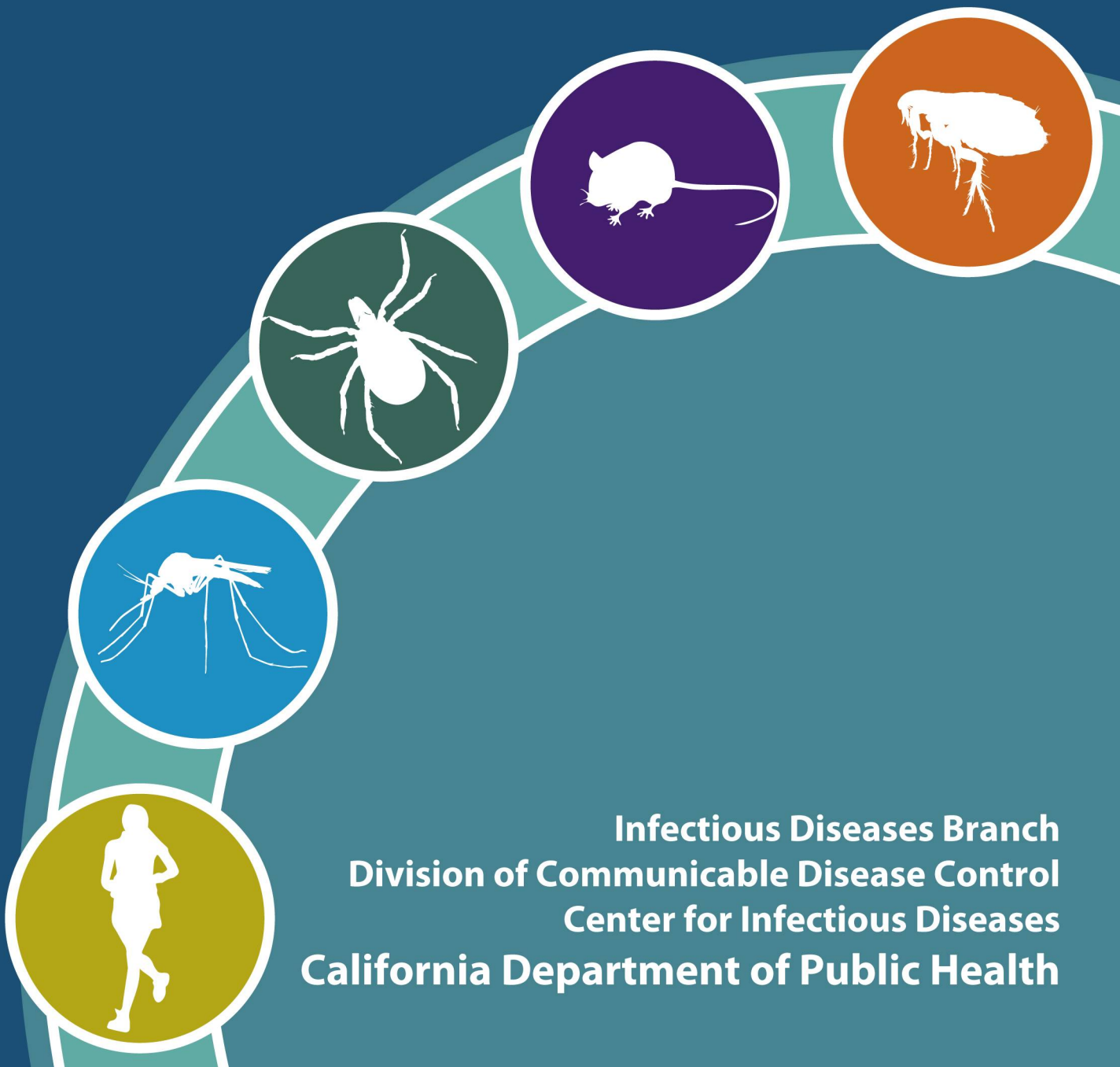
Vector-Borne Disease Section
Annual Report 2014



