

Vector-Borne Disease Section

2013 Annual Report



Infectious Diseases Branch
Division of Communicable Disease Control
Center for Infectious Diseases

California Department of Public Health



2013

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

INFECTIOUS DISEASES BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CENTER FOR INFECTIOUS DISEASES

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH



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Contents

Preface..... iii

Acknowledgements iv

Program Overview vi

Chapters

1	Rodent-borne Diseases	1
2	Flea-borne Diseases	4
3	Tick-borne Diseases	7
4	Mosquito-borne Diseases	13
5	U.S. Forest Service Cost-Share Agreement	20
6	Vector Control Technician Certification Program	25
7	Public Information Materials, Publications	27

Preface

I am pleased to present to you the 2013 Annual Report for the Vector-Borne Disease Section (VBDS) of the California Department of Public Health (CDPH). VBDS staff conducted surveillance, prevention, and control of existing and emerging vector-borne diseases and vectors throughout California in 2013.

In June 2013, an exotic mosquito species, *Aedes aegypti* (yellow fever mosquito), was detected in Madera County and subsequently in Fresno and San Mateo counties. These findings follow the detection of *Aedes albopictus* (Asian tiger mosquito) in Los Angeles County in 2011. Both species are aggressive day-biters and vectors of dengue and chikungunya viruses, which are currently not transmitted in California. CDPH-VBDS provided extensive consultation to local agencies on the surveillance and control of the invasive *Aedes* mosquitoes and coordinated regional response; both species now appear to be established in California. CDPH has enhanced surveillance for human cases of dengue and other mosquito-borne viruses in California by encouraging timely reporting and communication of cases to CDPH by local health departments.

West Nile virus (WNV) activity was detected in 44 counties in 2013, with 379 human cases reported. Over the ten-year period from 2004 to 2013, over 4,000 human WNV cases, including 145 fatalities, have been detected in California. The level of activity has fluctuated considerably from year to year, with many factors, such as hot temperatures and bird immunity, influencing the level of activity. CDPH works closely with local vector control agencies, health departments, and the University of California to support a comprehensive statewide WNV surveillance and response program.

Human cases of seven tick-borne diseases were reported in California in 2013, including Lyme disease, anaplasmosis, babesiosis, ehrlichiosis, Rocky Mountain spotted fever, tick-borne relapsing fever, and illness due to other spotted fever group rickettsia. VBDS activities included enhancing nymphal tick surveillance to better elucidate nymphal tick ecology, enhancing laboratory testing capacity for *Borrelia* species, and providing a geospatial presentation of *B. burgdorferi* data in an interactive map posted on the CDPH website.

In 2013, hantavirus infection was diagnosed in three California residents. To aid in risk assessment, VBDS developed an interactive map that provides county-level summaries of deer mice collections, hantavirus testing of deer mice, and the distribution of reported cases of hantavirus in California residents by most likely county of exposure. VBDS also produced several hantavirus prevention videos.

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

Vicki L. Kramer, PhD, Chief
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Acknowledgements

The 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 VBDS's key collaborators who provided significant contributions in 2013 are listed below.

Rodent-borne Diseases

Alameda County Vector Control District (VCD); Fresno County Department of Public Health (DPH); Inyo County Environmental Health Services (EHS); Mono County Health and Human Services (HHS); Napa County Mosquito Abatement District (MAD); National Park Service (NPS); Orange County VCD; Public Health Foundation Enterprises; Riverside County Vector Control Program (VCP); San Diego County Department of Environmental Health, Vector Control; U.S. Centers for Disease Control and Prevention (CDC); U.S. Forest Service (USFS).

Flea-borne Diseases

Amador County Environmental Health Department (EHD); Contra Costa Health Services (HS); El Dorado County VCD; Fresno County Department of Agriculture; Los Angeles County Agricultural Commissioner; Los Angeles County, Los Angeles County Department of Public Health (DPH); Vector Management Program; Mosquito and Vector Management District (MVMD) of Santa Barbara County; NPS; Orange County VCD; Orange County Health Care Agency; Redwood National and State Parks; Riverside County Environmental Health VCP; San Bernardino County DPH; San Bernardino County VCP; San Diego County Environmental Health VCP; Sedgwick Reserve, University of California; United States Department of Agriculture, Animal and Plant Inspection Service, Wildlife Services; Ventura County EHS; West Valley Mosquito and Vector Control District (MVCD); Yosemite National Park, NPS.

Tick-borne Diseases

CDC, Rickettsial Zoonoses Branch and Division of Vector-Borne Infectious Diseases; Fresno County DPH; Lake County VCD; Marin County Health and Human Services; Marin-Sonoma County MVCD; Napa County MAD; NPS; Placer County MVCD; San Diego Vector Control County Laboratory; San Mateo MVCD; MVMD of Santa Barbara County; Sacramento-Yolo MVCD; Center for Vectorborne Diseases, University of California, Davis (UCD); Northern Arizona University; Ventura County EHS.

Mosquito-borne Diseases

California Animal Health and Food Safety Laboratory; California Department of Food and Agriculture; Center for Vectorborne Diseases, UCD; Mosquito and Vector Control Association of California; participating local health departments, physicians, veterinarians, and local mosquito and vector control agencies.

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Microbial Diseases Laboratory

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Program Overview

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

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

1

Rodent-borne Diseases



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

Human disease surveillance

Sporadic hantavirus infection

In 2013, hantavirus infection was diagnosed in three California residents. The first case-patient was an adult who died shortly after being hospitalized. The case-patient had traveled in several western states during the six weeks prior to onset of illness; investigations by CDPH and other state departments of health failed to identify the likely site of exposure. The second case-patient was an adult who survived. The case-patient had resided in the eastern Sierra Nevada during the two months preceding onset of illness, and antibodies to Sin Nombre virus (SNV) were detected in three deer mice collected near the patient's lodgings. The third case-patient was an adolescent who survived. Antibodies to SNV were detected in one deer mouse collected in a natural area in the eastern Sierra Nevada that the case-patient reported having visited approximately one month prior to onset of illness.

Yosemite National Park hantavirus prevention

In May 2013, Yosemite National Park (YOSE) and Public Health Foundation Enterprises (PHFE) entered into a five-year cooperative agreement to decrease the public's risk of contracting vector-borne diseases through increased education, vector surveillance, and public health research. The California Department of Public Health, Vector-Borne Disease Section, (CDPH-VBDS), worked closely with PHFE staff in 2013 focusing efforts primarily on hantavirus prevention in YOSE. Activities included facilities evaluations, staff hantavirus prevention training, public education, and deer mouse surveillance to determine rodent abundance and estimate Sin Nombre virus prevalence. Four (10.5%) of 38 captured *Peromyscus maniculatus*, and zero of four *P. boylii* tested positive for antibodies to SNV. Positive deer mice came from the Tuolumne Meadows area. VBDS and PHFE staff provided recommendations to YOSE staff and associated partners based on surveillance results and facility evaluations.

Rodent surveillance

In 2013, a total of 685 *Peromyscus* spp. were collected and tested for serum antibodies to SNV (Table 1). Twenty-two (3.2%) had antibodies to SNV. Seroprevalence in *Peromyscus maniculatus*, the primary reservoir for SNV, was 6.3% (Table 1). At least one seroreactive *P. maniculatus* was detected in 7 of 10 California counties sampled in 2013 (Table 2). SNV has been detected in *P. maniculatus* from 30 of 42 counties sampled in the last 10 years with prevalence ranging from 4.4% to 38.5% (average 11.5%) over that time period (Table 2).

In addition, serum specimens from 5 (6.8%) of 73 harvest mice (*Reithrodontomys megalotis*), zero of 27 *Neotoma* spp., and zero of two meadow voles (*Microtus californicus*) tested positive to SNV. Seropositivity in these rodents may represent spillover of SNV from neighboring rodents or infection with other hantaviruses (e.g. El Moro Canyon or Isla Vista), which cross react to the Sin Nombre assay. These other hantaviruses have not been shown to be pathogenic to humans.

Table 1. Serologic evidence of hantavirus (Sin Nombre) infection in California rodents, 2004 - 2013

Species	Common name	2013			2004-2013		
		No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
<i>Peromyscus boylii</i>	brush mouse	53	1	1.9	1,750	47	2.7
<i>Peromyscus californicus</i>	parasitic mouse	137	2	1.5	1,188	17	1.4
<i>Peromyscus crinitus</i>	canyon mouse	3	0	0.0	119	3	2.5
<i>Peromyscus eremicus</i>	cactus mouse	4	1	25.0	2,289	83	3.6
<i>Peromyscus e. fraterculus</i>	northern Baja mouse	185	0	0.0	670	7	1.0
<i>Peromyscus maniculatus</i>	deer mouse	285	18	6.3	6,632	766	11.6
<i>Peromyscus truei</i>	piñon mouse	18	0	0.0	344	6	1.7
<i>Peromyscus</i> spp.	unspecified <i>Peromyscus</i>	0		0.0	9	0	0.0
<i>Reithrodontomys megalotis</i>	western harvest mouse	73	5	6.8	919	78	8.5
<i>Neotoma</i> spp.	woodrats	27	0	0.0	622	16	2.6
<i>Microtus</i> spp.	voles	2	0	0.0	250	32	12.8

Table 2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus* in California 2004-2013

County	2013			2004-2013		
	No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
Alameda				125	0	0.0
Alpine				29	5	17.2
Amador						
Butte				13	5	38.5
Calaveras				5	1	20.0
Colusa				2	0	0.0
Contra Costa	4	0	0.0	24	2	8.3
Del Norte						
El Dorado				694	92	13.3
Fresno				22	0	0.0
Glenn				5	0	0.0
Humboldt						
Imperial						
Inyo	4	1	25.0	31	5	16.1
Kern				6	1	16.6
Kings						
Lake						
Lassen				577	77	13.3
Los Angeles				13	1	7.7
Madera				42	10	23.8
Marin				18	1	5.6
Mariposa	3	0	0.0	92	11	12.0
Mendocino						
Merced						
Modoc				36	7	19.4
Mono	11	3	27.3	685	195	28.5
Monterey				20	1	5.0
Napa	10	1	10.0	60	10	16.7
Nevada				28	7	25.0
Orange	64	4	6.3	1,100	79	7.2
Placer				91	4	4.4
Plumas	6	0	0.0	101	24	23.8
Riverside	34	2	5.9	931	99	10.6
Sacramento						
San Benito				5	0	0
San Bernardino				377	20	5.3
San Diego	113	3	2.7	1,095	58	5.3
San Francisco				13	0	0
San Joaquin						
San Luis Obispo				2	0	0.0
San Mateo				37	3	8.1
Santa Barbara				58	12	20.7
Santa Clara				10	0	0.0
Santa Cruz				14	0	0.0
Shasta				35	4	11.4
Sierra				47	8	17.0
Siskiyou				48	8	16.7
Solano						
Sonoma						
Stanislaus						
Sutter				7	0	0
Tehama						
Trinity						
Tulare				4	0	0.0
Tuolumne	36	4	11.1	123	14	11.4
Ventura				6	2	33.3
Yolo				1	0	0
Yuba						
Total	285	18	6.3	6,632	766	11.6

2

Flea-borne Diseases



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

Human disease surveillance

Typhus

One hundred five cases of typhus were reported to the California Department of Public Health (CDPH) in 2013. Sixty-seven of these were classified as confirmed cases according to the CDPH surveillance case definition and 38 were probable. Ninety-two (87%) of the case-patients required hospitalization. Case-patients were residents of Los Angeles (71), Orange (32), Contra Costa (1), and San Bernardino (1) counties. Typhus is considered endemic in parts of Orange and Los Angeles counties. The case-patients from Contra Costa and San Bernardino counties reported travel outside the United States during the incubation period.

