	0	1	1	0	1	10	0.22
Sonoma	11	12	13	8	8	5	0	2	5	7	71	1.48
Stanislaus	0	1	1	3	2	0	0	0	0	0	7	0.13
Sutter	0	0	0	0	0	0	0	0	0	0	0	0.00
Tehama	0	0	3	1	0	0	0	0	0	0	4	0.62
Trinity	1	0	0	0	0	0	0	0	0	0	1	0.63
Tulare	0	1	1	0	0	4	0	0	0	1	7	0.15
Tuolumne	0	1	0	0	0	1	0	0	0	0	2	0.37
Ventura	0	0	2	4	2	2	0	3	1	1	15	0.18
Yolo	0	1	1	3	0	0	0	1	1	0	7	0.32
Yuba	0	1	0	0	0	0	1	1	1	0	4	0.48
TOTAL	**79**	**99**	**116**	**105**	**82**	**99**	**34**	**75**	**64**	**78**	**831**	**0.21**

Spotted fever group rickettsiosis

Nine cases of Rocky Mountain spotted fever (RMSF) caused by *Rickettsia rickettsii*, were reported to CDPH in 2023. Six (67%) met the surveillance criteria for a confirmed case and three (33%) were probable. Five (56%) were male, 4 (44%) were female; median age was 17 years (range, 1.5 to 78 years). Three (33%) of the cases were fatal. Of the eight patients self-reporting race and ethnicity, five (64%) were White, one (13%) self-reported as other; six (75%) were Hispanic or Latino. Patients were residents of San Diego (4), Imperial, San Bernardino, and Santa Barbara counties; two patients were residents of Mexico. Exposure locations included Mexicali, Mexico (1), Tecate, Mexico (5), and the southwestern United States (3).

Seven cases of spotted fever group *Rickettsia* (not including RMSF) caused by other *Rickettisia* spp. were reported to CDPH in 2023. Three of the cases were acquired in California. One was a confirmed case of a newly recognized rickettsial pathogen, currently called *Rickettsia* sp. CA6269 acquired in July in the San Francisco Bay Area. One probable case of Pacific Coast tick fever caused by *Rickettsia* strain 364D (proposed *Rickettsia rickettsii* subsp. *californica*) was reported in July from a Sonoma County resident. One case was a probable case related to a western blacklegged tick (*Ixodes pacificus*) bite acquired in Santa Clara County in March. The tick was PCR positive for a *Rickettsia* spp endosymbiont; the patient developed muscle aches and an elevated titer to *R. rickettsii*. Four cases were travel-related probable cases of *R. africae* acquired from tick bites in South Africa.

Tick-borne relapsing fever

Five cases of tick-borne relapsing fever (TBRF), caused by *Borrelia hermsii*, were reported to CDPH in 2023; all met CDPH working surveillance case definition criteria for confirmed cases. Median age was 47 years (range, 1.5 to 61 years), three (60%) were male, and two (40%) were female. Patients were residents of Alameda, Mono (2), Napa, and San Mateo counties. Counties where patients were likely exposed in the three weeks prior to illness onset were Alpine, Mono (2), and Nevada (2) counties.

Tularemia

No tick-exposure related tularemia cases were reported in 2023.

Tick surveillance

Anaplasma phagocytophilum

In 2023, a total of 6,902 adult, 1,695 nymphal, and 96 larval western blacklegged ticks (*Ixodes pacificus*) were collected and tested for the presence of *Anaplasma phagocytophilum*, the causative agent of anaplasmosis. Of these ticks, the CDPH Vector-Borne Disease Section (CDPH-VBDS) individually tested 3,506 adult and 521 nymphal western blacklegged ticks from 33 counties (Table 3.2). Thirty (0.9%) adult and 8 (1.5%) nymphal western blacklegged ticks tested positive by real-time polymerase chain reaction (RT-PCR) at the CDPH-VBDS laboratory (Table 3.2). Additionally, 96 larval western blacklegged ticks from Contra Costa, Marin, Sonoma, and Yuba counties were tested in 12 pools by CDPH-VBDS; all tested negative. Alameda County Department of Environmental Health and San Mateo Mosquito and Vector Control District (MVCD) share *A. phagocytophilum* tick testing data with CDPH-VBDS. In 2023, collectively their agencies collected and tested 3,396 adult western blacklegged ticks in 695 pools and 1,174 nymphal ticks in 591 pools from sites in their counties. Twenty-eight (0.8%) adult tick pools and 8 (0.7%) nymphal pools tested positive for *A. phagocytophilum* (Table 3.2). Statewide minimum infection prevalence (defined as the number of positive pools divided by the number of ticks tested multiplied by 100) is 0.9% in both adult and nymphal western blacklegged ticks (Table 3.2).

Francisella tularensis

In 2023, CDPH-VBDS tested a total of 160 adult American dog ticks (*Dermacentor variabilis*) and 9 adult Pacific Coast ticks (*D. occidentalis*) from Contra Costa, Marin, Mendocino, Monterey, Napa, Orange, Sacramento, San Francisco, San Joaquin, San Luis Obispo, and Santa Cruz counties for *Francisella tularensis*, the causative agent of tularemia. One adult *D. variabilis* from Marin County tested positive for *F. tularensis* by RT-PCR, for a statewide infection prevalence of 0.6%. Reported to CDPH-VBDS, the San Diego Environmental Health Vector

Table 3.2. Infection prevalence and minimum infection prevalence of *Anaplasma phagocytophilum* in *Ixodes pacificus* ticks, California, 2023

Non-pooled testing	No. Ticks Tested			Positive *A. phagocytophilum*			
County	**Adults**	**Nymphs**	**Larvae**	**Adults (IP[a])**	**Nymphs (IP[a])**	**Collected by**	**Laboratory**
Alameda	36					CDPH, VBDS	CDPH, VBDS
Colusa	86					CDPH, VBDS	CDPH, VBDS
Contra Costa	75	14	1			CDPH, VBDS	CDPH, VBDS
El Dorado	174	32				CDPH, VBDS	CDPH, VBDS
Humboldt	32			5 (15.6)		CDPH, VBDS	CDPH, VBDS
Kern	3					CDPH, VBDS	CDPH, VBDS
Lassen	10					CDPH, VBDS	CDPH, VBDS
Los Angeles	28			1 (3.6)		CDPH, VBDS	CDPH, VBDS
Marin	682	340	18	4 (0.6)	7 (2.1)	CDPH, VBDS; Marin-Sonoma MVCD	CDPH, VBDS
Mariposa	19	3				CDPH, VBDS	CDPH, VBDS
Mendocino	31	19		1 (3.2)		CDPH, VBDS	CDPH, VBDS
Merced	45	2				CDPH, VBDS	CDPH, VBDS
Napa	81					CDPH, VBDS	CDPH, VBDS
Orange	39					CDPH, VBDS	CDPH, VBDS
Placer	218	9		4 (1.8)		CDPH, VBDS	CDPH, VBDS
Riverside	66					CDPH, VBDS	CDPH, VBDS
San Benito	5					CDPH, VBDS	CDPH, VBDS
San Bernardino	36					CDPH, VBDS	CDPH, VBDS
San Diego	65					CDPH, VBDS	CDPH, VBDS
San Joaquin	1					CDPH, VBDS; San Joaquin MVCD	CDPH, VBDS
San Luis Obispo	519			2 (0.4)		CDPH, VBDS	CDPH, VBDS
Santa Barbara	80					CDPH, VBDS	CDPH, VBDS
Santa Cruz	404	1				CDPH, VBDS; Santa Cruz County MVCD	CDPH, VBDS
Siskiyou	5					CDPH, VBDS	CDPH, VBDS
Sonoma	413	97	19	13 (3.1)	1 (1.0)	CDPH, VBDS	CDPH, VBDS
Tehama	50					CDPH, VBDS	CDPH, VBDS
Trinity	5					CDPH, VBDS	CDPH, VBDS
Tulare	57					CDPH, VBDS; Delta MVCD	CDPH, VBDS
Tuolumne	1					CDPH, VBDS	CDPH, VBDS
Ventura	2					CDPH, VBDS	CDPH, VBDS
Yuba	238	4	58			CDPH, VBDS	CDPH, VBDS
Non-pooled totals	**3,506**	**521**	**96**	**30 (0.9)**	**8 (1.5)**		
Pooled testing	**No. Ticks Tested**			**Positive *A. phagocytophilum* pools**			
County	**Adults (pools)**	**Nymphs (pools)**		**Adults (MIP[b])**	**Nymphs (MIP[b])**	**Collected by**	**Laboratory**
Alameda	1,234 (250)	487 (244)		13 (1.1)	2 (0.4)	Alameda County DEH	Alameda County DEH
San Mateo	2,162 (445)	687 (347)		15 (0.7)	6 (0.9)	San Mateo MVCD	San Mateo MVCD
Pooled totals	**3,396 (695)**	**1, 174 (591)**		**28 (0.8)**	**8 (0.7)**		
All tick totals	**6,902 (4,201)**	**1,695 (1,112)**		**62 (0.9)**	**16 (0.9)**		

Abbreviations:

IP, Infection prevalence; MIP, Minimum infection prevalence; CDPH-VBDS, California Department of Public Health, Vector-Borne Disease Section; MVCD, Mosquito and Vector Control District; DEH, Department of Environmental Health.