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

2014

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

INFECTIOUS DISEASES BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CENTER FOR INFECTIOUS DISEASES

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

Edmund G. Brown Jr.
Governor
State of California

CHHS
California Health & Human Services Agency

Diana S. Dooley, Secretary
Health and Human Services Agency

California Department of PublicHealth

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

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Preface

I am pleased to present to you the 2014 Annual Report of the California Department of Public Health, Vector-Borne Disease Section (CDPH-VBDS). CDPH- VBDS staff conducted surveillance, prevention, and control of existing and emerging vectors and vector-borne diseases throughout California in 2014.

In 2014, California experienced widespread and elevated West Nile virus (WNV) activity. The number of human cases detected (801) was the second highest recorded since 2003 when WNV first invaded California. The level of WNV activity broke several records, including the highest number of West Nile neuroinvasive disease cases (561), the highest proportion of mosquitoes infected with WNV (6.0 minimum infection rate), and the highest prevalence of WNV infection in tested dead birds (60% positive). The record hot temperatures statewide likely contributed to the elevated activity, and the extended drought may also have been a contributing factor.

Invasive *Aedes* mosquitoes continued to be an emerging public health concern in California in 2014. In 2013, *Aedes aegypti* (yellow fever mosquito) was detected in Madera, Fresno, and San Mateo counties, and in 2014 this species again was found in those counties along with new infestations in Tulare, Kern, Los Angeles, and San Diego counties. The range of *Aedes albopictus* (Asian tiger mosquito) continued to expand in Los Angeles County in 2014. Both species are aggressive day-biters and vectors of dengue and chikungunya viruses, which are currently not transmitted in California, although cases of dengue and chikungunya were identified in travelers returning to California in 2014 from regions where these viruses are circulating. CDPH provided extensive consultation to local agencies on the surveillance and control of invasive *Aedes* mosquitoes and has enhanced surveillance for human cases of mosquito-borne viruses in California by encouraging timely reporting of cases to CDPH by local health departments.

Human cases of six tick-borne diseases were reported in California in 2014. Two of nine Rocky Mountain spotted fever (RMSF) cases were fatal, underscoring the potential severity of this disease. Follow-up case surveillance implicated the brown dog tick (*Rhipicephalus sanguineus*) as a probable vector of RMSF in California for the first time. CDPH-VBDS activities in 2014 included enhancing nymphal tick surveillance and laboratory capacity, and developing educational materials on preventing tick-bite exposure in the workplace.

Plague and hantavirus activity was detected in many regions of California with one human hantavirus case reported in 2014. CDPH-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 2014 are listed here.

Rodent-borne Diseases

Alameda County Vector Control District (VCD); 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 Mosquito and Vector Control District (MVCD); Mosquito and Vector Management District (MVMD) of Santa Barbara County; Riverside County Vector Control Program (VCP); San Bernardino County VCP; San Diego VCP; San Mateo MVCD; U.S. Centers for Disease Control and Prevention (CDC); United States Forest Service (USFS); Ventura County Environmental Health Division (EHD).

Flea-borne Diseases

Alpine County HHS; California Land Management; County of El Dorado, Environmental Management Division; Fresno County Department of Agriculture; Inyo County EHS; Kern County Department of Public Health (DPH); Kern County EHS; Los Angeles County Agricultural Commissioner; Mono County HHS; Nevada County Public Health Department (PHD); Nevada County EHD; NPS; Placer MVCD; Riverside County VCP; Sacramento County HHS; San Bernardino County VCP; Santa Clara County VCD; School of Veterinary Medicine, University of California, Davis (UCD); Tulare County HHS; United States Department of Agriculture Animal and Plant Health Inspection Service, Wildlife Services; USFS; West Valley MVCD.