Plague

No cases of plague in humans were reported in 2013.

Animal surveillance

Domestic pets

No cases of plague in domestic pets were reported in 2013.

Wild animals

In 2013, the Vector-Borne Disease Section (VBDS) plague surveillance program tested or received results for 475 wild rodents and 216 carnivores from 29 California counties (Table 3). Thirteen rodents and three carnivores from six counties tested positive for serum antibodies to *Yersinia pestis*. In addition, San Diego County Environmental Health, Vector Control program reported seven positive ground squirrels from campgrounds within the Mount Palomar Observatory area and Los Angeles County Vector Management found one positive ground squirrel in the Angeles National Forest (Figure 1).

Squirrels tested for plague antibodies included: 218 California ground squirrels (*Otospermophilus beecheyi*) from eight counties, 193 chipmunks (*Tamias* spp.) from ten counties, 32 mice (*Peromyscus* spp.) from three counties, 15 golden-mantled ground squirrels (*Callospermophilus lateralis*) from three counties and 17 Belding's ground squirrels (*Urocitellus beldingi*) from two counties. In May, plague antibodies were detected in three

The last urban commensal rat-associated human plague cases in California occurred in 1925. Between 1927 and 2006, 62 human plague cases have been documented associated with exposure in natural mountainous areas inhabited by wild rodents. Twenty-three (37%) of these case-patients were exposed in recreational settings outside their county of residence. Rarity of disease and extensive travel history may impede medical recognition and diagnosis of this potentially fatal disease. The last human plague case with exposure in California was reported in 2006.



Figure 1. Map of California counties where mammals were found to have evidence of *Yersinia pestis* infection, 2013

California ground squirrels and one yellow-pine chipmunk from 46 rodents tested from Inyo National Forest (Four Jeffrey Campground), Inyo County. Surveillance conducted in September found three seropositive yellow-pine chipmunks from 32 rodents tested from the U. S. Forest Service, Lake Tahoe Basin Management Unit (Taylor Creek Visitor Center) in El Dorado County. In October, six yellow-pine chipmunks from 28 rodents sampled, tested positive for plague antibody in the Tahoe National Forest (Boca Reservoir Campground), Nevada County. All three aforementioned locations experienced wild rodent plague activity in 2012.

Testing for plague antibody in 2013 was performed on 216 carnivores including: 166 coyotes (*Canis latrans*) from sixteen counties, 22 black bears (*Ursus americanus*) from seven counties, 2 badgers (*Taxidea taxus*) from one county, 6 bobcats (*Lynx rufus*) from five counties, 10 mountain lions (*Felis concolor*) from nine counties, 6 raccoons (*Procyon lotor*) from three counties, 2 gray fox (*Urocyon cinereoargenteus*) from one county and 2 striped skunks (*Mephitis mephitis*) from one county. Two coyotes near Canby, one near Lake City and one at Mud Lake, near Alturas, Modoc County tested positive for plague antibody. One black bear from Yosemite National Park also tested positive for plague antibody. All other carnivores were negative for serum antibody to *Y. pestis*.

Table 3. Vector-Borne Disease Section plague surveillance program results, 2013					
County Location	No. rodents tested	No. carnivores tested	Positive Specimens		
			Species	Result	Month
Alpine	18				
Amador	3				
Butte		4			
Calaveras		1			
Del Norte	1				
El Dorado	40	16			
LTBMU: Taylor Creek Visitor Center			Chipmunk, YP	1:512	September
LTBMU: Taylor Creek Visitor Center			Chipmunk, YP	1:32	September
LTBMU: Taylor Creek Visitor Center			Chipmunk, YP	1:256	September
Fresno		15			
Inyo	65				
Inyo NF: Four Jeffrey CG			Chipmunk, YP	1:64	May
Inyo NF: Four Jeffrey CG			CA G Sq	1:256	May
Inyo NF: Four Jeffrey CG			CA G Sq	1:64	May
Inyo NF: Four Jeffrey CG			CA G Sq	1:256	May
Kern		22			
Los Angeles		3			
Mariposa		37			
Mendocino		24			
Modoc		21			
Lake City, approximately 5 mi. NE			Coyote	1:64	February
Canby, approximately 5 mi. E			Coyote	1:64	April
Canby, approximately 5 mi. W			Coyote	1:32	May
Alturas, Mud Lake			Coyote	1:128	June
Mono	30				
Monterey		2			
Nevada	28				
Tahoe NF: Boca Reservoir CG			Chipmunk, YP	1:32	October
Tahoe NF: Boca Reservoir CG			Chipmunk, YP	1:512	October
Tahoe NF: Boca Reservoir CG			Chipmunk, YP	1:512	October
Tahoe NF: Boca Reservoir CG			Chipmunk, YP	1:128	October
Tahoe NF: Boca Reservoir CG			Chipmunk, YP	1:128	October
Tahoe NF: Boca Reservoir CG			Chipmunk, YP	1:32	October
Orange	13				
Plumas	75	6			
Vinton, approximately 4 mi. S			Coyote	1:32	April
Riverside	47				
San Bernardino	133				
San Luis Obispo		1			
Santa Barbara	17	4			
Sierra		4			
Siskiyou		47			
Stanislaus		1			
Tehama		1			
Trinity		1			
Tuolumne		6			
Yosemite NP: Tuolumne Meadows			Black Bear	1:256	July
Ventura	5				
Total	475	216			

Abbreviations: Chipmunk, YP: Yellow-pine chipmunk
 CA G Sq: California ground squirrel
 LTBMU: Lake Tahoe Basin Management Unit
 NF: National Forest
 NP: National Park
 CG: Campground

3

Tick-borne Diseases



At least seven tick-borne diseases have been documented in California. A goal of the 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 when necessary, management of tick populations when appropriate and possible, collation of state-wide tick data from participating agencies, and timely dissemination of findings and prevention messages to the public health, vector agencies, medical, and public communities.

Human disease surveillance

Anaplasmosis

Six cases of anaplasmosis caused by *Anaplasma phagocytophilum* were reported to the California Department of Public Health (CDPH) in 2013; all met national surveillance criteria for a probable case. Case-patients were residents of Fresno (1), San Francisco (1), Santa Barbara (2), Sonoma (1), and Tehama (1) counties. Mean age was 45 years (range 17-63 years) and 5 (83%) were male. Potential exposure in California to western blacklegged ticks (*Ixodes pacificus*) was documented for four of the case-patients who hiked or worked in Lake, Tehama, Marin, or Santa Barbara counties. One case-patient reported tick exposure while in Minnesota, and exposure was not documented for one case-patient.

Babesiosis

Three cases of babesiosis caused by *Babesia microti* were reported to CDPH in 2013; all met national surveillance criteria for a confirmed case. Ages of case-patients ranged from 67 years to 73 years and all were male. All three case-patients reported travel to and outdoor activity in the eastern United States seaboard or upper Midwest where *B. microti* is endemic.

Ehrlichiosis

Two cases of ehrlichiosis caused by *Ehrlichia chaffeensis* were reported to CDPH in 2013; both met national surveillance criteria for a probable case. Case-patients resided in Contra Costa or San Diego Counties. Both case-patients reported travel history compatible with disease onset and known areas of *E. chaffeensis* endemicity: one to Minnesota and the other to Colorado.

Lyme disease

A total of 120 cases of Lyme disease, caused by *Borrelia burgdorferi*, with onset in 2013 were reported to the CDPH; 97 of these met the surveillance case definition criteria for a confirmed case and 23 were probable. Of the 97 confirmed cases, case-patients were residents of 24 counties (Table 4). From 2004 to 2013, the highest incidence of Lyme disease was in the northwest coastal areas of California (Figure 2). Of 62 (64%) confirmed case-patients reporting travel history within the incubation period, 49 (79%) reported destinations compatible with exposure outside California. The most frequently reported location of likely exposure was the northeastern United States.

The median age of confirmed Lyme disease case-patients was 35 years (range, 1 to 77 years) and 44 (45%) were male. Of 77 case-patients for whom race was reported, 73 were white, two were Asian and two self-

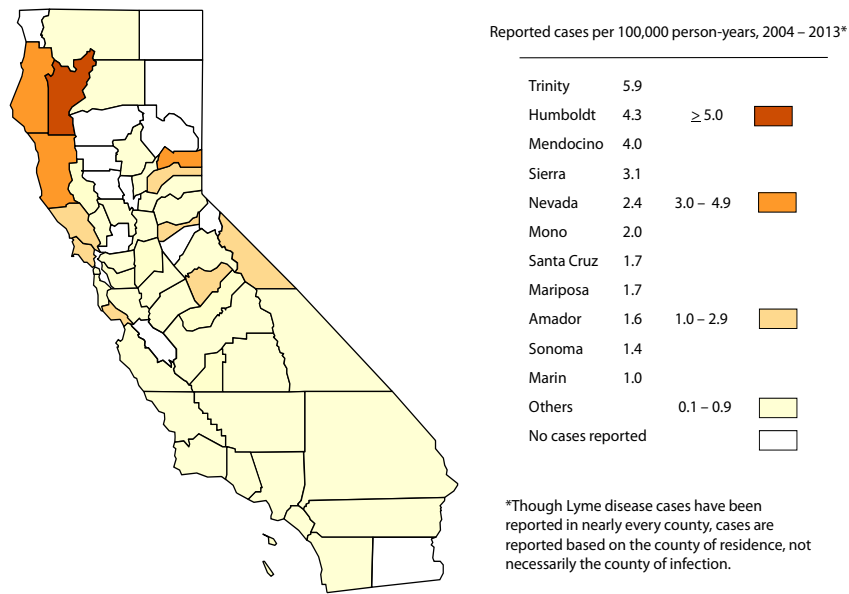


Figure 2. Incidence of Lyme disease, by county, California, 2004 - 2013

identified as other race. Erythema migrans (EM) was identified in 63 (65%) of the confirmed case-patients, 45 (71%) of whom had onset of EM noted between May and September.