[a] Infection prevalence is the number of individually tested ticks positive divided by the number of ticks tested multiplied by 100.

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

Control Program tested 2,623 adult Pacific Coast ticks and 516 adult American dog ticks for *F. tularensis* by RT-PCR. All ticks tested negative.

Spotted fever group rickettsiosis

In 2023, CDPH tested ticks for spotted fever group *Rickettsia* spp. (SFGR) including *R. rickettsii* subsp. *californica*, the causative agent of Pacific Coast tick fever, and *R. rickettsii*, the causative agent of RMSF. Ticks included 2,896 adult and 11 nymphal Pacific Coast ticks from Alameda, Amador, Calaveras, Colusa, Contra Costa, El Dorado, Humboldt, Kern, Lake, Lassen, Los Angeles, Madera, Marin, Mariposa, Mendocino, Merced, Monterey, Napa, Nevada, Orange, Placer, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Joaquin, San Luis Obispo, Santa Barbara, Santa Cruz, Solano, Sonoma, Sutter, Tehama, Trinity, Tulare, Tuolumne, Ventura, Yolo, and Yuba counties. Additionally, 37 nymphal and 9 larval rabbit ticks (*Haemaphysalis leporispalustris*) and 83 adult American dog ticks from Alameda, Contra Costa, Marin, Napa, Santa Clara, and Sonoma counties were tested following a novel SFGR human infection in the San Francisco Bay Area. DNA from all ticks was extracted by CDPH-VBDS and tested by RT-PCR by CDPH Viral and Rickettsial Disease Laboratory. All ticks tested negative for *R. rickettsii*. Thirty-six (1.2%) adult Pacific Coast ticks tested positive for *Ricketsia* 364D strain, with positive ticks detected from Lake (1 of 30 or 3.3%), Los Angeles (13 of 502 or 2.6%), Orange (5 of 153 or 3.3%), San Bernardino (3 of 303 or 1.0%), San Diego (5 of 185 or 2.7%), San Luis Obispo (1 of 146 or 0.7%), Santa Barbara (3 of 111 or 2.7%), and Santa Cruz (1 of 108 or 0.9%) counties. Orange County MVCD reported testing 175 adult Pacific coast ticks in 44 pools and

five adult American dog ticks for SFGR at their laboratory. All ticks tested negative.

Borrelia spirochetes

Borrelia burgdorferi sensu lato

In 2023, local, state, and federal agencies, in collaboration with CDPH-VBDS, collected 13,888 adult, 1,902 nymphal, and 96 larval western blacklegged ticks from 37 counties to test for *Borrelia burgdorferi*, the causative agent of Lyme disease (Tables 3.3, 3.4). Collection and testing data for western blacklegged ticks are collated by CDPH-VBDS. From the counties where ticks were tested individually by RT-PCR, 61 (1.7%) of 3,520 adult and 59 (8.1%) of 728 nymphal ticks tested positive for *B. burgdorferi* sensu lato (Table 3.3). Ticks tested by local vector control agencies in pools were tested by RT-PCR or immunoflurescent antibody test. In the counties where ticks were tested in pools, 151 (1.5% MIP) adult tick pools out of 10,368 collected and 53 (4.5% MIP) nymphal pools out of 1,174 tested positive for *B. burgdorferi* sensu lato (Table 3.4). All larval ticks tested negative.

Borrelia miyamotoi

In 2023, of the western blacklegged ticks collected, 12,931 adult, 1,902 nymphal, and 96 larval ticks were tested for *Borrelia miyamotoi*, the causative agent of hard tick relapsing fever. Of the 3,520 individually tested adults and 716 individually tested nymphs, 29 (0.8%) and 9 (1.3%), respectively, tested positive for *B. miyamotoi* (Table 3.3). Of the 9,411 adult ticks tested in 2,240 pools and 1,174 nymphs tested in 591 pools, 62 (0.7% MIP) and 18 (1.5% MIP), respectively, tested positive (Table 3.4).

Borrelia spp. coinfection

In 2023, eleven adult *I. pacificus* from Humboldt (2), Placer (2), San Luis Obispo (1), Sonoma (5), and Yuba (1) counties tested positive for both *B. burgdorferi* sl and *A. phagocytophilum*, for a statewide adult co-infection prevalence of 0.3% (11 positive out of 3,506 adults tested). Three *I. pacificus* nymphs from Marin County tested positive for both *B. burgdorferi* sl and *A. phagocytophilum*, for a statewide nymphal infection prevalence of 0.6% (three positive out of 521 nymphs tested). One adult tick from El Dorado County tested positive for both *B. burgdorferi* sl and *B. miyamotoi*, for a statewide adult infection prevalence of 0.03% (1 positive out of 3,520 adults tested).

Mammal surveillance

Francisella tularensis

CDPH-VBDS collaborates with the CDPH Microbial Disease Laboratory to test mammals for *Francisella tularensis*, the agent of tularemia, by serology, DFA, PCR, and culture. Mammals may be tested for tularemia in response to reported human cases or for environmental risk assessment including specific carcass testing requests. In 2023, two small mammal carcasses tested negative for *F. tularensis* from El Dorado (1) and Mono (1) counties.

Table 3.3. Infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* spirochetes in *Ixodes pacificus* ticks, California, 2023

County	No. Ticks Tested			Positive *B. burgdorferi*		Positive *B. miyamotoi*		Collected by	Laboratory
	Adults	Nymphs	Larvae[a]	Adults (IP)[b]	Nymphs (IP)[b]	Adults (IP)[b]	Nymphs* (IP)[b]		
Alameda	36			1 (2.8)				CDPH, VBDS	CDPH, VBDS
Colusa	86							CDPH, VBDS	CDPH, VBDS
Contra Costa	75	14	1			1 (1.3)		CDPH, VBDS	CDPH, VBDS
El Dorado	174	32		6 (3.4)	4 (12.5)	7 (4.0)		CDPH, VBDS	CDPH, VBDS
Humboldt	32			3 (9.4)				CDPH, VBDS	CDPH, VBDS
Kern	3							CDPH, VBDS	CDPH, VBDS
Lassen	10							CDPH, VBDS	CDPH, VBDS
Los Angeles	28							CDPH, VBDS	CDPH, VBDS
Marin	688	427	18	13 (1.9)	48 (11.2)	7 (1.0)	7 (1.6)	CDPH, VBDS; Marin-Sonoma MVCD	CDPH, VBDS; Marin-Sonoma MVCD
Mariposa	19	3			1 (33.3)			CDPH, VBDS	CDPH, VBDS
Mendocino	31	19		2 (6.5)	1 (5.3)	1 (3.2)		CDPH, VBDS	CDPH, VBDS
Merced	45	2						CDPH, VBDS	CDPH, VBDS
Napa	81							CDPH, VBDS	CDPH, VBDS
Orange	39			3 (7.7)				CDPH, VBDS	CDPH, VBDS
Placer	219	9		9 (4.1)		4 (1.8)		CDPH, VBDS	CDPH, VBDS
Riverside	66							CDPH, VBDS	CDPH, VBDS
Sacramento		12						Sacramento-Yolo MVCD	Sacramento-Yolo MVCD
San Benito	5							CDPH, VBDS	CDPH, VBDS
San Bernardino	36							CDPH, VBDS	CDPH, VBDS
San Diego	65							CDPH, VBDS	CDPH, VBDS
San Joaquin	1							San Joaquin MVCD	CDPH, VBDS
San Luis Obispo	519			2 (0.4)				CDPH, VBDS	CDPH, VBDS
Santa Barbara	80							CDPH, VBDS	CDPH, VBDS
Santa Clara		12						Santa Clara VCD	Santa Clara VCD
Santa Cruz	403	1		2 (0.5)		3 (0.7)		CDPH, VBDS; Santa Cruz County MVCD	CDPH, VBDS
Siskiyou	5			1 (20.0)				CDPH, VBDS	CDPH, VBDS
Sonoma	421	193	19	12 (2.9)	5 (2.6)	2 (0.5)	2 (1.0)	CDPH, VBDS; Marin-Sonoma MVCD	CDPH, VBDS; Marin-Sonoma MVCD
Tehama	50							CDPH, VBDS	CDPH, VBDS
Trinity	5							CDPH, VBDS	CDPH, VBDS
Tulare	57			2 (3.5)				CDPH, VBDS	CDPH, VBDS
Tuolumne	1							CDPH, VBDS	CDPH, VBDS
Ventura	2							CDPH, VBDS	CDPH, VBDS
Yuba	238	4	58	5 (2.1)		4 (1.7)		CDPH, VBDS	CDPH, VBDS
Total	**3,520**	**728**	**96**	**61 (1.7)**	**59 (8.1)**	**29 (0.8)**	**9 (1.3)**		

Abbreviations:
CDPH-VBDS, California Department of Public Health, Vector-Borne Disease Section; MVCD, Mosquito and Vector Control District; VCD, Vector Control District
All *Ixodes pacificus* ticks tested at CDPH-VBDS are tested by multiplex real-time polymerase chain reaction (RT-PCR) for *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi*.