Tick-borne Diseases

Alpine County HHS; Butte County MVCD; Rickettsial Zoonoses Branch and Division of Vector-Borne Infectious Diseases, CDC; City of Moorpark/Vector Control (VC); Fresno County DPH; Imperial County PHD, Division of Environmental Health; Lake County VCD; Marin County HHS; Marin-Sonoma MVCD; Napa County MAD; NPS; Nevada County Community Development Agency; Placer MVCD; Nevada County Community Development Agency; San Diego County Department of Environmental Health, VC; San Joaquin County MVCD; San Mateo County MVCD; Mosquito and Vector Management District of Santa Barbara County (MVMDSBC); Sacramento-Yolo County MVCD; Santa Clara County VCD: Santa Cruz County MVCD; Shasta MVCD; Sutter-Yuba MVCD; UCD, Center for Vectorborne Diseases (CVEC); University of Northern Arizona; USFS; Ventura County EHD.

Mosquito-borne Diseases

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

California Department of Public Health Contributors

Infectious Diseases Branch
Duc Vugia MD MPH; Janey Butner; Claudia Erickson MS CHES

Vector-Borne Disease Section
Sacramento: Vicki Kramer PhD; Anne Kjemtrup DVM MPVM PhD; Jesse Laxton; Charsey Porse PhD MPH; Stefanne Haro-Maendly
Northern Region: Mark Novak PhD; Lawrence Bronson; James Tucker MS; Michael Niemela MS; Ashley Freeman MSPH; Bryan Jackson PhD; Greg Hacker MS
Southern Region: Renjie Hu PhD; Marco Metzger PhD; Sarah Billeter PhD; Joseph Burns
Coastal Region: Kerry Padgett PhD; Tina Feiszli MSPH; Melissa Yoshimizu PhD; Denise Bonilla MS; Ervic Aquino; Leslie Foss MS; Robert Payne; Mary-Joyce Pakingan; Crystal Perreira; Ian Rose; Aidan Ward

Veterinary Public Health Section
Curtis Fritz DVM MPVM PhD

Viral and Rickettsial Disease Laboratory
Dongxiang Xia MD PhD; Barryett Enge MS PHM; Robert Chiles; Maria Salas MPH; Ruth Lopez; Diana Singh; Katharine Shimabukuro; Kristina Hsieh DrPH PHM; Maria Liu MPH PHM; Sharon Messenger PhD; Larry Penning PHM CLS; Pat Stoll MD MPH PHM; Maria Vu PHM; Kim Hansard, PHM; Debra Wadford PhD MS PHM; Wanda Wong PHM; Shigeo Yagi PhD; Alex Espinosa MS, PHM; Natasha Espinosa PHM; Oliver Oyler; David Cottam PHM; Tasha Padilla PHM; Chao-Yang Pan MPH PHM; Ashraf Fadol PHM; Regina Chase PHM; Jill Hacker PhD PHM; Chris Preas PHM; Giorgio Cosentino PHM

Microbial Diseases Laboratory
Margot Graves; Robin Hogue CLS PHM

Annual Report Cover Art
Daniela Muhawi, Graphic Design

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) 116108-116120, 116102, et. seq., and 116180; Government Code Section 12582]. CDPH-VBDS provides leadership, information, and consultation on vector-borne diseases and invasive vectors to the general public and agencies engaged in the prevention and control of vector-borne diseases. CDPH-VBDS staff, located in four regional offices and headquartered in Sacramento, provide the following services:

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

1 Rodent-borne Diseases

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

Human disease surveillance

In 2014, hantavirus infection was diagnosed in one Placer County resident. The case-patient was an adult male who survived after being hospitalized. The case-patient spent time outdoors but had not traveled outside his county of residence during the six weeks prior to onset of illness. California Department of Public Health, Vector-Borne Disease Section (CDPH-VBDS) investigators collected four deer mice (*Peromyscus maniculatus*) from the case-patient's residence; none had serum antibodies to Sin Nombre virus (SNV).