Spotted fever group rickettsiosis

Fifteen cases of Rocky Mountain spotted fever (RMSF), caused by *Rickettsia rickettsii*, were reported to CDPH in 2013; one met the national surveillance case definition for confirmed and 14 met the surveillance criteria for probable. The confirmed case-patient was a Fresno County resident who experienced fever, headache, myalgia, and rash. The case-patient succumbed to the illness. Organ tissues sent to the U.S. Centers for Disease Control and Prevention, Infectious Diseases Pathology Branch tested positive by immunohistochemistry for spotted fever group *Rickettsia*; kidney tissue tested positive by PCR for *Rickettsia rickettsii*. The case-patient had been in rural areas in southern Santa Barbara County and Fresno County one week preceding disease onset. Ticks were recovered and tested from the potential exposure site in Fresno County as described under tick surveillance below. The probable case-patients were residents of Alameda, Los Angeles (2), Riverside, San Diego (4), San Francisco, San Joaquin, San Mateo, Shasta, Sutter, and Ventura counties. Probable case-patient median age was 49 years (range, 16 to 73 years), nine (64%) were male. All had a febrile illness, seven described rash on extremities and trunk, and all were serologically positive to *Rickettsia rickettsii* at time of presentation but no follow-up serology could be obtained. Potential exposure areas included rural areas of Arizona, California, Oregon, Texas, or Mexico.

Three cases of spotted fever group (SFG) *Rickettsia* confirmed as type *Rickettsia philipii* (formerly 364D) were reported to CDPH in 2013. Confirmation was by PCR of cutaneous ulcers (eschars) and sequencing performed by the CDPH Viral and Rickettsial Disease Laboratory (VRDL). Case-patient ages ranged from 57 to 61 years; two were female and one was male. Case-patients were residents of San Francisco (2) and Monterey (1) counties. All cases occurred in August, and two required hospitalization. All case-patients presented with multiple eschars. Other symptoms included headache (3), lymphadenopathy (1), myalgia (1), and fever (2). Presumed exposure for two case-patients was camping in Lake County and one was camping in Monterey County. None of the case-patients reported a tick bite.

Table 4: Reported confirmed Lyme disease cases by county of residence and onset year, California, 2004 - 2013

County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Incidence per 100,000 person-years
Alameda	1	4	4	2	6	2	1	2	4	0	0.17
Alpine	0	0	0	0	0	0	0	0	0	0	0.00
Amador	0	1	1	2	1	0	0	0	0	1	1.62
Butte	2	0	1	0	2	2	0	0	0	0	0.32
Calaveras	0	0	0	0	0	0	0	0	0	0	0.00
Colusa	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	0	4	0	0	1	1	0	2	3	5	0.15
Del Norte	0	0	0	0	0	0	0	0	0	0	0.00
El Dorado	2	4	4	2	1	2	1	0	1	0	0.94
Fresno	0	0	1	0	2	0	1	1	4	0	0.10
Glenn	0	0	0	0	0	0	0	0	0	0	0.00
Humboldt	7	11	4	7	5	4	8	6	2	4	4.30
Imperial	0	0	0	0	0	0	0	0	0	0	0.00
Inyo	0	0	1	0	0	0	0	0	0	0	0.54
Kern	0	2	1	5	2	1	2	0	0	0	0.15
Kings	0	0	0	0	0	1	0	0	0	1	0.13
Lake	1	1	0	1	0	0	0	0	0	0	0.47
Lassen	0	0	0	0	0	0	0	0	0	0	0.00
Los Angeles	2	8	12	10	6	3	6	7	1	17	0.07
Madera	0	0	0	0	0	0	0	1	0	0	0.07
Marin	0	2	8	1	2	2	2	1	3	5	1.03
Mariposa	1	0	0	0	0	0	0	0	1	1	1.67
Mendocino	2	1	2	7	8	7	2	4	3	0	4.09
Merced	0	0	0	0	0	0	0	1	0	0	0.04
Modoc	0	0	0	0	0	0	0	0	0	0	0.00
Mono	1	0	0	0	0	0	1	0	0	1	2.08
Monterey	1	0	0	1	0	0	0	1	1	1	0.12
Napa	1	1	0	2	0	1	0	1	1	0	0.51
Nevada	1	3	2	4	1	3	1	6	1	1	2.36
Orange	0	1	2	1	1	0	5	5	0	0	0.05
Placer	3	2	0	1	1	1	0	1	2	1	0.34
Plumas	0	0	0	0	0	0	0	0	0	0	0.00
Riverside	3	1	0	0	1	4	0	4	0	2	0.07
Sacramento	3	3	2	2	0	1	1	1	0	0	0.06
San Benito	0	0	0	0	0	0	0	0	0	0	0.00
San Bernardino	0	0	0	0	1	0	0	2	1	1	0.02
San Diego	3	7	10	5	3	10	4	8	7	6	0.20
San Francisco	1	9	3	5	3	1	2	1	3	2	0.37
San Joaquin	0	0	0	0	0	0	0	0	1	0	0.01
San Luis Obispo	0	1	0	0	2	0	0	1	0	4	0.29
San Mateo	1	3	2	1	2	1	2	0	1	9	0.30
Santa Barbara	0	1	0	2	1	0	2	3	0	6	0.35
Santa Clara	0	3	8	2	2	2	4	12	4	13	0.28
Santa Cruz	2	1	6	4	2	6	5	9	4	6	1.70
Shasta	2	2	0	0	0	0	1	1	1	0	0.39
Sierra	0	0	0	0	0	0	0	0	1	0	3.15
Siskiyou	0	0	0	0	0	0	0	1	0	1	0.45
Solano	0	0	0	0	0	0	0	0	0	0	0.00
Sonoma	1	12	2	10	9	7	5	5	12	6	1.41
Stanislaus	0	1	0	0	1	1	0	0	0	0	0.06
Sutter	0	0	0	0	0	0	0	0	0	0	0.00
Tehama	0	0	0	0	0	0	0	0	0	0	0.00
Trinity	4	3	0	0	0	0	0	0	1	0	5.94
Tulare	0	0	0	1	0	0	0	0	1	0	0.04
Tuolumne	1	1	0	0	0	0	0	0	0	0	0.37
Ventura	2	1	0	4	2	0	1	0	2	2	0.17
Yolo	1	0	2	0	0	0	0	0	1	1	0.24
Yuba	0	0	0	0	0	1	0	0	1	0	0.28
California	49	94	78	82	68	64	57	87	68	97	0.19

Tick-borne relapsing fever

Six cases of tick-borne relapsing fever (TBRF) caused by *Borrelia hermsii* were reported to CDPH in 2013; four of these met the surveillance case definition criteria for a confirmed case and two were suspect. Median age of confirmed case-patients was 42 years (range, 4 to 55 years) and three were male. Confirmed case-patients were residents of three counties: Inyo, Mono, and Sonoma (2). Counties where case-patients were likely exposed in the three weeks prior to onset included El Dorado, Inyo, Mono, and Tuolumne counties.

Tick surveillance

Anaplasma phagocytophilum

In 2013, the Vector-Borne Disease Section (VBDS), in collaboration with Marin-Sonoma Mosquito and Vector Control District (MVCD), Napa Mosquito Abatement District (MAD), and San Mateo MVCD, collected 270 adult and 90 nymphal western blacklegged ticks (*Ixodes pacificus*) from their respective counties to test for the presence of *Anaplasma phagocytophilum*. Four (1.5%) adult western blacklegged ticks and seven (7.8%) nymphs tested positive by real-time polymerase chain reaction (RT-PCR) at the University of California Davis Center for Vector-Borne Disease Research, or at the CDPH-VRDL. One adult western blacklegged tick was coinfecting with *A. phagocytophilum* and *Borrelia burgdorferi sensu stricto*.

Borrelia spirochetes

B. burgdorferi sensu lato

In 2013, local, state and federal agencies collected 4,498 adult and 362 nymphal western blacklegged ticks from 15 counties to test for *B. burgdorferi*. Collection and testing data for western black legged ticks are collated by VBDS. Ticks were tested individually either by RT-PCR only or by direct fluorescent antibody (DFA) followed by RT-PCR (Table 5). Ticks tested in pools were tested by RT-PCR (Table 6). From the 12 counties where ticks were tested individually, the overall prevalence of *B. burgdorferi* in adult ticks was 1.4% (95% CI: 1.0-2.0%) and 5.0% (95% CI: 3.3-7.7%) for nymphal ticks (Table 5). In the three counties where adult ticks were tested in pools, the minimum infection prevalence (the number of positive pools divided by total ticks tested multiplied by 100) was 1.2% (95% CI: 0.8-1.7%) (Table 6).

Borrelia miyamotoi

In 2013, of the western blacklegged ticks collected by VBDS, 776 adult and 256 nymphal ticks were tested for *B. miyamotoi*, a relapsing fever-type spirochete implicated in human disease in the eastern United States and Europe. Three adult ticks (0.4%; 95% CI: 0.1-1.1%) and six nymphal ticks (2.3%; 95% CI: 1.1-5.0%) tested positive (Table 5).

Borrelia hermsii

In response to human cases of TBRF, soft ticks, *Ornithodoros hermsi*, were collected from El Dorado County (1) and Tuolumne County (4). All ticks tested negative for *B. hermsii* by RT-PCR at Northern Arizona University.

Rickettsia philipii

In 2013, VBDS collected 55 nymphal and six larval Pacific Coast ticks (*Dermacentor occidentalis*) from Contra Costa, Lake, and Mendocino counties for *Rickettsia philipii* testing. Other tick species and life stages tested included 30 adult, 1 nymphal, and 72 larval rabbit ticks (*Haemaphysalis leporispalustris*), 2 adult *Ixodes angustus*, and 4 adult western blacklegged ticks. Tick collection in Lake County was done in collaboration with Lake County Vector Control District. All ticks were tested by RT-PCR at the CDPH-VRDL. One Pacific coast tick nymph from Mendocino National Forest, Lake County, tested positive.

Borrelia miyamotoi is in the relapsing-fever spirochete group (more closely related to *B. hermsii* than *B. burgdorferi*) but has been documented in ticks of *Ixodes ricinus* complex ("deer ticks") only. A relapsing fever type illness associated with infection with *B. miyamotoi* has been described in human patients from the eastern United States and in Europe. CDPH-VBDS has detected *B. miyamotoi* in western blacklegged ticks since 2000; no human cases in California have been described to date.