[a] No larvae tested positive for *B. burgdorferi* sensu lato or *B. miyamotoi*, so IP was not calculated.
[b] 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.

Table 3.4. Minimum infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* in *Ixodes pacificus* ticks, California, 2023

County	No. Ticks Tested		Positive Pools, *B. burgdorferi*		Positive Pools, *B. miyamotoi*[c]		Collected by	Laboratory
	Adults (pools)	Nymphs (pools)	Adults (MIP)[b]	Nymphs (MIP)[b]	Adults (MIP)[b]	Nymphs (MIP)[b]		
Alameda	1,234 (250)	487 (244)	25 (2.0)	34 (7.0)	8 (0.7)	4 (0.8)	Alameda County DEH	Alameda County DEH
Butte	335 (74)		9 (2.7)		2 (0.6)		Butte County MVCD	Placer MVCD
Los Angeles[a]	142 (27)						Los Angeles County West VCD	Los Angeles County West VCD
Marin	318 (72)		10 (3.1)		2 (0.6)		Marin-Sonoma MVCD	Marin-Sonoma MVCD
Orange	10 (7)						Orange County MVCD	Orange County MVCD
Placer	2,157 (507)		42 (1.9)		19 (0.9)		Placer MVCD	Placer MVCD
Sacramento	899 (274)		20 (2.2)				Sacramento-Yolo MVCD	Sacramento-Yolo MVCD
San Diego	850 (139)						County of San Diego VCP	County of San Diego VCP
San Mateo	2,162 (445)	687 (347)	23 (1.1)	19 (2.8)	12 (0.6)	14 (2.0)	San Mateo MVCD	San Mateo MVCD
Santa Clara	1,461 (546)		16 (1.1)		15 (1.0)		Santa Clara VCD	Santa Clara VCD
Shasta	534 (126)		3 (0.6)		1 (0.2)		Shasta MVCD	Placer MVCD
Sonoma	208 (47)		3 (1.4)		3 (1.4)		Marin-Sonoma MVCD	Marin-Sonoma MVCD
Yolo	58 (24)						Sacramento-Yolo MVCD	Sacramento-Yolo MVCD
Total	**10,368 (2,538)**	**1,174 (591)**	**151 (1.5)**	**53 (4.5)**	**62 (0.7)**	**18 (1.5)**		

Abbreviations:
DEH, Department of Environmental Health; MVCD, Mosquito and Vector Control District; VCD, Vector Control District; VCP, Vector Control Program.
[a] Tested by immunofluorescent antibody (IFA) test.
[b] MIP: Measure of prevalence. MIP (minimum infection prevalence) is equal to the number of positive pools divided by the number of ticks tested multiplied by 100.
[c] 9,411 (2,240) adult ticks and 1,174 (591) nymphs tested for *Borrelia miyamotoi,* Sacramento-Yolo MVCD does not test for *B. miyamoto* i.

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), local public health laboratories, and commercial laboratories. Local and commercial laboratories tested for WNV using an IgM enzyme immunoassay (EIA) and/or an IgM immunofluorescence assay (IFA). Specimens from the first WNV case of the year from each county, as well as specimens from all cases from counties with enzootic St. Louis encephalitis virus (SLEV) activity, were forwarded to the CDPH-VRDL for further testing with plaque reduction neutralization tests (PRNT). Additional WNV infections were identified through nucleic acid test screening performed by blood and organ donation centers.

In 2023, a total of 433 symptomatic and 40 asymptomatic infections with WNV were identified, which was a 114% increase compared to the number of total infections (221) reported in 2022 (Table 4.1). Of the 433 symptomatic cases, 334 (77%) were classified as West Nile neuroinvasive disease (e.g., encephalitis, meningitis, acute flaccid paralysis, or other neurologic dysfunction) and 99 (23%) were classified as West Nile non-neuroinvasive disease. There were 20 fatal cases for a case-fatality of 4.6%. Patients were residents of 34 counties and incidence was highest in Yolo County (17.66 cases per 100,000 persons, Table 4.1, Figure 4.1). Two hundred seventy-three (63%) patients were male. The median age

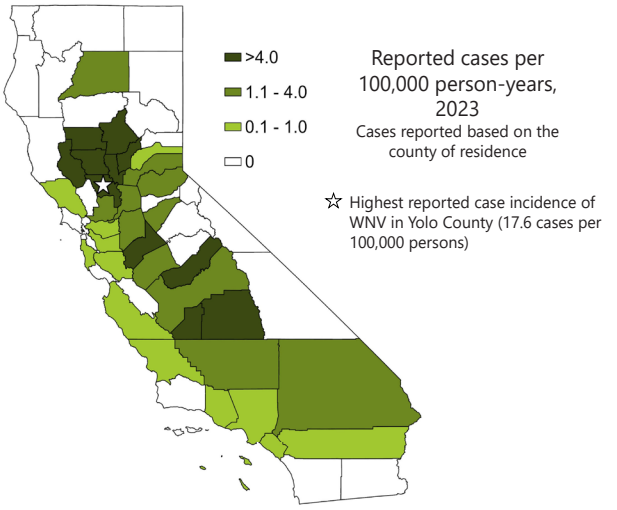


Figure 4.1. Incidence of reported human cases of West Nile virus, by county, California, 2023

for neuroinvasive cases was 61 years (range, 13 to 94 years), and among non-neuroinvasive cases, the median age was 54 years (range, 26 to 80 years). The median age of the 20 WNV-associated fatalities was 70 years (range, 27 to 94 years). Dates of symptom onset for all reported cases ranged from June 30 to December 10.

St. Louis encephalitis virus

Nineteen symptomatic cases of SLEV infection were identified in 2023 (Table 4.5). Twelve (63%) cases presented with neuroinvasive disease, seven (37%) with non-neuroinvasive diseases and two (11%) fatalities were reported. Patients were residents of ten counties (Table 4.5) and fifteen (79%) were male. The median age was 62 years (range, 21 to 82 years) and dates of symptom onset ranged from May 20 to October 29.

Table 4.1. Reported West Nile virus human cases by county of residence, California, 2014-2023