Yosemite National Park hantavirus prevention

In May of 2013, Yosemite National Park (YOSE) and Public Health Foundation Enterprises (PHFE) entered into a five-year cooperative agreement to decrease the risk of contracting vector-borne diseases through increased health education, vector surveillance, and public health research. CDPH-VBDS worked closely with YOSE and PHFE staff in 2014, focusing efforts primarily on hantavirus prevention in YOSE. Activities included facility evaluations, hantavirus prevention training for staff, public education, and deer mouse surveillance to estimate rodent abundance and SNV prevalence. None of the 20 deer mice or 45 brush mice (*P. boylii*) trapped in Yosemite Valley was reactive to SNV antibody. However, 8 (12.3%) of 65 deer mice from the Tuolumne Meadows area tested positive for SNV antibody. PHFE staff provided recommendations to YOSE staff and associated partners based on surveillance results and facility evaluations.

Rodent surveillance

In 2014, CDPH-VBDS tested 835 rodents (Genera: *Neotoma, Microtus, Peromyscus*, and *Reithrodontomys*) for antibodies to SNV (Table 1.1). Of 780 *Peromyscus* spp. sampled, 37 (4.7%) were positive for SNV antibodies. Seroprevalence in deer mice, the primary reservoir for SNV, was 8.6% (Table 1.1). At least one deer mouse was SNV antibody-positive in 6 of 15 counties sampled in 2014 (Table 1.2). In the last 10 years, SNV antibody has been detected in deer mice from 28 of 42 counties sampled; prevalence in the 28 counties with seropositive mice ranged from 4.0% to 38.5% (average 12.0%) over that time period (Table 1.2).

Additionally in 2014, none of 12 woodrats (*Neotoma* spp.) tested positive for SNV antibody. Four (11.8%) of 34 harvest mice (*Reithrodontomys megalotis*) and 3 (33.3%) of 9 voles (*Microtus* spp.) demonstrated reactivity to SNV (Table 1.1). 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 reacts to the Sin Nombre assay. These other hantaviruses have not been shown to be pathogenic to humans.

Lassen Volcanic National Park hantavirus prevention

In May of 2014, the National Park Service, Pacific West Region and PHFE entered into a master agreement that allows other park units within California to obtain vector-borne disease related services from PHFE and CDPH. A task agreement

Table 1.1 Serologic evidence of hantavirus (Sin Nombre) infection in California rodents, 2005 - 2014

		2014			2005-2014		
Species	Common name	No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
Peromyscus boylii	brush mouse	77	0		1,542	39	2.5
Peromyscus californicus	parasitic mouse	126	1	0.8	1,221	17	1.4
Peromyscus crinitus	canyon mouse				92	1	1.1
Peromyscus eremicus	cactus mouse	4	0		2,266	81	3.6
Peromyscus e. fraterculus	northern Baja mouse	184	3	1.6	854	10	1.2
Peromyscus maniculatus	deer mouse	360	31	8.6	5,888	708	12.0
Peromyscus truei	piñon mouse	29	2	6.9	286	8	2.8
Peromyscus sp.	unspeciated *Peromyscus*				5	0	
Peromyscus spp. subtotal		780	37	4.7	12,154	864	7.1
Reithrodontomys megalotis	western harvest mouse	34	4	11.8	844	71	8.4
Neotoma spp.	woodrats	12	0		557	16	2.9
Microtus spp.	voles	9	3	33.3	216	31	14.4

with Lassen Volcanic National Park was initiated in August 2014 for services that included facility inspections for rodent-borne disease risk, technical assistance for rodent exclusion issues, and deer mouse trapping for Sin Nombre virus (SNV) surveillance. A total of 32 structures were evaluated for vector-borne disease and rodent exclusion issues. Thirteen (23.2%) of 56 deer mice tested were seropositive for SNV antibodies.