Table 5. Infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* spirochetes in *Ixodes pacificus* ticks, California 2013

County Location	No. Ticks Tested		Positive <i>B. burgdorferi</i>		Positive <i>B. miyamotoi</i>		Collected by	Laboratory
	Adults	Nymphs	Adults (IP) ^a	Nymphs (IP)	Adults (IP)	Nymphs (IP)		
Eldorado								
Salmon Falls SRA	0	73		5 (6.8)			CDPH, VBDS	Sac-Yolo MVCD
Lake								
Clear Lake SP	0	85		4 (4.7)		3 (3.5)	Lake County VCD	CDPH, VBDS
Clear Lake Riviera	0	16		0		0	Lake County VCD	CDPH, VBDS
Lakeport	0	3		0		0	Lake County VCD	CDPH, VBDS
Middle Creek CG, Mendocino NF	0	44		4 (9.1)		2 (4.5)	CDPH, VBDS	CDPH, VBDS
Middletown	0	22		0		0	Lake County VCD	CDPH, VBDS
Los Angeles								
Palo Verde Rattlesnake Trail								
Stough Canyon Park	12	0	0		0		CDPH, VBDS	CDPH, VBDS
Marin								
Marin Headlands, GGNRA	39	0	0		1 (2.6)		CDPH, VBDS	CDPH, VBDS
Marin Municipal Water District	38	13 ^b	0	1 (7.7) ^b	0	0	M/S MVCD	CDPH, VBDS
Point Reyes National Seashore	18	0	0		0		CDPH, VBDS	CDPH, VBDS
Monterey								
Garrapata SP	33	0	0		0		CDPH, VBDS	CDPH, VBDS
Pfeiffer Big Sur SP	28		0				CDPH, VBDS	CDPH, VBDS
Napa								
Bothe-Napa Valley SP	46	0	0		1 (2.2)		Napa MAD	CDPH, VBDS
Skyline Regional Park	42		0		0		Napa MAD	CDPH, VBDS
Orange								
Crystal Cove SP	33	0	0		0		CDPH, VBDS	CDPH, VBDS
Placer								
Auburn SRA		6 ^b		0			Placer MVCD	Placer MVCD
Sacramento								
Negro Bar SP		2 ^b		0			Sac/Yolo MVCD	Sac/Yolo MVCD
San Mateo								
Edgewood County Park	110	3	3 (2.7)	0	1 (0.9)	0	CDPH, VBDS	CDPH, VBDS
Huddart County Park	183	2	3 (1.6) ^b	0			San Mateo MVCD	San Mateo MVCD
Laurelwood Park	206	0	0 ^b				San Mateo MVCD	San Mateo MVCD
Los Trancos OSP	171	22	5 (2.9) ^b				San Mateo MVCD	San Mateo MVCD
Pescadero Creek County Park	36	10	4 (11.1)	0	0	0	CDPH, VBDS	CDPH, VBDS
Pulgas Ridge OSP	155	0	1 (0.7) ^b				San Mateo MVCD	San Mateo MVCD
Skyline Ridge OSP	301	0	6 (2.0) ^b				San Mateo MVCD	San Mateo MVCD
Sweeny Ridge, GGNRA	29	0	1 (3.4)		0		CDPH, VBDS	CDPH, VBDS
Thornewood OSP	52	26	2 (3.8)	4 (15.4)	0	1 (3.8)	CDPH, VBDS	CDPH, VBDS
Santa Barbara								
Channel Islands NP	102	0	0		0		NPS	CDPH, VBDS
Los Padres NF	136	9	0	0	0	0	CDPH, VBDS	CDPH, VBDS
Santa Clara								
Long Ridge OSP	19	5	1 (5.3)	0	0	0	CDPH, VBDS	CDPH, VBDS
Shasta								
Shasta Lake	0	20		0		0	CDPH, VBDS	CDPH, VBDS
Stanislaus								
Patterson	31	0	0		0		CDPH, VBDS	CDPH, VBDS
Yolo								
Cache Creek CG		1 ^b		0			Sac/Yolo MVCD	Sac/Yolo MVCD
Total	1,820	362	26 (1.4)	18 (5.0)	3 (.04)^c	6 (2.3)^c		

All tested by direct fluorescent antibody test (DFA) for the genus *Borrelia* and then Real-Time Polymerase Chain Reaction (RT-PCR) for *Borrelia burgdorferi* sensu lato unless otherwise noted

^aIP - Infection Prevalence=number of positive ticks divided by ticks tested multiplied by 100.

^bTested by Real-Time Polymerase Chain Reaction (RT-PCR) specific for *Borrelia burgdorferi sensu stricto*

^cNumber of ticks tested for *B. miyamotoi* are 776 adults and 256 nymphs

Abbreviations:

Location: NF, National Forest OSP, Open Space Preserve CG, Campground GGNRA, Golden Gate National Recreation Area
 NP, National Park SRA, State Recreation Area SP, State Park

Laboratory: CDPH, VBDS, California Department of Public Health, Vector-Borne Disease Section
 MAD, Mosquito Abatement District M/S MVCD, Marin/Sonoma Mosquito & Vector Control District
 MVCD, Mosquito and Vector Control District NPS, National Park Service
 VCD, Vector Control District

Rickettsia rickettsii

In 2013, VBDS conducted surveillance for *Rickettsia rickettsii*, the bacteria that cause Rocky Mountain spotted fever, in response to a reported human case from Fresno County. Four adult Pacific Coast ticks and 32 adult American dog ticks (*D. variabilis*) were collected from Fresno County and tested. One adult rabbit tick was collected from Santa Barbara County and tested. All ticks tested negative by RT-PCR at CDPH-VRDL.

Francisella tularensis

In 2013, VBDS, in collaboration with Napa County MAD, conducted surveillance for *Francisella tularensis*, the bacteria that cause tularemia, in ticks collected from Napa County from areas where potential tick-bite exposure in human cases had been reported historically. Tested ticks included: 257 adult and 2 nymphal American dog ticks, 2 Pacific Coast adult ticks, 29 adult and 2 nymphal rabbit ticks, and 2 adult brown dog ticks (*Rhipicephalus sanguineus*). All ticks tested negative by RT-PCR at the San Diego Vector Control County Laboratory.

Table 6. Minimum infection prevalence of *Borrelia burgdorferi sensu lato* in *Ixodes pacificus* ticks, California 2013^a

County	Adults (pools)	Positive		
		Pools (MIP) ^b	Collected by	Laboratory
Placer				
Auburn	1 (1)	0	Placer MVCD	Placer MVCD
Auburn SRA	299 (64)	2 (0.7)	Placer MVCD	Placer MVCD
Hidden Falls RP	113 (24)	1 (0.9)	Placer MVCD	Placer MVCD
Horseshoe Bar Preserve	40 (9)	2 (5.0)	Placer MVCD	Placer MVCD
Placer Nature Center	43 (9)	0	Placer MVCD	Placer MVCD
Steven's Trail	52 (13)	3 (5.7)	Placer MVCD	Placer MVCD
Sugar Pine Point Trail, Tahoe NF	130 (28)	4 (3.1)	Placer MVCD	Placer MVCD
Sacramento				
Ancil Hoffman Park	5 (4)	0	Sac/Yolo MVCD	Sac/Yolo MVCD
East Lake Natoma Trail	274 (58)	0	Sac/Yolo MVCD	Sac/Yolo MVCD
Folsom	61 (18)	0	Sac/Yolo MVCD	Sac/Yolo MVCD
Gold Lake Drive	18 (6)	0	Sac/Yolo MVCD	Sac/Yolo MVCD
Mississippi Bar	284 (65)	6 (2.1)	Sac/Yolo MVCD	Sac/Yolo MVCD
Negro Bar SP	224 (49)	2 (0.8)	Sac/Yolo MVCD	Sac/Yolo MVCD
Nimbus Dam Overlook	144 (33)	6 (4.2)	Sac/Yolo MVCD	Sac/Yolo MVCD
Snipes Pershing Park	303 (67)	3 (1.0)	Sac/Yolo MVCD	Sac/Yolo MVCD
Willow Creek	105 (28)	2 (1.9)	Sac/Yolo MVCD	Sac/Yolo MVCD
Yolo				
Cache Creek CG	230 (51)	0	Sac/Yolo MVCD	Sac/Yolo MVCD
Cache Creek, Blue Ridge Trail	352 (76)	2 (0.6) ^a	Sac/Yolo MVCD	Sac/Yolo MVCD
Total	2,678	33 (1.2)		

^aTested by polymerase chain reaction (PCR) specific for *Borrelia burgdorferi sensu stricto*

^bMIP - Measure of prevalence. MIP (minimum infection prevalence) is equal to the number of positive pools divided by the number of ticks pooled multiplied by 100.

Abbreviations:

Location: CG, Campground NF, National Forest SP, State Park SRA, State Recreation Area
RP, Regional Park

Laboratory: MVCD, Mosquito and Vector Control District

4

Mosquito-borne Diseases



Mosquito-borne diseases under surveillance in California include the endemic arboviral diseases caused by West Nile virus, western equine encephalomyelitis virus, and St. Louis encephalitis virus, as well as the travel-associated diseases caused by *Plasmodium* spp. (malaria) and dengue virus. 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), 26 local county public health and commercial laboratories. Local laboratories tested for WNV using an IgM or IgG immunofluorescent assay (IFA) and/or an IgM enzyme immunoassay (EIA). Specimens with inconclusive results were forwarded to the VRDL for further testing with a plaque reduction neutralization test (PRNT) or reverse transcriptase-polymerase chain reaction (RT-PCR). Additional WNV infections were identified through screening tests performed at blood donation centers.

A total of 379 symptomatic and 54 asymptomatic human infections with WNV were identified in 2013, an 18% decrease in infections compared to 2012 (Table 7). Of the 379 clinical cases, 138 (36%) were classified as West Nile fever and 241 (64%) were classified as West Nile neuroinvasive disease (i.e. encephalitis, meningitis, or acute flaccid paralysis). Case-patients were residents of 30 counties and 236 (62%) were male. Incidence was highest (31.7 cases per 100,000 persons) in Glenn County (Table 7, Figure 3). The median ages for West Nile fever and neuroinvasive cases were 57 years (range, 5 to 92 years) and 56.5 years (range, 1 to 93 years), respectively. The median age of the 15 WNV-associated fatalities was 74 years (range, 55 to 92 years). Dates of symptom onset ranged from May 22 – November 7, 2013.

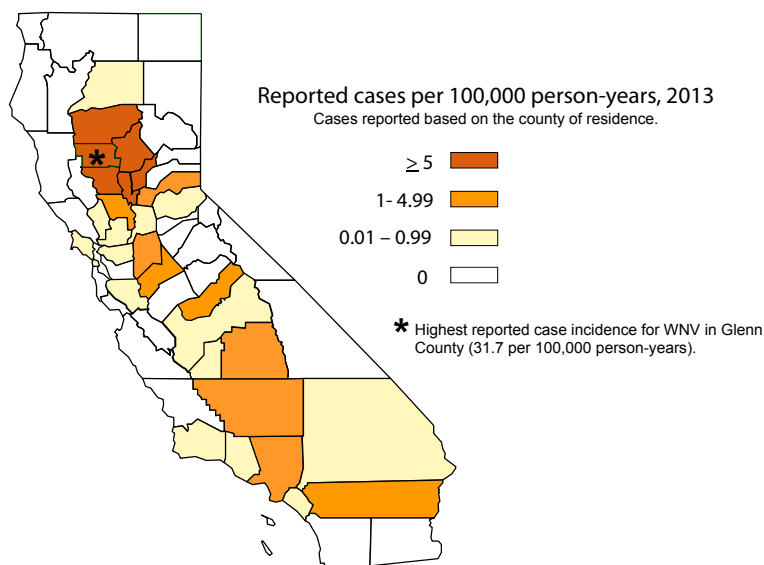


Figure 3. Incidence of reported human cases of West Nile virus, by county California 2013