County	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2023 incidence per 100,000 person-years	10-year incidence per 100,000 person-years
Alameda	1	0	0	1	0	1	0	0	1	1	0.07	0.03
Alpine	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Amador	0	0	1	0	1	1	0	0	0	0	0.00	0.75
Butte	24	53	21	4	12	5	4	13	3	18	8.76	7.64
Calaveras	0	0	0	0	0	0	0	0	0	1	2.23	0.22
Colusa	3	1	2	0	0	1	0	0	1	1	4.59	4.13
Contra Costa	5	1	4	4	4	1	4	2	1	10	0.87	0.31
Del Norte	0	0	0	0	0	0	0	0	0	0	0.00	0.00
El Dorado	0	0	1	0	0	0	1	1	0	3	1.59	0.32
Fresno	43	8	14	13	14	51	10	14	30	23	2.27	2.18
Glenn	10	19	6	0	2	0	1	2	1	4	13.97	15.71
Humboldt	0	0	0	0	1	0	0	0	0	0	0.00	0.07
Imperial	1	1	0	3	0	3	1	0	0	0	0.00	0.50
Inyo	0	0	0	4	0	0	0	0	0	0	0.00	2.12
Kern	11	11	17	30	13	28	8	8	22	16	1.76	1.81
Kings	4	0	8	5	0	3	2	8	7	9	5.96	3.05
Lake	1	2	1	0	1	0	2	0	0	6	8.98	1.95
Lassen	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Los Angeles	253	286	151	277	43	31	90	16	61	62	0.67	1.30
Madera	3	4	6	2	4	3	6	3	3	9	5.69	2.72
Marin	0	1	0	0	0	0	0	0	0	0	0.00	0.04
Mariposa	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Mendocino	1	2	0	0	0	0	0	0	0	0	0.00	0.34
Merced	1	1	0	10	2	10	12	6	7	8	2.80	2.00
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	1	0	0	0	0	2	0.46	0.07
Napa	0	0	0	0	1	0	0	0	0	0	0.00	0.09
Nevada	0	2	0	0	1	0	0	0	0	1	0.99	0.40
Orange	263	92	32	33	9	5	17	3	9	6	0.19	1.49
Placer	7	0	7	0	9	1	2	2	2	6	1.46	0.88
Plumas	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Riverside	14	127	11	32	15	12	10	3	0	20	0.82	1.00
Sacramento	10	4	25	6	15	4	7	6	5	53	3.37	0.88
San Benito	0	0	0	0	0	0	0	0	0	0	0.00	0.00
San Bernardino	21	54	8	57	9	7	3	1	4	28	1.28	0.88
San Diego	11	42	20	2	2	3	1	3	3	0	0.00	0.27
San Francisco	0	0	0	1	0	0	0	1	0	0	0.00	0.02
San Joaquin	9	2	13	14	14	7	2	7	4	15	1.91	1.11
San Luis Obispo	0	0	0	0	0	2	0	2	0	2	0.72	0.22
San Mateo	0	0	0	0	0	0	0	1	1	3	0.41	0.07
Santa Barbara	0	0	0	0	0	0	0	2	0	0	0.00	0.05
Santa Clara	10	8	1	0	1	1	0	3	1	3	0.16	0.15
Santa Cruz	0	0	0	0	0	0	0	1	0	0	0.00	0.04
Shasta	2	3	1	1	1	0	2	3	1	6	3.34	1.11
Sierra	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Siskiyou	0	1	0	0	0	0	0	0	0	0	0.00	0.23
Solano	5	1	4	1	0	1	1	2	2	6	1.35	0.52
Sonoma	0	0	0	0	0	0	0	0	0	1	0.21	0.02
Stanislaus	33	13	26	28	15	16	35	5	15	33	6.04	4.01
Sutter	8	2	12	3	1	1	1	0	1	7	7.07	3.64
Tehama	4	5	5	2	2	0	2	0	3	0	0.00	3.58
Trinity	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Tulare	21	13	10	12	8	24	7	8	15	25	5.26	3.01
Tuolumne	0	0	0	0	1	0	0	0	0	0	0.00	0.18
Ventura	1	6	7	1	2	2	0	0	0	1	0.12	0.24
Yolo	15	8	16	6	11	1	4	3	3	39	17.66	4.80
Yuba	6	10	11	1	2	0	0	0	1	5	6.05	4.35
Total WNV disease	**801**	**783**	**442**	**553**	**217**	**225**	**235**	**129**	**207**	**433**	**1.11**	**1.03**
Asymptomatic Infections[a]	91	77	41	47	26	18	28	19	14	40		
Total WNV infections	**892**	**860**	**483**	**600**	**243**	**243**	**263**	**148**	**221**	**473**		

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

Local dengue virus transmission was confirmed for the first time in California in late 2023. Two human cases were reported from Los Angeles County: one from Pasadena and one from Long Beach. The virus is spread between people by invasive *Aedes* mosquitoes.

Dengue

In 2023, 250 cases of dengue were reported to CDPH; patients were residents of 30 California counties (Table 4.2). The median age was 44 years (range, 1 to 81 years) and 112 (45%) were male. Two locally acquired cases were reported from symptomatic residents of Pasadena and Long Beach, Los Angeles County. For the travel-associated cases, travel history included Latin America and the Caribbean (174), South Asia (56), and East Asia and the Pacific (17). The place of exposure was unknown for one patient.

Malaria

In 2023, 157 cases of malaria were reported to CDPH. Patients were residents of 25 California counties and 107 (68%) were male. The median age was 41 years (range, 4 to 81 years). Of the 131 cases for which the *Plasmodium* species was determined, 75 were *P. falciparum*, 45 *P. vivax*, 6 *P. malariae,* and 5 *P. ovale*. All patients but one reported compatible travel history to malaria-endemic areas including Sub-Saharan Africa (101), Latin America (37), South Asia (11), Central Asia, (6), and the Middle East (1). Travel history was unavailable for one patient.

Chikungunya

Twenty-three cases of chikungunya were reported to CDPH in 2023 (Table 4.2). Patients were residents of 13 California counties, 13 (57%) were male, and the median age was 47 years (range, 29 to 68 years). No locally acquired cases were reported. Twenty-two patients reported travel to chikungunya endemic or outbreak areas including South Asia (13), East Asia & Pacific (6), Sub-Saharan Africa (2), and Latin America & the Caribbean (1). Travel history was unavailable for one patient.

Zika

In 2023, three infections of Zika virus were reported to CDPH. Patients were residents of Riverside and Sacramento (2) counties; all had travel history compatible with exposure to Zika-endemic regions.

Table 4.2. Reported confirmed and probable *Aedes*-transmitted diseases in humans by county, California, 2023

County	Chikungunya	Dengue	Zika	TOTAL
Alameda	2	22	0	24
Alpine	0	0	0	0
Amador	0	0	0	0
Butte	0	1	0	1
Calaveras	0	0	0	0
Colusa	0	0	0	0
Contra Costa	1	4	0	5
Del Norte	0	0	0	0
El Dorado	0	0	0	0
Fresno	1	4	0	5
Glenn	0	0	0	0
Humboldt	0	0	0	0
Imperial	0	1	0	1
Inyo	0	0	0	0
Kern	0	4	0	4
Kings	0	0	0	0
Lake	0	0	0	0
Lassen	0	0	0	0
Los Angeles	4	80	0	84
Madera	0	0	0	0
Marin	0	3	0	3
Mariposa	0	0	0	0
Mendocino	0	1	0	1
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	0	0	0	0
Orange	1	18	0	19
Placer	0	0	0	0
Plumas	0	0	0	0
Riverside	2	4	1	7
Sacramento	4	3	2	9
San Benito	0	1	0	1
San Bernardino	0	5	0	5
San Diego	0	25	0	25
San Francisco	0	12	0	12
San Joaquin	0	4	0	4
San Luis Obispo	0	1	0	1
San Mateo	1	8	0	9
Santa Barbara	1	3	0	4
Santa Clara	3	29	0	32
Santa Cruz	1	1	0	2
Shasta	0	0	0	0
Sierra	0	0	0	0
Siskiyou	0	0	0	0
Solano	0	0	0	0
Sonoma	1	4	0	5
Stanislaus	1	5	0	6
Sutter	0	0	0	0
Tehama	0	1	0	1
Trinity	0	0	0	0
Tulare	0	2	0	2
Tuolumne	0	0	0	0
Ventura	0	1	0	1
Yolo	0	1	0	1
Yuba	0	0	0	0
TOTAL	**23**	**250**	**3**	**276**

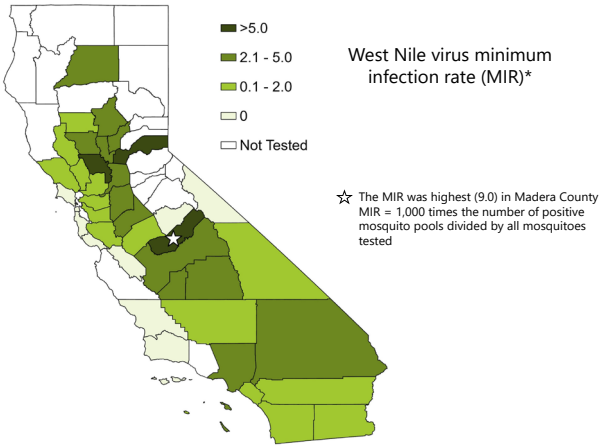


Figure 4.2. West Nile virus minimum infection rate of mosquitoes, by county, California, 2023

Mosquito surveillance

In 2023, a total of 1,807,993 mosquitoes (63,208 pools) collected in 41 counties were tested at the University of California, Davis Arbovirus Research and Training (DART) laboratory or at one of 13 local agencies by a real-time (TaqMan) reverse transcriptase-polymerase chain reaction (RT-qPCR) for SLEV, western equine encephalitis virus (WEEV), and/or WNV viral RNA (Table 4.3). WNV was detected in 4,522 mosquito pools from 31 counties, and SLEV was detected in 728 mosquito pools from 15 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 2.5; the MIR was highest (9.0) in Madera 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). Statewide, the SLEV MIR in all mosquitoes tested was 0.4; the MIR was highest (6.7) in Kings County.

St. Louis encephalitis virus (SLEV) activity was high during 2023, with 19 human cases and the largest number of SLEV positive mosquito pools reported since the reemergence of SLEV in 2015.