Table 1.2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus* in California, 2005-2014

	2014			2005-2014		
County	No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
Alameda	5	0	0.0	130	0	
Alpine				7	1	14.3
Amador	4	0	0.0	4	0	
Butte				13	5	38.5
Calaveras				2	0	
Colusa				2	0	
Contra Costa				24	2	8.3
El Dorado				656	138	21.0
Fresno				8	0	
Glenn				5	0	
Inyo				31	5	16.1
Kern				6	1	16.6
Lassen				338	42	12.4
Los Angeles	7	0	0.0	8	0	
Madera				42	10	23.8
Marin				18	1	5.6
Mariposa	20	0	0.0	112	11	9.8
Modoc				23	7	30.4
Mono				685	195	28.5
Monterey				20	1	5.0
Napa				18	2	11.1
Nevada				5	0	
Orange				914	66	7.2
Placer	8	0	0.0	99	4	4.0
Plumas				34	7	20.6
Riverside	4	0	0.0	652	65	10.0
San Benito				5	0	
San Bernardino	51	0	0.0	347	16	4.6
San Diego	74	1	1.4	1,101	49	4.5
San Francisco				13	0	
San Luis Obispo				2	0	
San Mateo	26	8	30.8	58	10	17.2
Santa Barbara				58	12	20.7
Santa Clara				10	0	
Santa Cruz				14	0	
Shasta	25	7	28.0	60	11	18.3
Sierra	11	0	0.0	58	8	13.8
Siskiyou				48	8	16.7
Tehama	53	6	11.3	53	6	11.3
Tulare	4	0	0.0	8	0	
Tuolumne	65	8	12.3	188	22	11.7
Ventura	3	1	33.3	9	3	33.3
Total	**360**	**31**	**8.6**	**5,888**	**708**	**12.0**

2 Flea-borne Diseases

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

Human disease surveillance

Typhus

Sixty-nine cases of typhus fever were reported to the California Department of Public Health (CDPH) in 2014. Fifty-two of these were classified as confirmed cases according to CDPH working surveillance definition and seventeen were probable. Sixty-three (91%) of the case-patients required hospitalization. Case-patients were residents of Los Angeles (49), Orange (18), Contra Costa (1), and Ventura (1) counties. Typhus is considered endemic in parts of Orange and Los Angeles counties. The case-patient from Contra Costa County reported travel outside the United States during the incubation period.

Plague

No cases of plague in humans were reported in 2014.

Animal disease surveillance

Domestic pets

No cases of plague in domestic pets were reported in 2014.

Wild animals

The CDPH-Vector-Borne Disease Section (VBDS) plague surveillance program received test results for 580 wild rodents and 198 carnivores from 33 California counties in 2014. Two rodents and seven carnivores from six counties tested positive for serum antibodies to *Yersinia pestis*. San Diego County Department of Environmental Health, Vector Control Program (SDCEH) reported an additional 454 rodents with 10 positive ground squirrels from the Mount Palomar Observatory area (Figure 2.1, Table 2.1).

The rodent species tested for plague antibodies in 2014 included: 670 California ground squirrels (*Otospermophilus beecheyi*), 236 chipmunks (*Tamias* spp.), 76 mice (*Peromyscus* spp., *Microtus* spp. and *Mus musculus*), 32 golden-mantled ground squirrels (*Callospermophilus lateralis*), 9 Belding's ground squirrels (*Urocitellus beldingi*), 6 wood rats (*Neotoma* spp.), 3 Douglas pine squirrels (*Tamiasciurus douglasii*), 1 western gray squirrel (*Sciurus griseus*), and 1 northern flying squirrel (*Glaucomys sabrinus*).

Plague positive rodents included two chipmunks from El Dorado County and ten California ground squirrels (tested by SDCEH) from Mount Palomar State Park or from Fry Creek campground, Cleveland National Forest (Table 2.1).

A total of 198 carnivores were tested by CDPH-VBDS for plague antibodies including: 147 coyotes (*Canis latrans*), 29 black bears (*Ursus americanus*), 3 bobcats (*Lynx rufus*), 6 mountain lions (*Felis concolor*), 4 raccoons (*Procyon lotor*), 8 gray foxes (*Urocyon cinereoargenteus*), and 1 striped skunk (*Mephitis mephitis*). Positive coyotes were detected in Modoc (2), Plumas (2), Santa Barbara, and Sierra counties. A positive black bear was detected in Mariposa County. Additionally, eight feral pigs from five counties tested negative (data not shown).