Table 7. Reported WNV human cases by county of residence, California, 2004-2013

County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2013 Incidence per 100,000 person-years	10 year incidence per 100,000 person-years
Alameda	0	1	1	0	1	0	1	0	2	0	0.00	0.04
Alpine	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Amador	0	3	0	0	0	0	0	1	0	0	0.00	1.06
Butte	7	24	31	16	6	2	1	3	10	24	10.85	5.69
Calaveras	0	2	0	0	1	0	0	0	0	0	0.00	0.66
Colusa	0	2	4	2	1	0	0	0	3	2	9.24	6.62
Contra Costa	0	11	8	3	4	5	4	3	4	5	0.46	0.45
Del Norte	0	0	0	0	0	0	0	0	0	0	0.00	0.00
El Dorado	0	1	2	0	1	1	0	1	0	1	0.55	0.39
Fresno	11	59	11	17	3	13	23	9	24	8	0.84	1.95
Glenn	3	13	12	7	1	0	2	1	7	9	31.87	19.68
Humboldt	0	1	0	0	0	0	0	0	0	0	0.00	0.07
Imperial	1	1	1	3	0	0	0	0	1	0	0.00	0.41
Inyo	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Kern	59	67	49	140	2	18	15	18	25	25	2.90	5.13
Kings	0	32	1	7	2	3	1	1	3	1	0.66	3.41
Lake	1	0	2	0	0	0	0	0	1	0	0.00	0.62
Lassen	1	0	0	0	0	0	0	0	0	0	0.00	0.29
Los Angeles	306	40	13	36	156	20	4	58	163	151	1.52	0.96
Madera	0	18	0	2	0	1	7	2	3	3	1.97	2.44
Marin	0	0	1	0	0	0	0	0	0	2	0.79	0.12
Mariposa	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Mendocino	0	0	0	2	0	0	0	0	0	0	0.00	0.23
Merced	1	25	4	4	1	4	1	1	13	0	0.00	2.15
Modoc	0	0	2	0	0	0	0	0	0	0	0.00	2.09
Mono	0	0	1	0	0	0	0	0	0	0	0.00	0.71
Monterey	0	0	0	0	0	1	0	0	1	0	0.00	0.05
Napa	0	0	1	1	0	0	0	0	0	1	0.72	0.22
Nevada	0	4	1	0	0	0	0	0	0	0	0.00	0.51
Orange	62	17	6	9	71	4	1	10	42	10	0.32	0.77
Placer	1	35	8	4	6	0	3	1	12	6	1.66	2.26
Plumas	0	1	0	0	0	0	0	0	0	0	0.00	0.49
Riverside	109	103	4	17	62	3	0	7	19	35	1.55	1.70
Sacramento	3	163	15	25	13	0	12	4	29	11	0.76	1.96
San Benito	0	0	0	0	0	0	0	0	0	0	0.00	0.00
San Bernardino	187	33	3	4	36	2	5	4	33	13	0.63	1.59
San Diego	2	1	1	15	35	4	0	0	1	0	0.00	0.19
San Francisco	0	2	0	0	0	0	1	0	1	1	0.12	0.06
San Joaquin	2	34	8	10	12	10	6	5	13	8	1.14	1.60
San Luis Obispo	1	0	1	0	0	0	0	0	0	0	0.00	0.08
San Mateo	0	1	0	0	0	0	0	0	0	0	0.00	0.01
Santa Barbara	0	2	0	0	1	0	0	1	0	1	0.23	0.12
Santa Clara	1	5	5	4	1	0	0	1	0	2	0.11	0.11
Santa Cruz	0	0	0	0	0	0	0	1	0	0	0.00	0.04
Shasta	5	1	4	9	1	0	0	0	1	1	0.56	1.25
Sierra	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Siskiyou	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Solano	0	5	8	1	1	0	0	0	2	1	0.24	0.44
Sonoma	0	1	0	1	0	0	0	0	0	0	0.00	0.04
Stanislaus	0	84	11	21	17	14	12	11	26	17	3.25	4.18
Sutter	0	9	12	3	0	0	0	0	8	10	10.49	4.54
Tehama	10	4	6	4	4	0	0	1	4	5	7.87	6.10
Trinity	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Tulare	3	56	6	10	5	4	12	11	7	5	1.10	2.76
Tuolumne	0	1	0	0	0	0	0	0	0	0	0.00	0.18
Ventura	2	1	3	1	0	0	0	0	7	2	0.24	0.20
Yolo	1	11	27	2	1	2	0	0	10	6	2.93	3.05
Yuba	0	6	5	0	0	1	0	3	4	13	17.74	4.53
Total WNV disease	779	880	278	380	445	112	111	158	479	379	1.00	1.08
Asymptomatic Infections ^a	51	55	14	29	53	17	20	18	48	54		
Total WNV infections	830	935	292	409	498	129	131	176	527	433	1.14	1.18

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

No cases of western equine encephalomyelitis (WEE) or St. Louis encephalitis (SLE) were identified in California residents in 2013.

Malaria

In 2013, a total of 100 confirmed cases of malaria were reported to CDPH. Case-patients were residents of 27 California counties and 63 (63%) were male. The median age was 33 years (range, 2-76). Of 93 cases for which the *Plasmodium* species was determined, 51 were *P. falciparum*, 36 *P. vivax*, 4 *P. ovale*, and 2 *P. malariae*. Compatible travel history within past three years to malaria-endemic areas was reported by 97 case-patients, including travel to Africa (67), Asia (25), South America (4) and Central America (1). Exposure information for three case patients was not available.

Dengue

A total of 126 cases of dengue were reported to CDPH in 2013; 8 of these met the criteria for a confirmed case and 117 were probable. Case-patients were residents of 27 California counties, 69 (56%) were male, and the median age was 42 years (range 8-83). All case-patients reported travel to dengue-endemic areas including Mexico (32), Asia (29), Central America (26), India (18), the Caribbean (16), South America (2), and Africa (2). No locally acquired cases were reported.

Mosquito surveillance

A total of 29,363 mosquito pools (777,619 mosquitoes) collected in 37 counties were tested at the University of California, Center for Vectorborne Diseases (CVEC) or at one of seven local agencies by a real-time (TaqMan) reverse transcriptase-polymerase chain reaction (qRT-PCR) for SLEV, WEEV, and/or WNV viral RNA. Four local agencies also tested an additional 615 pools (13,425 mosquitoes) for WNV using a commercial rapid assay-RAMP® (Rapid Analyte Measurement Platform, Response Biomedical Corp) (Table 8).

West Nile virus was detected in 2,528 mosquito pools from 27 counties; 2,509 were positive by RT-PCR and 19 were positive by RAMP only (Table 8, 12). Statewide, the minimum infection rate (MIR) - defined as the number of infected mosquito pools divided by the number of mosquitoes tested

Table 8. Results of testing mosquitoes for West Nile (WNV) virus, California 2013

County	No. mosquito pools tested ^a	No. mosquitoes	WNV positive pools ^a	WNV Minimum Infection Rate ^b
Alameda	60	1,835	0	0.0
Alpine		0		
Amador		0		
Butte	147	7,069	33	4.7
Calaveras		0		
Colusa		0		
Contra Costa	453	12,729	13	1.0
Del Norte		0		
El Dorado		0		
Fresno	836	30,139	66	2.2
Glenn	42	2,100	16	7.6
Humboldt		0		
Imperial		0		
Inyo	2	88	0	0.0
Kern	804	33,299	181	5.4
Kings	426	12,593	78	6.2
Lake	427	15,223	62	4.1
Lassen		0		
Los Angeles	3,155	122,741	417	3.4
Madera	88	1,849	16	8.7
Marin	534	2,764	0	0.0
Mariposa		0		
Mendocino		0		
Merced	170	2,686	8	3.0
Modoc		0		
Mono		0		
Monterey	16	720	0	0.0
Napa	141	2,401	0	0.0
Nevada		0		
Orange	1,803	40,892	48	1.2
Placer	1,967	31,705	89	2.8
Plumas		0		
Riverside	3,004	106,139	81	0.8
Sacramento	4,558	75,458	384	5.1
San Benito		0		
San Bernardino	2,262	55,468	249	4.5
San Diego	202	7,808	0	0.0
San Francisco	7	183	0	0.0
San Joaquin	1,676	35,643	163	4.6
San Luis Obispo	38	1,454	1	0.7
San Mateo	174	3,101	0	0.0
Santa Barbara	401	17,474	0	0.0
Santa Clara	631	9,719	25	2.6
Santa Cruz	54	1,228	1	0.8
Shasta	262	7,153	15	2.1
Sierra		0		
Siskiyou		0		
Solano	75	2,879	1	0.3
Sonoma	908	9,836	5	0.5
Stanislaus	1,523	49,438	158	3.2
Sutter	336	10,722	61	5.7
Tehama		0		
Trinity		0		
Tulare	653	20,036	97	4.8
Tuolumne		0		
Ventura	34	1,534	0	0.0
Yolo	1,997	51,921	246	4.7
Yuba	112	3,017	14	4.6
Total	29,978	791,044	2,528	3.2

^aTested by University of California at Davis Center for Vectorborne Diseases or local mosquito/vector control agency.

^bMinimum Infection Rate = (No. pools positive/No. mosquitoes in pool) X 1000

multiplied by 1,000 - of WNV in all mosquitoes tested was 3.2; the MIR was highest (8.7) in Madera County (Table 8, Figure 4). Since 2003, the MIR of WNV in California has ranged from a low of 0.08 (2003) to a high of 3.2 (2013). West Nile virus was identified from six *Culex* species (*Cx. erythrothorax*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. stigmatosoma*,

Cx. tarsalis, *Cx. thriambus*) and one other species (*Anopheles freeborni*) (Table 9). In 2013, the first detection of WNV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in Tulare County on May 8. The last detection of WNV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in San Bernardino County on November 27.

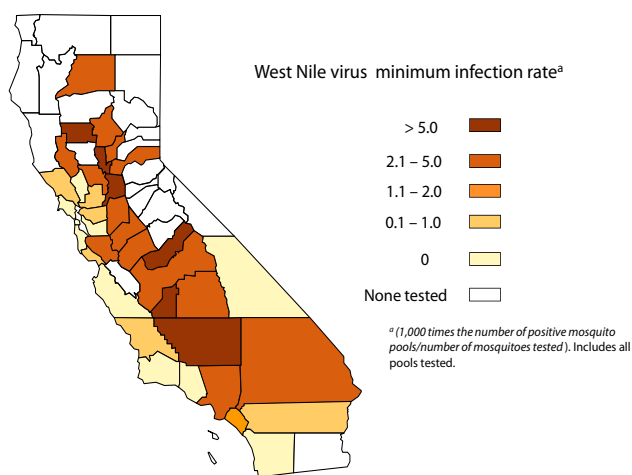


Figure 4. West Nile Virus minimum infection rate of mosquitoes, California, 2013

Animal surveillance

Chicken

In 2013, 40 local mosquito and vector control agencies in 34 counties maintained 183 sentinel chicken flocks (Table 10). Blood samples were collected from chickens every other week and tested for antibodies to WNV, SLEV, and WEEV by an EIA at the Vector-Borne Disease Section (VBDS) laboratory or at one of two local agencies. Positive samples were confirmed at the VBDS laboratory by IFA or western blot. Samples with inconclusive results were tested by PRNT at the VRDL-CDPH.

Out of 16,849 chicken blood samples that were tested, 485 seroconversions to WNV were detected among 112 flocks in 26 counties (Table 10, 12). Statewide, 33.8% 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 34.2% (2013). In 2013, the first WNV seroconversion was detected in Los Angeles County on May 29, and the last seroconversion was detected in Riverside County on November 14.