Table 4.3. West Nile virus positive mosquito pools and minimum infection rate, by county, California, 2023

County	No. mosquitoes tested[a]	No. mosquito pools tested	WNV positive pools[a]	WNV Minimum Infection Rate[b]
Alameda	23,152	896	18	0.8
Alpine	0	0	0	0.0
Amador	0	0	0	0.0
Butte	21,706	488	69	3.2
Calaveras	0	0	0	0.0
Colusa	500	10	2	4.0
Contra Costa	21,648	732	26	1.2
Del Norte	0	0	0	0.0
El Dorado	0	0	0	0.0
Fresno	73,883	2,139	232	3.1
Glenn	794	16	1	1.3
Humboldt	0	0	0	0.0
Imperial	2,824	215	3	1.1
Inyo	3,949	81	2	0.5
Kern	64,348	1,635	107	1.7
Kings	22,814	484	70	3.1
Lake	13,769	447	26	1.9
Lassen	0	0	0	0.0
Los Angeles	187,535	4,587	580	3.1
Madera	22,974	643	207	9.0
Marin	2,548	160	0	0.0
Mariposa	213	8	0	0.0
Mendocino	0	0	0	0.0
Merced	27,761	1,007	43	1.5
Modoc	0	0	0	0.0
Mono	300	6	0	0.0
Monterey	0	0	0	0.0
Napa	10,062	309	7	0.7
Nevada	0	0	0	0.0
Orange	162,340	5,398	218	1.3
Placer	30,086	1,823	177	5.9
Plumas	0	0	0	0.0
Riverside	293,680	8,325	182	0.6
Sacramento	69,423	5,144	342	4.9
San Benito	74	24	0	0.0
San Bernardino	57,553	2,934	158	2.7
San Diego	20,415	2,311	1	0.0
San Francisco	95	8	0	0.0
San Joaquin	128,385	3,066	607	4.7
San Luis Obispo	543	15	0	0.0
San Mateo	7,175	497	0	0.0
Santa Barbara	3,287	143	0	0.0
Santa Clara	24,153	3414	18	0.7
Santa Cruz	1,312	91	0	0.0
Shasta	73,996	2,214	151	2.0
Sierra	0	0	0	0.0
Siskiyou	0	0	0	0.0
Solano	15,660	399	24	1.5
Sonoma	11,456	528	6	0.5
Stanislaus	89,626	2,235	293	3.3
Sutter	14,464	374	66	4.6
Tehama	0	0	0	0.0
Trinity	0	0	0	0.0
Tulare	237,143	7,339	566	2.4
Tuolumne	0	0	0	0.0
Ventura	953	24	0	0.0
Yolo	57,947	2,842	294	5.1
Yuba	7,447	197	26	3.5
Total	**1,807,993**	**63,208**	**4,522**	**2.5**

[a] Tested by University of California Davis Arbovirus Research and Training Laboratory or local mosquito/vector control agency.

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

Table 4.4. West Nile virus positive mosquito pools and minimum infection rate, by mosquito species, California, 2023

Mosquito Species	No. Pools Tested	No. Mosquitoes	WNV positive pools	Minimum Infection Rate[a]
***Culex* species**				
Cx. erythrothorax	2,273	85,444	9	0.1
Cx. pipiens	11,046	199,605	705	3.5
Cx. quinquefasciatus	22,478	690,367	1,797	2.6
Cx. restuans	17	40	0	0.0
Cx. stigmatosoma	796	9,644	51	5.3
Cx. tarsalis	25,552	809,820	1,956	2.4
Cx. thriambus	38	50	0	0.0
Culex species	14	262	1	3.8
All Culex	**62,214**	**1,795,232**	**4,519**	**2.5**
***Anopheles* species**				
An. franciscanus	1	1	0	0.0
An. freeborni	6	109	0	0.0
An. hermsi	1	10	0	0.0
All *Anopheles*	**8**	**120**	**0**	**0.0**
***Aedes* species**				
Ae. aegypti	595	6,246	2	0.3
Ae. melanimon	28	987	0	0.0
Ae. nigromaculis	2	22	0	0.0
Ae. vexans	1	2	0	0.0
All *Aedes*	**626**	**7,257**	**2**	**0.3**
Other species				
Culiseta incidens	252	3,801	1	0.3
Culiseta inornata	102	1,379	0	0.0
Psorophora columbiae	1	3	0	0.0
Unknown	5	201	0	0.0
All other	**360**	**5,384**	**1**	**0.2**

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

Mosquitoes infected with SLEV were reported for the first time in Inyo, Napa, and Shasta counties. WNV was identified from one *Aedes* species, one *Culiseta* species, and six *Culex* species (*Ae. aegypti*, *Cs. incidens*, *Cx. erythrothorax*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. restuans*, *Cx. stigmatosoma*, and *Cx. tarsalis*) (Table 4.4), and SLEV was identified from two *Aedes* species and five *Culex* species (*Ae. aegypti*, *Ae. melanimon*, *Cx. erythrothorax*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. stigmatosoma*, and *Cx. tarsalis*). In 2023, the first detection of WNV in mosquitoes was from a *Cs. incidens* pool collected in Los Angeles County on January 19, and the last detection was from a *Cx. quinquefasciatus* pool collected in Orange County on December 19. The first detection of SLEV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in Kern County on May 26, and the last detection was from a *Cx. tarsalis* pool collected in Riverside County on October 31.

Animal surveillance

Chicken serosurveillance

In 2023, 24 local mosquito and vector control agencies in 20 counties maintained 77 sentinel chicken flocks (Table 4.6). Blood samples were collected from chickens every other week and

Table 4.5. Infections with St. Louis encephalitis virus in humans, mosquito pools, and sentinel chickens, by county, California, 2023

County	Humans	Mosquito pools[a]	Sentinel chickens
Fresno	3	160	NT
Imperial	0	3	NT
Inyo	0	1	NT
Kern	2	75	NT
Kings	2	44	NT
Los Angeles	1	0	0
Madera	0	47	NT
Marin	1	0	NT
Merced	0	12	0
Napa	0	1	NT
Placer	0	1	NT
Riverside	1	118	NT
Sacramento	1	0	0
San Joaquin	0	9	NT
Shasta	0	3	1
Stanislaus	5	23	NT
Tulare	1	228	0
Yolo	2	3	0
State Totals	**19**	**728**	**1**

NT= no samples tested

[a]Positive mosquito pools included *Culex quinquefasciatus (387), Cx. tarsalis (276), Cx. pipiens (33), Cx. stigmatosoma (28), Cx. erythrothorax (1), Aedes melanimon (2), and Ae. aegypti (1)*

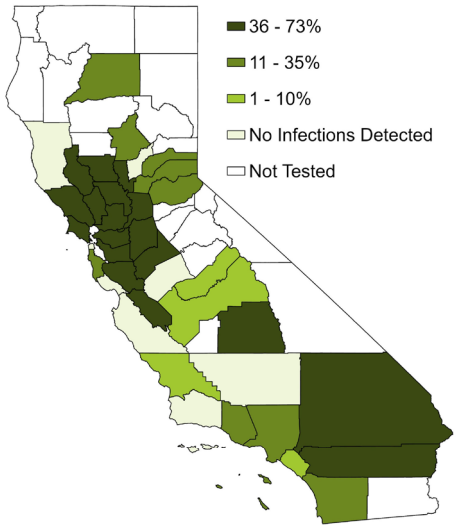


Figure 4.3. Prevalence of West Nile virus infection in dead birds, California, 2023

tested for antibodies to WNV, SLEV, and WEEV by an EIA at the CDPH Vector-Borne Disease Section (CDPH-VBDS) and one local agency. Positive samples were confirmed at CDPH-VBDS by IFA or western blot. Of 3,790 chicken blood samples tested, 186 seroconversions to WNV were detected among 54 flocks in 17 counties (Tables 4.6, 4.8). Statewide, 40% 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 40% (2023). In 2023, the first and last WNV seroconversions were detected in Merced County on July 14 and in San Benito County on October 25, respectively. One SLEV seroconversion was also detected in one chicken from Shasta County on September 11 (Table 4.5).

Dead bird surveillance for West Nile virus

In 2023, the California WNV and Dead Bird Call Center and website received 6,793 dead bird reports from the public in 51 counties (Table 4.7). Oral swabs or other samples (e.g., brain, kidney, ocular) from dead bird carcasses were tested either at the DART laboratory or at one of 13 local agencies by RT-qPCR. Of the 2,049 carcasses deemed suitable for testing, WNV was detected in 857 (42%) carcasses from 31 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 2023, the first WNV-positive dead bird was an American crow reported from Santa Clara County on April 14, and the last WNV-positive dead bird was a Red-tailed hawk reported from San Diego County on December 31.

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 2023, WNV infection was detected in 31 horses from 20 counties (Table 4.8). Eight of the horses died or were euthanized because of their infection.