Wild Rodent Flea Testing

Fleas were collected from 20 rodents at Boca Reservoir Campground, an area where plague

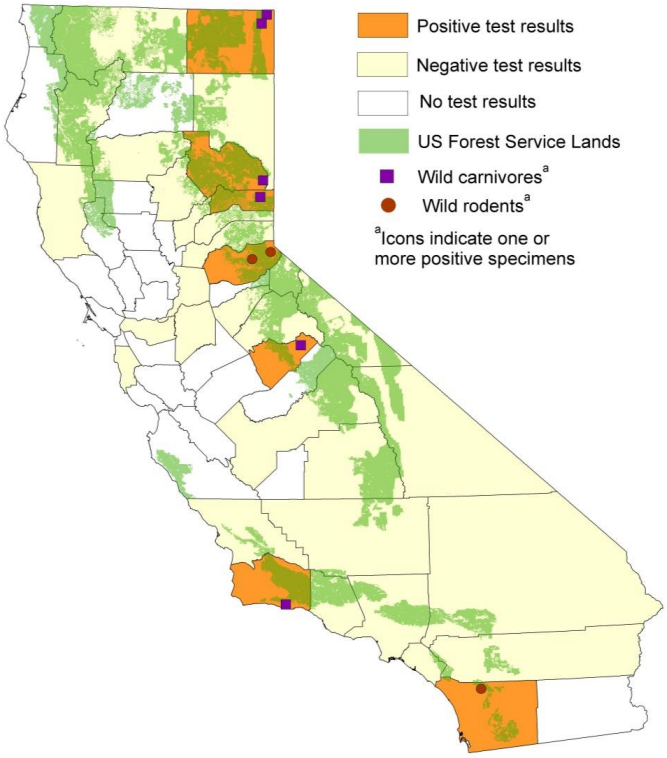

Figure 2.1. Results of serum antibodies to *Yersinia pestis* in in tested mammals by counties, California 2014

activity was observed in 2013, and from 27 rodents from Logger Campground at Stampede Reservoir within the Tahoe National Forest. A total of 228 fleas were identified to species, pooled into five pools from Boca Reservoir Campground, and seven pools from Logger Campground, and tested for the presence of *Y. pestis* bacteria. All flea-pools were negative. None of the rodent hosts tested positive for plague antibody.

Table 2.1. CDPH-VBDS plague surveillance program testing results in wild rodents and carnivores by location, California 2014

County Location	No. rodents tested	No. carnivores tested	Postive Specimens Species	 Titer	 Month
Alpine	3	0			
Butte	0	4			
Calaveras	0	8			
Contra Costa	0	4			
El Dorado	70	17			
LTBMU, Fallen Leaf CG			Chipmunk, S	1:128	September
Eldorado NF, Northwind CG			Chipmunk, LP	1:64	July
Fresno	0	5			
Inyo	27	0			
Kern	9	44			
Lassen	0	7			
Los Angeles	15	2			
Mariposa	1	9			
Yosemite NP			Black Bear	1:32	July
Mendocino	0	25			
Modoc	0	12			
Fort Bidwell, 4 mi. SW			Coyote	1:32	January
Fort Bidwell, 3 mi. SE			Coyote	1:32	January
Mono	49	0			
Nevada	48	0			
Orange	7	0			
Placer	0	7			
Plumas	0	10			
Vinton, 2 mi. N			Coyote	1:32	January
Vinton, 2 mi. N			Coyote	1:32	January
Riverside	87	1			
Sacramento	0	1			
San Bernardino	60	0			
San Diego	454	3			
Mount Palomar SP, Doane School Camp			CaGSq	1:32	June
Mount Palomar SP, Doane School Camp			CaGSq	1:512	June
Mount Palomar SP, Cedar Grove Group Camp			CaGSq	1:256	July
Mount Palomar SP, Cedar Grove Group Camp			CaGSq	1:32	July
Mount Palomar SP, Doane CG			CaGSq	1:256	July
Mount Palomar SP, Doane CG			CaGSq	1:2048	July
Mount Palomar SP, Doane School Camp			CaGSq	1:32	July
Mount Palomar SP, Doane School Camp			CaGSq	1:32	July
Cleveland NF, Fry Creek CG			CaGSq	1:128	July
Mount Palomar SP, Doane CG			CaGSq	1:512	September
San Joaquin	0	1			
San Luis Obispo	0	2			
San Mateo	31	0			
Santa Barbara	8	3			
Goleta			Coyote	1:32	January
Sierra	77	4			
Loyalton, 4 mi. S			Coyote	1:32	January
Siskiyou	0	21			
Tehama	9	0			
Trinity	0	1			
Tulare	12	0			
Tuolumne	52	7			
Ventura	13	0			
Yuba	1	0			
Total	1,034	198			