Table 9. Results of mosquito testing by species for West Nile virus (WNV), California 2013

Mosquito Species	No. Pools Tested	No. Mosquitoes	WNV +	Minimum Infection Rate ^a
Culex species				
<i>Cx. boharti</i>	3	3	0	0.0
<i>Cx. erythrothorax</i>	1,634	54,921	20	0.4
<i>Cx. pipiens</i>	7,349	125,339	523	4.2
<i>Cx. quinquefasciatus</i>	8,098	247,833	935	3.8
<i>Cx. restuans</i>	2	50	0	0.0
<i>Cx. stigmatosoma</i>	622	5,345	23	4.3
<i>Cx. tarsalis</i>	11,610	341,303	1,021	3.0
<i>Cx. territans</i>	1	7	0	0.0
<i>Cx. thriambus</i>	101	184	1	5.4
unknown	19	72	1	13.9
All Culex	29,439	775,057	2,524	3.3
Anopheles species				
<i>An. franciscanus</i>	7	114	0	0.0
<i>An. freeborni</i>	57	2,673	1	0.4
<i>An. hermsi</i>	50	1,435	0	0.0
All Anopheles	114	4,222	1	0.2
Aedes species				
<i>Ae. aegypti</i>	13	214	0	0.0
<i>Ae. albopictus</i>	1	12	0	0.0
<i>Ae. dorsalis</i>	30	568	0	0.0
<i>Ae. melanomom</i>	18	654	0	0.0
<i>Ae. squamiger</i>	6	137	0	0.0
<i>Ae. taeniorhynchus</i>	2	61	0	0.0
<i>Ae. vexans</i>	16	700	0	0.0
<i>Ae. washinoi</i>	21	922	0	0.0
All Aedes	107	3,268	0	0.0
Other species				
<i>Coquillettidia perturbans</i>	1	50	0	0.0
<i>Culiseta incidens</i>	205	4,479	0	0.0
<i>Culiseta inornata</i>	25	229	0	0.0
<i>Culiseta particeps</i>	34	1,089	0	0.0
Unknown	53	2,650	3	1.1
All other	318	8,497	3	0.4

^a Minimum Infection Rate = (No. pools positive/No. mosquitoes tested) X 1000

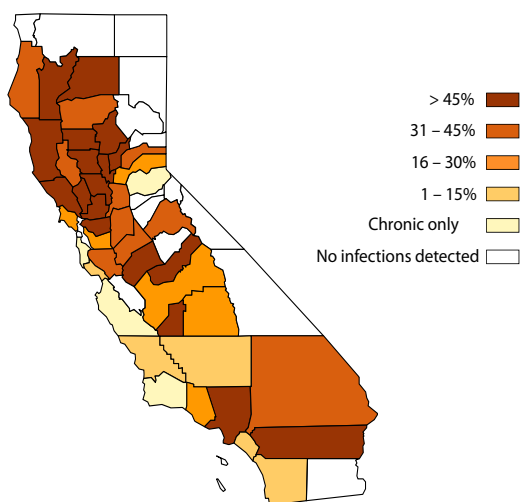


Figure 5. Prevalence of acute West Nile virus infection in dead birds, California, 2013

Dead bird and dead tree squirrel

In 2013, the WNV hotline and website received 14,727 dead bird reports from the public in 57 counties (Table 11). Dead bird carcasses were tested either at CVEC by RT-PCR, the California Animal Health & Food Safety Laboratory (CAHFS) by RT-PCR or IHC, or at one of 13 local agencies by RT-PCR or RAMP. Of the 3,306 carcasses deemed suitable for testing, WNV was detected in 1,416 (43%) carcasses from 40 counties; 1,251 (37.8%) tested as acute infections (recent within current surveillance season) from 39 counties, and 156 (4.7%) tested as chronic infections (exposed at an undeterminable time in the past) from 32 counties (Table 11, 12 Figure 5). Since 2003, the prevalence of WNV positive dead birds has ranged from a low of 5% (2003) to a high of 56% (2004). Of the acute infections, 1,145 were confirmed positive by RT-PCR, 105 by RAMP, and 1 by IHC. In 2013, the first WNV positive dead bird was an American crow reported from Los Angeles County on February 4, and the last WNV positive dead bird was an American crow reported from Santa Clara County on November 26. In 2013, 461 dead squirrels were reported through the WNV Hotline; 97 carcasses were tested and WNV RNA was detected by RT-PCR in eight (8.2%) carcasses from seven counties (Table 12). These included seven fox squirrels (*Sciurus niger*) and one western gray squirrel (*S. griseus*).

Table 10. Results of testing sentinel chickens for West Nile (WNV) virus, California 2013

County	No. flocks	No. chickens ^a	No. WNV positive flocks	WNV positive sera
Alameda	3	21	0	0
Alpine	0			
Amador	0			
Butte	7	77	7	57
Calaveras	1	10	0	0
Colusa	1	10	1	8
Contra Costa	5	54	3	7
Del Norte	0			
El Dorado	0			
Fresno	0			
Glenn	1	11	1	9
Humboldt	0			
Imperial	0			
Inyo	0			
Kern	2	20	2	12
Kings	0			
Lake	2	14	1	6
Lassen	0			
Los Angeles	48	308	31	151
Madera	2	12	2	2
Marin	1	6	1	1
Mariposa	0			
Mendocino	0			
Merced	7	42	6	21
Modoc	0			
Mono	0			
Monterey	2	21	0	0
Napa	0			
Nevada	2	20	1	2
Orange	0			
Placer	4	24	4	13
Plumas	0			
Riverside	21	178	10	44
Sacramento	3	25	3	6
San Benito	1	10	1	1
San Bernardino	16	106	10	29
San Diego	2	20	0	0
San Francisco	0			
San Joaquin	0			
San Luis Obispo	0			
San Mateo	2	20	0	0
Santa Barbara	5	50	0	0
Santa Clara	7	49	2	2
Santa Cruz	2	20	0	0
Shasta	7	52	5	21
Sierra	0			
Siskiyou	0			
Solano	3	38	2	12
Sonoma	3	18	1	2
Stanislaus	2	16	2	8
Sutter	6	42	6	35
Tehama	3	30	3	8
Trinity	0			
Tulare	2	20	2	5
Tuolumne	0			
Ventura	5	48	0	0
Yolo	3	25	3	12
Yuba	2	14	2	11
Total	183	1,431	112	485

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

Horses

Serum or brain tissue specimens from horses displaying neurological signs were tested for WNV at CAHFS. West Nile virus infection was detected in 13 horses from seven counties (Table 12). Five of the horses died or were euthanized as a result of their infection.

Invasive mosquito surveillance

Aedes aegypti, also known as the yellow fever mosquito and the primary vector of dengue, was detected in Madera, Fresno, and San Mateo counties in 2013. The detections resulted from responses to routine resident service calls, as well as from enhanced surveillance for invasive *Aedes* mosquito species. *Aedes albopictus*, also known as the Asian Tiger mosquito, continues to be detected in Los Angeles County in 2013.

Property inspections for invasive *Aedes* mosquitoes show extensive larval breeding in planter saucers and other backyard containers. Enhanced mosquito surveillance methods have included the use of Biogents (BG)-Sentinel traps, ovitraps, and autocidal gravid ovitraps (AGOs) provided by the US Centers for Disease Control and Prevention Dengue Branch. Enhanced control measures have included public education, sanitation, and chemical control targeting both immature and adult mosquitoes. In 2013, a total of 214 adult *Ae. aegypti* (from Fresno County) tested at CVEC were negative for dengue virus.

Table 11. Dead birds reported, tested^a, and positive for West Nile virus, California 2013

County	Reported	Tested	Positive-acute (%)	Positive-chronic (%)
Alameda	516	77	22 (28.6)	6 (7.8)
Alpine	3	0		
Amador	23	1	0	0
Butte	390	82	42 (51.2)	5 (6.1)
Calaveras	23	1	0	0
Colusa	24	2	1 (50.0)	0
Contra Costa	1396	123	68 (55.3)	6 (4.9)
Del Norte	0			
El Dorado	145	25	0	1 (4.0)
Fresno	412	67	12 (17.9)	7 (10.3)
Glenn	23	10	8 (80.0)	0
Humboldt	25	3	1 (33.3)	0
Imperial	2	0		0
Inyo	8	1	0	0
Kern	148	21	2 (9.5)	2 (9.5)
Kings	93	22	12 (54.5)	2 (9.1)
Lake	117	24	10 (41.7)	0
Lassen	2	0		0
Los Angeles	2,640	522	313 (60.0)	34 (6.5)
Madera	65	13	7 (53.8)	3 (23.1)
Marin	266	33	7 (21.2)	1 (2.9)
Mariposa	7	2	0	0
Mendocino	34	4	2 (50.0)	0
Merced	302	60	39 (65.0)	3 (5.0)
Modoc	4	0		
Mono	6	1	0	0
Monterey	67	14	0	1 (7.1)
Napa	93	4	2 (50.0)	0
Nevada	86	17	6 (35.3)	1 (5.9)
Orange	215	318	42 (13.2)	0
Placer	358	186	39 (21.0)	9 (4.8)
Plumas	7	0		
Riverside	467	42	22 (52.4)	2 (4.8)
Sacramento	1,495	459	179 (39.0)	19 (4.1)
San Benito	27	3	0	0
San Bernardino	452	100	37 (37.0)	4 (4.0)
San Diego	137	107	9 (8.4)	0
San Francisco	72	7	0	0
San Joaquin	417	91	34 (37.4)	4 (4.4)
San Luis Obispo	79	17	1 (5.9)	2 (11.8)
San Mateo	317	62	0 (9.3)	4 (6.5)
Santa Barbara	47	9	0	1 (11.1)
Santa Clara	1046	234	77 (32.9)	14 (6.0)
Santa Cruz	169	19	1 (5.3)	2 (41.0)
Shasta	118	73	38 (52.1)	4 (10.5)
Sierra	1	0		
Siskiyou	1	0		
Solano	336	26	15 (57.7)	0
Sonoma	486	74	37 (50.0)	3 (4.1)
Stanislaus	379	38	13 (34.2)	4 (10.5)
Sutter	175	33	16 (48.5)	1 (4.7)
Tehama	37	7	3 (42.9)	1 (3.0)
Trinity	6	1	1 (100)	0
Tulare	161	35	7 (20.0)	2 (5.3)
Tuolumne	14	3	1 (33.3)	0
Ventura	234	38	8 (21.1)	2 (5.3)
Yolo	463	175	106 (60.6)	5 (2.9)
Yuba	91	20	11 (55.0)	1 (5.0)
Totals	14,727	3,306	1,251 (37.8)	156 (4.7)