Invasive mosquito surveillance

Three species of invasive *Aedes* mosquitoes became established in California between 2011 and 2014: the Asian tiger mosquito, *Ae. albopictus* (2011), the yellow fever mosquito, *Ae. aegypti* (2013), and the Australian backyard mosquito, *Ae. notoscriptus* (2014). All three

Table 4.6. Results of testing sentinel chickens for West Nile virus, by county, California, 2023

County	No. flocks	No. chickens[a]	No. WNV positive flocks	WNV positive chickens
Alameda	3	20	3	4
Alpine	0	0	0	0
Amador	0	0	0	0
Butte	7	45	7	33
Calaveras	1	10	1	3
Colusa	1	10	1	2
Contra Costa	4	22	3	11
Del Norte	0	0	0	0
El Dorado	0	0	0	0
Fresno	0	0	0	0
Glenn	0	0	0	0
Humboldt	0	0	0	0
Imperial	0	0	0	0
Inyo	0	0	0	0
Kern	0	0	0	0
Kings	0	0	0	0
Lake	2	12	0	0
Lassen	0	0	0	0
Los Angeles	21	81	13	30
Madera	0	0	0	0
Marin	0	0	0	0
Mariposa	0	0	0	0
Mendocino	0	0	0	0
Merced	8	48	6	22
Modoc	0	0	0	0
Mono	0	0	0	0
Monterey	0	0	0	0
Napa	0	0	0	0
Nevada	2	12	1	2
Orange	0	0	0	0
Placer	0	0	0	0
Plumas	0	0	0	0
Riverside	0	0	0	0
Sacramento	3	17	2	7
San Benito	1	8	1	6
San Bernardino	0	0	0	0
San Diego	0	0	0	0
San Francisco	0	0	0	0
San Joaquin	0	0	0	0
San Luis Obispo	0	0	0	0
San Mateo	2	13	0	0
Santa Barbara	0	0	0	0
Santa Clara	0	0	0	0
Santa Cruz	0	0	0	0
Shasta	3	20	1	5
Sierra	0	0	0	0
Siskiyou	0	0	0	0
Solano	3	20	3	11
Sonoma	0	0	0	0
Stanislaus	0	0	0	0
Sutter	5	32	5	19
Tehama	3	27	2	4
Trinity	0	0	0	0
Tulare	1	10	1	10
Tuolumne	0	0	0	0
Ventura	3	30	0	0
Yolo	2	17	2	10
Yuba	2	12	2	7
Total	**77**	**466**	**54**	**186**

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

Table 4.7. Dead birds reported, tested, and positive for West Nile virus, by county, California, 2023

County	Reported	Tested[a]	Positive	Percent
Alameda	505	158	80	51
Alpine	0	0	0	0
Amador	2	0	0	0
Butte	72	18	2	11
Calaveras	5	0	0	0
Colusa	10	4	2	50
Contra Costa	556	131	95	73
Del Norte	0	0	0	0
El Dorado	59	17	4	24
Fresno	138	10	1	10
Glenn	3	0	0	0
Humboldt	10	0	0	0
Imperial	2	0	0	0
Inyo	1	0	0	0
Kern	16	2	0	0
Kings	14	0	0	0
Lake	25	16	8	50
Lassen	0	0	0	0
Los Angeles	812	128	44	34
Madera	29	12	1	8
Marin	50	4	2	50
Mariposa	3	0	0	0
Mendocino	18	2	0	0
Merced	41	2	0	0
Modoc	0	0	0	0
Mono	4	0	0	0
Monterey	16	1	0	0
Napa	29	10	4	40
Nevada	17	6	1	17
Orange	169	43	2	5
Placer	276	146	43	29
Plumas	0	0	0	0
Riverside	265	113	69	61
Sacramento	941	456	196	43
San Benito	8	2	1	50
San Bernardino	119	25	11	44
San Diego	213	96	14	15
San Francisco	68	15	0	0
San Joaquin	152	43	20	47
San Luis Obispo	34	12	1	8
San Mateo	348	84	15	18
Santa Barbara	16	10	0	0
Santa Clara	642	199	117	59
Santa Cruz	44	12	0	0
Shasta	25	6	2	33
Sierra	0	0	0	0
Siskiyou	1	0	0	0
Solano	123	42	18	43
Sonoma	177	25	16	64
Stanislaus	165	15	6	40
Sutter	51	11	6	55
Tehama	7	0	0	0
Trinity	0	0	0	0
Tulare	52	13	5	38
Tuolumne	3	0	0	0
Ventura	91	25	4	16
Yolo	340	132	67	51
Yuba	26	3	0	0
Totals	**6,793**	**2,049**	**857**	**42**

[a] Tested by the University of California Davis Arboviral Research and Training laboratory 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, 2023

County	Humans[a]	Horses	Dead birds	Mosquito pools	Sentinel chickens
Alameda	2	0	80	18	4
Alpine	0	0	NT	NT	NT
Amador	1	0	NT	NT	NT
Butte	19	1	2	69	33
Calaveras	1	0	NT	NT	3
Colusa	1	0	2	2	2
Contra Costa	12	0	95	26	11
Del Norte	0	0	NT	NT	NT
El Dorado	3	0	4	NT	NT
Fresno	25	2	1	232	NT
Glenn	4	0	NT	1	NT
Humboldt	0	0	NT	NT	NT
Imperial	0	0	NT	3	NT
Inyo	0	0	NT	2	NT
Kern	19	2	0	107	NT
Kings	11	1	NT	70	NT
Lake	6	0	8	26	0
Lassen	0	0	NT	NT	NT
Los Angeles	68	0	44	580	30
Madera	9	1	1	207	NT
Marin	0	0	2	0	NT
Mariposa	0	0	NT	0	NT
Mendocino	0	0	0	NT	NT
Merced	9	2	0	43	22
Modoc	0	0	NT	NT	NT
Mono	0	0	NT	0	NT
Monterey	2	0	0	NT	NT
Napa	0	1	4	7	NT
Nevada	1	0	1	NT	2
Orange	7	1	2	218	NT
Placer	6	1	43	177	NT
Plumas	0	0	NT	NT	NT
Riverside	21	3	69	182	NT
Sacramento	60	2	196	342	7
San Benito	0	0	1	0	6
San Bernardino	30	2	11	158	NT
San Diego	0	0	14	1	NT
San Francisco	0	0	0	0	NT
San Joaquin	16	3	20	607	NT
San Luis Obispo	2	2	1	0	NT
San Mateo	4	1	15	0	0
Santa Barbara	0	0	0	0	NT
Santa Clara	3	1	117	18	NT
Santa Cruz	0	0	0	0	NT
Shasta	6	0	2	151	5
Sierra	0	0	NT	NT	NT
Siskiyou	0	1	NT	NT	NT
Solano	7	0	18	24	11
Sonoma	1	0	16	6	NT
Stanislaus	34	2	6	293	NT
Sutter	7	0	6	66	19
Tehama	0	0	NT	NT	4
Trinity	0	0	NT	NT	NT
Tulare	25	1	5	566	10
Tuolumne	0	0	NT	NT	NT
Ventura	1	0	4	0	0
Yolo	45	0	67	294	10
Yuba	5	1	0	26	7
State Totals	**473**	**31**	**857**	**4,522**	**186**

[a]Includes asymptomatic infections detected through blood bank screening

NT= no samples tested

species have similar biology and behavior, 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 *Ae. albopictus* can also 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. None of these viruses are endemic to California.

Since 2011, local vector control agencies have detected one or more species of invasive *Aedes* mosquitoes in 402 cities or census-designated places (CDP) in 29 counties; however, populations of *Ae. aegypti* and *Ae. albopictus* are only considered established within urbanized areas of 24 and 5 counties, respectively. (Figure 4.4). *Aedes notoscriptus* are established in parts of Los Angeles, Orange, and San Diego counties, and since 2014, have been detected in over 45 cities. In 2023, *Ae. aegypti* mosquitoes were discovered for the first time in nine new cities, six CDP, and three counties: Glenn, Solano, and Yuba. *Aedes albopictus* mosquitoes were discovered in one new CDP.

Local vector control agencies with invasive *Aedes* have continuously worked to improve the efficacy and efficiency of *Aedes*-specific surveillance and control, and improve and expand public education and outreach programs aimed at personal protection from mosquito bites and elimination of backyard mosquito larval habitats. Some agencies have pursued agreements with public utilities agencies to eliminate *Aedes* mosquito production from utilities vaults, while others are developing sterile male release programs to enhance control. Agencies have streamlined their response to travel-associated human cases of *Aedes*-borne arboviruses, such as dengue, following U.S. Centers for Disease Control and Prevention (CDC) recommended guidelines to minimize the potential for local transmission in areas with established populations of *Ae. aegypti* or *Ae. albopictus*. As a result, the response to the first two locally-acquired human cases of dengue infection in Los Angeles County in late 2023 was rapid and efficient, conducted in collaboration with local health departments, and in consultation with CDPH and CDC. None of the *Aedes aegypti* mosquitoes collected prior to and following mosquito control measures tested positive for dengue virus. For all of 2023, a total of 38,779 *Ae. aegypti* mosquitoes were tested for chikungunya, dengue, and Zika viruses; all were negative. In addition, 6,246 *Ae. aegypti* were tested for WNV, SLEV, and WEEV; 2 were WNV positive (Table 4.4).