Abbreviations: Chipmunk, S: Shadow chipmunk
Chipmunk, LP: Lodge-pole chipmunk
CaGSq: California ground squirrel
NF: National Forest
NP: National Park
SP: State Park

3 Tick-borne Diseases

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

Human disease surveillance

Anaplasmosis

Four cases of anaplasmosis caused by *Anaplasma phagocytophilum* were reported to the California Department of Public Health (CDPH): one met national surveillance criteria for a confirmed case; the other three met the criteria for a probable case. Case-patients were residents of Humboldt, Mariposa, Santa Clara, and Santa Cruz counties. Mean age was 47 years (range, 22-73 years) and two (50%) were male. Potential exposure to ticks in California was documented for two of the probable case-patients who hiked or worked in Santa Cruz or Mariposa counties. The confirmed case-patient reported tick exposure while in New York, and exposure was not documented for one probable case-patient.

Babesiosis

Two cases of babesiosis caused by *Babesia microti* were reported to CDPH; both met national surveillance criteria for a confirmed case. Ages of case-patients were 51 and 74 years old, and both were female. Both case-patients reported travel to and outdoor activity in the eastern United States seaboard or upper Midwest where *B. microti* is endemic.

Ehrlichiosis

One case of ehrlichiosis caused by *Ehrlichia chaffeensis* was reported to CDPH. The case met the national surveillance criteria for a probable case. The case-patient resided in San Francisco County and reported travel history to Rhode Island where *E. chaffeensis* is endemic.

Lyme disease

A total of 112 cases of Lyme disease, caused by *Borrelia burgdorferi*, with illness onset in 2014 were reported to CDPH; 82 of these met the surveillance case definition criteria for a confirmed case, and 30 were probable (Figure 3.1). Of the 82 confirmed cases, case-patients were residents of 22 counties, with Los Angeles County reporting the largest number of cases (14) (Table 3.1). Of 38 (46%) confirmed case-patients reporting travel history within the incubation period, 28 (74%) reported exposure outside California, most commonly in the northeastern United States. The median age of confirmed Lyme disease case-patients was 43 years (range, 4 to 82 years) and 46 (56%) were female. Of 53 case-patients for whom race was reported, 49 self-identified as white, 2 as Asian, 1 as American Indian or Alaska Native, and 1 as other. Erythema migrans (EM) was identified in 46 (63%) case-patients, 32 (69%) of whom had onset of EM noted between May and September.