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

Table 12. Infections with West Nile virus in California, 2013

County	Humans ^a	Dead	Mosquito	Sentinel	Dead	Horses
		Birds	Pools	Chickens	Squirrels	
Alameda	1	22	0	0	0	0
Alpine	0	0	0	0	0	0
Amador	0	0	0	0	0	0
Butte	24	42	33	57	0	0
Calaveras	0	0	0	0	0	0
Colusa	2	1	0	8	0	0
Contra Costa	5	68	13	7	1	1
Del Norte	0	0	0	0	0	0
El Dorado	1	0	0	0	0	0
Fresno	8	12	66	0	0	0
Glenn	9	8	16	9	0	0
Humboldt	1	1	0	0	0	0
Imperial	1	0	0	0	0	0
Inyo	0	0	0	0	0	0
Kern	30	2	181	12	0	2
Kings	1	12	78	0	0	0
Lake	0	10	62	6	0	0
Lassen	0	0	0	0	0	0
Los Angeles	172	313	417	151	3	0
Madera	4	7	16	2	0	0
Marin	4	7	0	1	0	0
Mariposa	0	0	0	0	0	0
Mendocino	0	2	0	0	0	0
Merced	0	39	8	21	0	0
Modoc	0	0	0	0	0	0
Mono	0	0	0	0	0	0
Monterey	0	0	0	0	0	0
Napa	1	2	0	0	0	0
Nevada	0	6	0	2	0	0
Orange	12	42	48	0	1	0
Placer	6	39	89	13	0	3
Plumas	0	0	0	0	0	0
Riverside	40	22	81	44	0	1
Sacramento	13	179	384	6	0	3
San Benito	0	0	0	1	0	1
San Bernardino	17	37	249	29	1	0
San Diego	0	9	0	0	0	0
San Francisco	1	0	0	0	0	0
San Joaquin	10	34	163	0	0	0
San Luis Obispo	0	1	1	0	0	0
San Mateo	0	0	0	0	0	0
Santa Barbara	1	0	0	0	0	0
Santa Clara	2	77	25	2	0	0
Santa Cruz	0	1	1	0	0	0
Shasta	1	38	15	21	1	0
Sierra	0	0	0	0	0	0
Siskiyou	0	0	0	0	0	0
Solano	1	15	1	12	0	0
Sonoma	0	37	5	2	0	0
Stanislaus	19	13	158	8	0	2
Sutter	10	16	61	35	0	0
Tehama	5	3	0	8	0	0
Trinity	0	1	0	0	0	0
Tulare	9	7	97	5	0	0
Tuolumne	0	1	0	0	0	0
Ventura	2	8	0	0	1	0
Yolo	6	106	246	12	0	0
Yuba	14	11	14	11	0	0
Totals	433	1,251	2,528	485	8	13

^aIncludes asymptomatic infections detected through blood bank screening

The statewide WNV minimum infection rate in mosquitoes was higher in 2013 than in any other year since surveillance began for WNV in California in 2000.

5

U.S. Forest Service Cost-Share Agreement



In 1992, the Vector-Borne Disease Section, California Department of Public Health, entered into a Challenge Cost-Share Agreement with the Pacific Southwest Region of the United States Department of Agriculture Forest Service to maintain cooperative surveillance and control of vector-borne diseases within the National Forests. This report highlights some of the vector-borne disease monitoring, risk assessment, risk reduction, and education of personnel, concessionaires, and the public that the Vector-Borne Disease Section and local collaborators conducted at the 18 National Forests in California in 2013.

Angeles National Forest

In July 2013, a California ground squirrel (*Otospermophilus beecheyi*) captured at Table Mountain Campground and tested by the Los Angeles County Department of Public Health Vector Control and Management Program (LACDPH/VCMP), was positive for serum antibodies to *Yersinia pestis*, the causative agent for plague, resulting in a partial campground closure. Vector-Borne Disease Section (VBDS) biologists informed the Forest Safety Officer and District Ranger for Santa Clara/Mojave Rivers Ranger District of the test results and observed flea reduction measures instituted by Los Angeles County agencies. VBDS maintained communications with the United States Forest Service (USFS) and LACDPH/VCMP to minimize public health risk. This was the only positive plague specimen from 192 samples submitted from 30 Angeles National Forest sites where sampling was conducted. Neither of the two carnivores tested from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*. The Los Angeles County Agricultural Commissioner's Office conducted general flea control at 58 Forest recreational sites.

Cleveland National Forest

VBDS biologists conducted adult tick surveillance along Secret Canyon and Maple Springs Trails, collecting a total of 95 *Ixodes pacificus* and 111 *Dermacentor occidentalis* ticks. Biologists conducted plague surveillance at Blue Jay Campground where none of the 13 samples tested was positive for antibodies to *Y. pestis* and visually assessed several other campgrounds for evidence of plague activity. A bobcat sampled by Orange County Vector Control District was negative for plague serum antibodies. The Forest Safety Officer was notified of a serologically plague positive California ground squirrel found at Fry Creek campground by the San Diego County Vector Control Program on the Mt. Palomar Ranger District. Advice regarding hantavirus precautions for carpeted floors was provided upon request along with links to hantavirus safety training videos.

The San Diego and Orange County vector control programs also provided VBDS with test results from surveillance conducted on ticks and rodents from Forest lands.

Eldorado National Forest

Two carnivores from lands adjacent to the Forest were negative for serum antibodies to *Y. pestis*. Upon request, biologists conducted visual hantavirus risk assessments at locations on the Amador and Pacific Ranger Districts with written recommendations submitted to staff. Hantavirus and plague concerns were discussed with the Forest Supervisor and Safety Officer (SO) and the SO was supplied with materials and guidance to conduct tick bite prevention training for Forest staff. Plague caution signs were posted and vector-borne disease education and prevention materials were distributed to campground hosts and the District Ranger Station on the Amador Ranger District.

Inyo National Forest

In July 2013, VBDS biologists and Mono County Environmental Health investigated a non-fatal hantavirus pulmonary syndrome (HPS) human case with potential exposure at a long-term lease recreational location near June Lake. Three (28%) of 11 deer mice were positive for serum antibodies to Sin Nombre virus (SNV), causative agent of HPS. The lease-holder was given hantavirus educational brochures and warning placards to be posted in rental units. Brochures were also given to staff and made available to customers. In August, an HPS case in Inyo County with potential exposure locales on Forest lands was also investigated with assistance from the county health department. One deer mouse from the Buttermilks bouldering area was positive for serum antibodies to SNV.

Four (8.7%) rodents of 46 tested for plague from Four Jeffrey campground were positive for serum antibodies to *Y. pestis* but no evidence of a plague epizootic was found. The campground has been posted with Plague Warning signs for over a decade and the campground concessionaire and Forest Safety Officer were aware of the elevated risk for plague in the area. Additional rodent plague sampling was conducted at the Schulman Grove Visitor Center and Grandview, Saddlebag, North Lake campgrounds and a private, long-term lease campground. None of the 42 samples evidenced serum antibodies for plague. Visual assessments for plague risk were conducted at campgrounds throughout the Forest. One black bear from Yosemite National Park, bordering the Forest, was also positive for serum antibodies to plague.

VBDS staff gave an annual safety talk to Forest staff at the All Forest meeting held in Bishop and provided the Safety Officer with vector-borne disease prevention and educational brochures. Discussions were held with Forest leadership regarding the most effective method to ensure public awareness of vector-borne diseases found on Forest and long-term lease lands. Advice regarding rodent exclusion and respiratory protection was provided upon request and an employee submitted a tick for identification. The District Biologist also provided the Forest Safety Officer with the results from the CDPH Occupational Health Branch findings on Yosemite National Park's hantavirus outbreak.

Klamath National Forest

The Forest Safety Officer was contacted by VBDS and invited to participate in a tick bite prevention project. All necessary materials and guidance were provided to conduct the training.

None of the 41 carnivores tested from lands adjacent to Forest lands were positive for serum antibodies to *Y. pestis*.

Lake Tahoe Basin Management Unit

Biologists conducted adult tick surveillance at Camp Richardson Resort and plague surveillance at Taylor Creek Visitor Center. Three yellow-pine chipmunks of the 34 rodents sampled were positive for serum antibodies to *Y. pestis*. All fleas collected and two rodent carcasses submitted separately tested negative for *Y. pestis* bacteria by culture. Visual inspections of rodent abundance were conducted at the Tallac Historical Site, Camp Richardson Resort, and Taylor Creek Visitor Center. Diurnal rodent numbers were considered relatively low compared to previous visits but no visual evidence of a plague epizootic was noted. Meetings with El Dorado County Vector Control and Forest leadership were held to discuss recent plague activity and hantavirus issues.

Lassen National Forest

VBDS staff was asked to evaluate the Almanor Ranger District facilities for hantavirus risk, other vector-borne disease risk, and bat incursion issues. Specific rodent and bat exclusion recommendations were made for evaluated structures. Hantavirus awareness training for all District staff was also re-emphasized and the Forest was encouraged to enlist the services of a private pest control operator to clean heavily rodent-infested sites. Visual assessments for plague activity were conducted at South Almanor and Legacy campgrounds where plague caution signs were present. Staff at the District Ranger Station was provided with vector-borne disease prevention and educational brochures and plague caution signs for posting in campgrounds. One carnivore sampled was negative for serum antibodies to *Y. pestis*.

Los Padres National Forest

Adult tick collecting and testing was conducted at several locations on the Forest in Santa Barbara County. None of the 145 western blacklegged ticks collected and tested was positive for *Borrelia burgdorferi*. Upon request, a VBDS biologist evaluated five structures on the Santa Barbara Ranger District for hantavirus risk. Written recommendations were submitted to the District Ranger and Forest Safety Officer. Rodent plague surveillance was conducted at Mt. Piños, Chuchupate, and Upper Oso campgrounds. None of the 21 rodents and seven carnivore samples submitted through the year was positive for serum antibodies to *Y. pestis*. Visual assessments for plague risk were conducted on the Mt. Piños Ranger District and Plague Caution signs were posted.

VBDS biologists gave safety talks to staff at the Mt. Piños and Santa Barbara Ranger Districts. VBDS staff also reviewed an OSHA report concerning rodent incursion problems on the Ojai Ranger District.

Mendocino National Forest

VBDS biologists conducted tick collecting at Middle Fork Creek Campground. Testing showed infection with *B. burgdorferi* and *B. miyamotoi* by RT-PCR in four and two (of 44) nymphal western blacklegged ticks, respectively. The Forest Safety Officer was invited to participate in the VBDS tick bite prevention project and the Safety Officer was supplied with necessary materials and guidance to conduct the training. A visual assessment for plague activity was conducted at Middle Fork Creek Campground: no unusual rodent activity was noted. None of the three carnivores sampled and tested from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*. The Upper Lake Ranger District received Spanish language tick cards and a VBDS biologist spoke with staff regarding services available under the Cost-Share Agreement.

Modoc National Forest

Four of the 19 carnivores sampled from lands adjacent the Forest were positive for serum antibodies to *Y. pestis* indicating plague activity in or near the Forest. The Plague Caution poster at Lower Rush Creek Campground was replaced and the Forest Safety Officer was informed of the occupational tick bite prevention project.

Plumas National Forest

Plague surveillance was conducted on three occasions at Cottonwood Springs Group campground as part of an ectoparasite study. None of the 64 rodents sampled and tested for serum antibodies to plague and three of the 36 rodents sampled for hantavirus were positive for serum antibodies to SNV. One carnivore from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*. Cell phone photographs of dead rodents at Gold Lake campground aided in the evaluation of a possible plague epizootic and provided an opportunity to educate Forest staff regarding dead rodent submission protocols. Upon request, VBDS biologists also evaluated three barracks for hantavirus risk and rodent incursion. Recommendations were provided to the Beckwourth Ranger District's facilities manager.