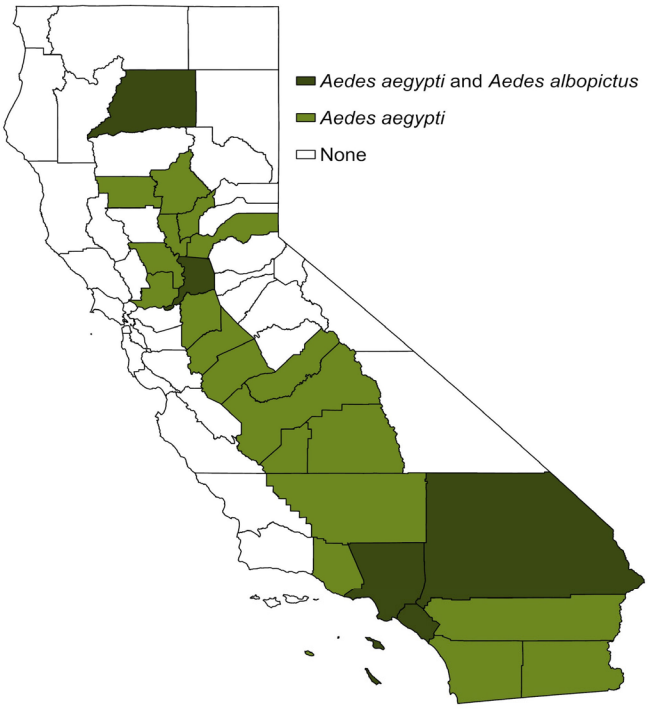


Figure 4.4. Invasive *Aedes* mosquito detections, by county, California, 2023

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 maintained cooperative surveillance and control of vector-borne diseases within the National Forests. The agreement was completed in 2023.

Major objectives and activities related to the United States Department of Agriculture Forest Service (USFS) Region 5 (R5) cost-share agreement included:

- 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 2023. For each National Forest, activities and test results for selected vector-borne diseases are summarized in Tables 5.1 through 5.3, and highlights are described below.

2023 U.S. Forest Service Highlights

- Seventeen of 18 R5 Forests had samples tested for vector-borne disease pathogens by CDPH (Table 5.3).
- Bacterial and serological evidence of plague activity continued to be documented annually on the Lake Tahoe Basin Management Unit without interruption since 2012, including a human case in 2020. Only one (3%) of 38 of rodents from the Management Unit tested positive in 2023, a significant decrease compared to the 27% seroprevalence in 2022 (Tables 5.2, 5.3).
- Rodent-borne disease surveillance at Alto Campground yielded the first Sin Nombre virus positive deer mouse in 19 years in the Los Padres National Forest (Tables 5.2, 5.3).
- Tick-borne disease agent testing expanded to include rickettsial pathogen testing of *Dermacentor* ticks. (Table 5.3).
- Tick surveillance and testing from the River Trail at Johnsondale Bridge in the Sequoia National Forest found adult *Ixodes pacificus* and adult *Dermacentor occidentalis* ticks infected with human pathogens (*Borrelia burgdorferi* and *Rickettsia* sp. 364D, respectively) the causative agents of Lyme disease and Pacific Coast tick fever (Tables 5.2, 5.3).
- After 31 years, the Challenge Cost-Share Agreement between USFS R5 and CDPH-VBDS ended in July due to federal budgetary constraints.

Table 5.1: Summary of United States Forest Service Activities (Region 5)
Performed by the California Department of Public Health Under the USFS-CDPH Cost-Share Agreement, 2023

National Forest	Disease Risks/Services Addressed	Facility Evaluation	Presentation Audiences	Forest Locations Visited/Contacted[a]
Angeles/ San Gabriel Mountain National Monument	Hantavirus; Plague			Supervisor's Office; Gateway Ranger District; Oak Flat Ranger Station: Little Rock Reservoir
Cleveland	Plague; Tick-borne diseases			Supervisor's Office, Descanso, Palomar, and Trabuco Ranger Ranger District offices; Blue Jay, Bobcat Meadow OHV, Boulder Oaks, Burnt Rancheria, Cibbets Flat, Corral Canyon OHV, El Cariso, Fry Creek, Horse Heaven, Palomar, and Wooded Hill campgrounds: Maple Springs and Tenaja trails.
Eldorado	Hantavirus			Supervisor's Office, Amador and Pacific Ranger Districts; Lumberyard Fire Station; Leek Springs Lookout.
Inyo	Plague; Tick-borne diseases			Supervisor's Office; Mammoth Lakes, Mono Lake, Mt. Whitney and White Mountain Ranger District Offices; East Fork, French, June Lake, Oh Ridge, Old Shady Rest, Palisades Group, Pine Grove, Reversed Creek, Rock Creek, Sherwin Creek, Silver Lake, Twin Lakes, Upper and Lower Gray's Meadow campgrounds; Aerie Crag Day Use Area .
Klamath	Tick-borne diseases			Supervisor's Office; Oak Knoll Ranger District; Sarah Totten Campground.
Lake Tahoe Basin Management Unit	Hantavirus; Plague		Fallen Leaf Campground concessionaires	LTBMU Supervisors Office; Tallac Historical Site; Taylor Creek Visitor Center; Fallen Leaf and Meeks Bay campgrounds.
Lassen	Hantavirus; Plague, Tick-borne diseases			Supervisor's Office; Almanor, Eagle Lake, Hat Creek District Offices; Christie, Eagle Lake, and Merrill campgrounds; Deer Creek Trail.
Los Padres	Hantavirus; Plague	Follow-up Questionnaires for Chuchupate RS, Apache and Ozena Fire Stations		Supervisor's Office; Monterey, Mt. Pinos, and Santa Barbara Ranger District Offices; Camp Alto, road to Dome Springs and Pine Springs, McGill, Reyes Creek campgrounds; Gene Marshall Trailhead.
Mendocino	Tick-borne diseases			Supervisor's Office; Upper Lake Ranger District; Fuller Grove, Middle Creek, Mill Creek, Navy Camp, Oak Flat, Pine Point, Southfork and Sunset Point campgrounds; Squaw Creek Trail; Potato Hill Paragliding Landing Zone; M10 roadside USFS lands.
Modoc	Plague			Supervisor's Office; Devil's Garden/Warner Mountain Ranger District.
Plumas	Plague			Supervisor's Office.
San Bernardino	Plague; Tick-borne diseases		Southern California Mountains Foundation staff and volunteers	Supervisor's Office; Front Country, Mountaintop; San Jacinto District Ranger Offices; Mill Creek and Barton Flats Visitor Centers; Big Bear Discovery Center; Barton Flats, Buttercup Group, Coon Cabin Group, Dogwood, Green Spot Equestrian Group, Green Valley, Hanna Flat, Heart Bar, Pine Knot, San Gorgonio, Serrano, South Fork, and Wildhorse Equestrian campgrounds; Bonita Falls and South Fork Canyon (Lytle Creek); Pacific Crest Trail in Swarthout Canyon; Big Falls, Momyer, and Vivian Creek trailheads; Big Falls, Forest Falls Jenks Lake, Juniper Point, Meadows Edge, and Thurman Flats picnic areas; Greyback Amphitheater.
Sequoia	Hantavirus; Plague; Tick-borne diseases			Supervisor's Office; Kern River and Western Divide Ranger District Offices; Boulder Gulch, Camp 3, Gold Ledge, Fairview, Headquarters, Hospital Flat, Hungry Gulch, Landers Camp, Limestone, Live Oak, Paradise Cove, Quaking Aspen, Redwood, and Tillie Creek campgrounds; Brush Creek, Calkins Flat, Chamise Flat, French Gulch, and South Fork recreation areas; Isabella Peak, Rincon, River Trail (at Johnsondale Bridge), and Whiskey Flat trails; South Fork Wildlife Area.
Shasta-Trinity				Supervisor's Office;Trinity River Management Unit; Weaverville Ranger Station.
Sierra	Plague; Tick-borne diseases			Supervisor's Office; Bass Lake Ranger District; Willow Creek Trail
Six Rivers	Hantavirus; Plague; Tick-borne diseases	Willow Creek Ranger Station; Oak Bottom Work Station		Supervisor's Office; Lower Trinity and Orleans Ranger Districts; Oak Bottom Work Station; Aikens Creek and Oak Bottom campgrounds; Geary, Hawking Bar, and Tunnel Flat river access; Sayler Guard Station
Stanislaus	Hantavirus; Plague; Tick-borne diseases			Supervisor's Office; Calaveras, Groveland, Mi-Wok, and Summit Ranger District Offices; Baker Historical Station; Arnot Creek, Baker, Brightman Flat, Camp Liahona Alp, Cascade Creek, Clark Fork, Clark Fork Horse Camp, Dardanelles, Deadman, Disaster Creek, Eureka Valley, Kennedy Meadows, Pigeon Flat, Sanc Flat, and Spicer Reservoir campgrounds; Columns of the Giants, Cottonwood Creek, and Douglas picnic areas; Camp Peaceful Pines; Cascade Creek OHV Registration Sign.
Tahoe	Plague; Tick-borne diseases		American River, Sierraville, Truckee, and Yuba River Ranger Districts	Supervisor's Office; American River, Sierraville, Truckee, and Yuba River Ranger District Offices; Bullard's Bar Reservoir Trail,

[a] Locations visited or contacted not already listed under Facility Evaluations.

Table 5.2: Vector-Borne Disease Related Services and Findings, USFS-CDPH Cost-Share Agreement, 2023

National Forest	Unique Services/ Unusual Findings
Angeles / San Gabriel Mountain National Monument	Upon request, plague and hantavirus surveillance and sample testing were conducted at two locations on the Forest and National Monument. Leadership were notified of test results.
Cleveland	One (12%) of eight adult *Dermacentor occidentalis* ticks collected from Maple Springs Truck Trail was positive for *Rickettsia* 364D, causative agent for Pacific Coast tick fever
Eldorado	One (14%) of seven and two (20%) of ten deer mice collected from Lumberyard Fire Station and Leek Springs Lookout, respectively, tested positive for antibodies to Sin Nombre virus (SNV) causative agent for hantavirus cardiopulmonary syndrome (HPS). Test results and recommendations were communicated to Ranger District and Forest leadership.
Inyo	Twenty and 13 rodents collected from Oh Ridge and Twin Lakes campgrounds, respectively, were tested for *Yersinia pestis*, causative agent for plague. One (5%) of 20 from Twin Lakes, and 3 (23%) of 13 from Oh Ridge were positive for antibodies to *Y. pestis*. Campgrounds remained open with Plague Warning signage and VBDS plague disease prevention brochures made available to campers.
Klamath	One (20%) of five *Ixodes pacificus* ticks from Sarah Totten Campground, tested postive for a potential human pathogen, *Borrelia burgdorferi* sensu lato, by PCR.
Lake Tahoe Basin Management Unit	One (8%) of 12 rodents from Tallac Historical Site tested positive for antibodies to *Y. pestis*.
Lassen	One (14%) of seven rodents tested postive for antibodies to *Y. pestis*.
Los Padres	One (14%) of seven deer mice (*Peromyscus maniculatus*) sampled at Alto Campground, tested postitive for antibodies to SNV: the first positive mouse from the Forest since 2005.
Mendocino	Two *Dermacentor occidentalis* tick tested positive for *Rickettsia* 364D.
Modoc	None of the 14 carnivore samples from lands adjacent to the Forest was positive for antibodies to *Y. pestis*.
Plumas	None of three carnivore samples from lands adjacent to the Forest, was positive for antibodies to *Y. pestis*.
San Bernardino	Adult *D. occidentalis* ticks from the Pacific Crest Trail in Swarthout Canyon tested positive for rickettsial organisms, and one *D. occidentalis* tick from Middle Fork Creek tested positive for *R. rickettsii subsp. californica.*
Sequoia	Adult ticks collected along the River Trail at Johnsondale Bridge were positive for *Borrelia burgdorferi* sensu lato in *Ixodes pacificus* ticks and *Rickettsia* 364D in *D. occidentalis* ticks.
Sierra	Two (22%) of nine carnivores from lands adjacent to the Forest tested positive for antibodies to *Y. pestis*.
Six Rivers	Biologists conducted facility evaluations and hantavirus surveillance at Oak Bottom Work Station and Orleans Ranger District headquarters. None of the four deer mice sampled from the Forest tested positive for antibodies to SNV.
Stanislaus	Biologists conducted hantavirus surveillance at Spicer Reservoir Campground. None of the seven *Peromyscus* mice were positive for antibodies to SNV, and none of the diurnal rodents were positve for antibodies to *Y. pestis*.
Tahoe	Three human pathogens (*B. burgdorferi* sensu stricto, *B. miyamotoi*, and *A. phagocytophylum*) continue to be recovered from *I. pacificus* ticks at Bullard's Bar Reservoir. Two ticks had more than one human pathogen (co-infection).
R5 (District Level)	Provided a pre-season letter for distribution throughout R5. Notified the R5 Safety Officer with reports of significant findings from sampling test results or human cases with probable exposure from USFS lands.

Table 5.3. Testing results for selected vector-borne disease agents in U.S. National Forests, California, 2023

National Forest	Sin Nombre virus (hantavirus pulmonary syndrome)		*Yersinia pestis* (plague)						*Borrelia spp.*		*Anaplasma phagocytophilum*		*Rickettsia spp.*	
	Peromyscus mice		rodents		flea pools[a]		carnivore[b]		*Ixodes* spp. or *Ornithodoros* ticks		*Ixodes pacificus* ticks		*Dermacentor* ticks	
	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested
Angeles	0	18	0	15										
Cleveland[c]	5	37	0	125					2	80	0	80	1	17
Eldorado	3	17												
Inyo			4	56	0	30								
Klamath									1	5	0	5		
Lake Tahoe BMU	0	5	1	38	0	25	0	1						
Lassen	0	13	1	22	0	18			0	50	0	50	0	4
Los Padres	1	13	0	29	0	22	0	8						
Mendocino									0	10	0	10	2	5
Modoc							0	14						
Plumas							0	3						
San Bernardino									0	36	0	36	7	193
Sequoia	0	16	0	24	0	7			2	60	0	60	4	41
Sierra							2	9					1	1
Six Rivers	0	4							0	5	0	5	1	6
Stanislaus	0	7	0	9										
Tahoe			1	25	0	18			8[d]	211	4	211		
Total, all forests	**9**	**130**	**7**	**343**	**0**	**120**	**2**	**35**	**13**	**457**	**4**	**457**	**16**	**267**

[a] Flea pools may contain 1-10 fleas; a single rodent may have more than one flea pool associated with it.
[b] Carnivore specimens taken directly from or adjacent to USFS lands. Because of the broad home range of some carnivores, results obtained can be inferred to a large area, including both USFS and adjacent lands.
[c] Hantavirus and plague samples collected by San Diego County Vector Control Program. Some plague samples tested by the Vector-Borne Disease Section laboratory
[d] Includes *B. miyamotoi*, a relapsing fever-type spirochete and emerging disease.

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 134 continuing education events in 2023. 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 2023, 1,190 Vector Control Technicians employed at 101 local public health agencies and CDPH held 2,904 certificates (Table 6.2). The agencies include special districts, departments of county government, departments of city government, and CDPH. Of these agencies, 72 are signatory to a cooperative agreement with CDPH.

In 2023, 916 individuals employed at 72 agencies held full certification status. In addition, 274 employees from 49 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://bit.ly/VCTCertification

Table 6.1. Results of certification examinations administered in 2023

Exam section	No. Exams Given	No. Passed (%)
Core	165	94 (57)
Mosquito Control	163	76 (47)
Terrestrial Invertebrate Control	119	67 (56)
Vertebrate Vector Control	111	64 (58)
Totals	**558**	**301 (54)**

Table 6.2 Vector Control Technician certificates in effect as of December 2023

Certification Category	No. Certificates		
	Full Status	Limited Status	Total
Mosquito Control	905	196	1,101
Terrestrial Invertebrate Vector Control	732	151	883
Vertebrate Vector Control	730	190	920
Totals	**2,367**	**537**	**2,904**

7 Public Information, Scientific Publications

A goal of the California Department of Public Health, Vector-Borne Disease Section is to provide clear and effective information on disease prevention and injurious pests to a wide audience. 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 staff from the California Department of Public Health, Vector-Borne Disease Section were principal or collaborating investigators are published in peer-reviewed scientific literature.

New public information materials in 2023

- Tick-Borne Disease Prevention (webpage)
- A How-To Guide for Nit Combing (handout)

Expanded resources in 2023

- What You Need to Know About Bed Bugs (flyer)
- Hantavirus Infection (webpage)
- Mosquito Control FAQs (fact sheet)
- Common Ticks in California (ID card)
- Dengue Fact Sheet

Information for health departments and healthcare providers, added in 2023

- Spotted Fever Group Rickettsioses Information for Healthcare Professionals (webpage)
- Tick-Borne Disease Information for Health Professionals (webpage)
- Guidance for Managing Select Communicable Diseases: West Nile Virus Infections (Communicable Disease Manual chapter)
- Guidance on the Treatment and Control of Head Lice and Pubic Lice in Congregate Living Settings (guidance document)
- Recommendations for the Prevention and Control of Scabies for School Districts and Child Care Facilities (guidance document)

Publications*

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VECTOR-BORNE
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