San Bernardino National Forest

Tick, hantavirus, and plague surveillance was conducted at numerous locations on Forest lands by VBDS biologists and in collaboration with the Riverside County Department of Environmental Health Vector Control Program (RCDEH-VCP) and San Bernardino County Mosquito and Vector Control Program.

Adult tick collecting was conducted at locations in the Lytle Creek recreation area: along the trail to Bonita Falls, Penstock Road, Applewhite campground, Middle Fork Lytle Creek, and near the Front Country Ranger District Office. Adult ticks were also collected from the South Fork Trail and Spittler Peak Trail on the San Jacinto Ranger District. Two of 53 *Peromyscus* spp. mice were positive for serum antibodies to SNV during routine surveillance conducted by RCDEH-VCP at a Forest site near human dwellings. The volunteer staff at Keller Peak Lookout was given a hantavirus presentation and brochures were left for other volunteers.

Plague surveillance was conducted in campgrounds on all three Ranger Districts. None of the 121 rodents tested was positive for serum antibodies to *Y. pestis*. Visual surveys for plague were also conducted at campgrounds on the Front Country and Mountaintop Ranger Districts. No evidence of plague activity was noted, and most campgrounds had an overabundance of California ground squirrels. Disease prevention brochures and tick cards were delivered to staff at all Ranger Districts. Campground concessionaires were also given disease prevention brochures and campgrounds were posted with Plague Caution signs. The Forest Safety Officer and Mountaintop District Ranger were notified by email of a West Nile virus positive gray squirrel (*Sciurus griseus*).

Sequoia National Forest

VBDS was contacted by the Hot Springs District Ranger regarding hantavirus Job Hazard Analysis. Information and links to the VBDS website for safety brochures, general education about vector-borne diseases and available services under the Cost-Share Agreement were provided. The Forest Supervisor was also informed of

the Cost-Share Agreement by email. None of the five carnivore samples from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*.

Shasta-Trinity National Forest

Tick surveillance was conducted at locations on the Shasta Lake and Yolla Bolla Ranger Districts. None of the 20 western blacklegged ticks collected from along a road cut near McCloud Bridge campground was positive for *B. burgdorferi*. Concessionaires at Hirz Bay campground were shown how to identify common tick species and given vector-borne disease prevention brochures. Biologists conducted hantavirus surveillance at Hirz Mountain lookout. None of the 11 *Peromyscus* spp. mice tested was positive for serum antibodies to SNV. Test results were communicated to the Forest Safety Officer who was also invited to participate in the occupational tick bite prevention project. Upon request, VBDS biologists visited the Harrison Gulch Ranger Station to discuss rodent ingress issues and provide staff with disease prevention and education materials. Neither of two carnivores sampled from lands adjacent to the Forest were positive for serum antibodies to *Y. pestis*.

Sierra National Forest

None of the 13 carnivore samples from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*. The Forest Safety Officer was invited to participate in the occupational tick bite prevention project. All necessary materials and guidance were provided to conduct the training. The Forest was also contacted regarding the availability of VBDS biologists to conduct safety presentations.

Six Rivers National Forest

The Forest Safety Officer was invited to participate in the occupational tick bite prevention project. All necessary materials and guidance to conduct tick bite prevention training were provided. Consultation regarding a West Nile virus positive golden eagle was sought by staff on the Mad River Ranger District and a VBDS biologist visited the Gasquet Ranger District to distribute vector-borne disease prevention and educational brochures.

Stanislaus National Forest

Plague surveillance was conducted at Mosquito Lake, Pine Marten, and Silver Valley campgrounds on the Calaveras Ranger District. None of the 18 rodent samples tested positive for serum antibodies to *Y. pestis*. Two carnivores sampled from lands adjacent to the Forest were also negative for serum antibodies to plague. Plague Caution signs were posted at numerous campgrounds throughout the Forest on all Ranger Districts.

As follow-up of human cases of tick-borne relapsing fever (TBRF) reported in 2011 with potential exposure near Mosquito Lake, whole blood samples from nine chipmunks (*Tamias* spp.), one deer mouse (*Peromyscus maniculatus*), one golden-mantled ground squirrel (*Callospermophilus lateralis*), and one vole (*Microtus californicus*) were tested and found negative for the TBRF agent (*Borrelia hermsii*). Four *Ornithodoros* ticks from this same location also tested negative for *B. hermsii* by PCR.

Hantavirus risk assessments were conducted on the Summit Ranger District with written summaries and recommendations provided. VBDS biologists contacted all Ranger Districts and offered vector-borne disease safety training. The staff at Groveland and Calaveras Ranger Districts was given safety presentations on awareness and prevention of vector-borne diseases. Vector-borne disease prevention materials and brochures were provided to the Forest Headquarters, Calaveras, Groveland and Summit Ranger Districts. The Forest Safety Officer was invited to participate in the occupational tick bite prevention project and supplied with all necessary materials and guidance to conduct the training.

Tahoe National Forest

VBDS biologists conducted plague surveillance at Boca Reservoir campground after conducting pre-opening evaluations at Boca Reservoir, Boca Springs, and Logger campgrounds which were all sites with plague seropositive rodents in 2012. Six of 43 rodents tested positive for serum antibodies to *Y. pestis*. However, none of the 109 fleas collected and tested was positive for *Y. pestis* bacteria. VBDS staff notified the District Ranger and the Nevada County Health Officer. Ranger Districts were contacted by biologists and informed

Table 13. Testing results for selected vector-borne disease agents in U.S. National Forests, California 2013

National Forest	Hantavirus (<i>Peromyscus</i> mice)		<i>Yersinia pestis</i> (rodents)		<i>Yersinia pestis</i> (carnivores) ^a		<i>Borrelia</i> spp. (<i>Ixodes</i> ticks except where noted)	
	Positive	Tested ^b	Positive	Tested ^b	Positive	Tested	Positive	Tested
Angeles			1	192	0	2		
Cleveland	0	13	1	119	0	1	0	19
Eldorado					0	2		
Inyo	4	22	4	88	1	1		
Klamath					0	41		
Lake Tahoe BMU			3	36				
Lassen					0	1		
Los Padres			0	21	0	7	0	145
Mendocino					0	3	6	44
Modoc					4	19		
Plumas	3	36	0	64	1	7		
San Bernardino	2	53	0	121				
Sequoia					0	5		
Shasta-Trinity	0	11			0	2	0	20
Sierra					0	13		
Stanislaus			0	18	0	2	0	4 ^c
Tahoe			6	43	0	4		
Total, all forests	9	135	15	702	6	110	6	232

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

^b Additional data shown here may not be reflected in text since some animal collection and testing was conducted by county public health agencies and laboratories.

of the services provided under the Cost-Share Agreement. Vector-borne disease prevention and educational materials were mailed or provided upon request. Hantavirus and tick-borne relapsing fever safety and prevention training was provided to American River Ranger District employees and fire crews and a safety presentation was also given to the California Land Management staff and campground concessionaires. VBDS staff worked with Forest and Region 5 staff to film a rodent exclusion video for use Region-wide. The Forest Safety Office participated in the occupational health training project to reduce tick bites in Region 5 with VBDS assisting at a training event on the Yuba River Ranger District.

Other Region 5 Activities

VBDS provided the Forest Regional staff with information on public health pesticide usage on Region 5 lands, quarterly reports on activities conducted under the Cost-Share Agreement, and updated VBDS biologist contact lists by county for each Forest. VBDS biologists and staff edited and made available to the Region a hantavirus prevention video detailing proper procedure for trapping and removing deer mice from inside structures and provided the CDPH Occupational Health Branch findings on the Yosemite National Park hantavirus outbreak. Work continued on additional hantavirus and tick bite prevention videos and the Region was invited to participate at the Forest level in an occupational tick bite prevention project with all materials and necessary instructions provided by VBDS. Upon request, vector-borne disease prevention and educational materials were sent to the Region 5 Safety Officer and hantavirus prevention information and consultation was made available outside the Region after a USFS hantavirus fatality in New Mexico. VBDS continues to host an annual meeting with Region representation to review activities and plan future goals.

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. 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 14). 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 Technicians must pay annual renewal fees and fulfill minimum continuing education requirements. The California Department of Public Health (CDPH) Vector-Borne Disease Section (VBDS), approved 145 continuing education events in 2013. 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 2013, 1,236 Vector Control Technicians employed at 113 local public health agencies and CDPH held 2,968 certificates (Table 15). The agencies include special districts, departments of county government, departments of city government, the University of California, and CDPH. Of these agencies, 79 are signatory to a cooperative agreement with CDPH.

Table 14. Results of certification examinations administered in 2013.

Exam section	No. Exams Given	No. Passed (%)
Core	123	76 (62)
Mosquito Control	124	74 (60)
Terrestrial Invertebrate Control	74	45 (61)
Vertebrate Vector Control	75	55 (73)
Totals	396	250 (63)

In 2013, 834 individuals employed at 78 agencies held full certification status. In addition, 402 employees from 60 agencies held limited status. Many agencies employ technicians with both full and limited status.

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

Table 15. Vector Control Technician certificates in effect as of December 2013

Certification Category	No. Certificates		
	Full Status	Limited Status	Total
Mosquito Control	817	264	1,081
Terrestrial Invertebrate Vector Control	667	222	889
Vertebrate Vector Control	674	324	998
Totals	2,158	810	2,968

7

Public Information Materials, Publications



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

Public Information Materials

In 2013, new public education materials as listed below were created and distributed. To find information on a specific vector or disease, go to <http://www.cdph.ca.gov> and enter a term in the “search” box. All public education materials are available from the VBDS webpage: <http://www.cdph.ca.gov/programs/vbds/Pages/default.aspx>.

- How to Clean Up a Dead Mouse In a Trap (June 2013, video)
- How to Exclude Mice from Buildings (produced in partnership with United States Forest Service) (July 2013, video)
- Protect Yourself from Ticks Where You Work (July 2013, training video)
- The Western Blacklegged Tick: Surveillance and Identification (November 2013, video)
- California Work Place Tick Bite Prevention (November 2013, video demonstration)
- Interactive Map of Hantavirus Surveillance in California (May 2013, Geographic Information System [GIS] data display)
- Distribution of 51 Reported Cases of Hantavirus Pulmonary Syndrome (HPS) (May 2013, static data display)
- Interactive Map of Lyme Disease and Tick Surveillance in California (May 2013, GIS data display)
- Dengue Fact Sheet (November 2013)
- Information for Clinicians: *Aedes aegypti* and *Aedes albopictus*

New videos posted on the CDPH YouTube website were viewed over 4,000 times in 2013

Publications*

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Geraghty EM, Margolis HG, **Kjemtrup A**, Reisen WK, Franks P. Correlation between aerial insecticide spraying to interrupt West Nile virus transmission and emergency department visits in Sacramento County, California. *Public Health Rep.* 2013 May-Jun; 128(3):221-30.

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