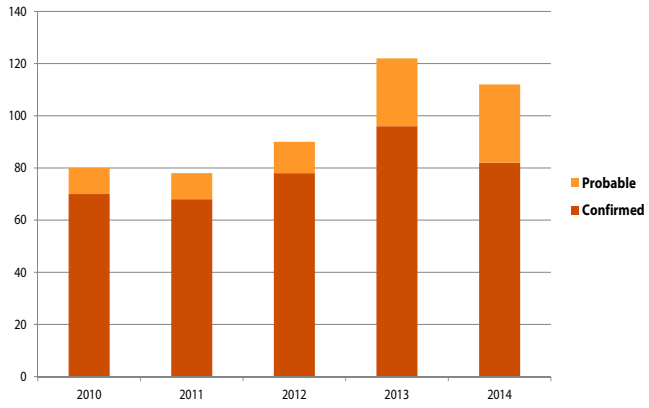

Figure 3.1. Confirmed and probable Lyme disease cases by report year 2010 - 2014

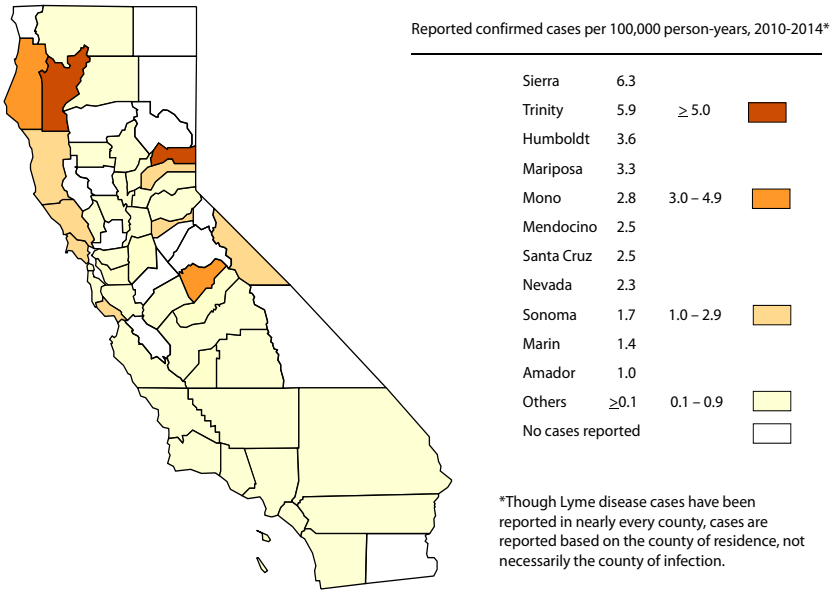

Figure 3.2. Incidence of confirmed Lyme disease, by county, California, 2010 - 2014

Between 2010 and 2014, the highest incidence of Lyme disease was in the northwest and northern counties with western-facing Sierra slopes (Figure 3.2).

Spotted fever group rickettsiosis

Nine cases of Rocky Mountain spotted fever (RMSF), caused by *Rickettsia rickettsii*, were reported to CDPH in 2014; three met the national surveillance case definition for confirmed, and six met the surveillance criteria for probable. The three confirmed case-patients were residents of Imperial (2) and Riverside counties. The case-patients' ages were 39, 52, and 79: two were female and two died. Infection with *R. rickettsii* was confirmed in the three case-patients with a four-fold antibody titer increase between acute and convalescent sera tested at the CDPH Viral and Rickettsial Disease Laboratory (CDPH-VRDL). The case-patients, had either travelled to Mexicali, Mexico or were in close contact with household members and pets that had travelled to Mexicali, Mexico during the incubation period.

One case of spotted fever group *Rickettsia* confirmed as *Rickettsia philipii* (formerly 364D) was reported to CDPH in 2014. Confirmation was by polymerase chain reaction (PCR) and sequencing by CDPH-VRDL of specimens from a cutaneous ulcer (eschar). Presumed exposure was in Lake County; illness onset was in early May. The case-patient did not recall a tick bite.

Tick-borne relapsing fever

Eleven cases of tick-borne relapsing fever (TBRF), caused by *Borrelia hermsii*, were reported to CDPH in 2014; seven of these met CDPH working surveillance case definition criteria for a confirmed case, two were probable, and two were suspect. Median age of confirmed case-patients was 44 years (range, 4 to 59 years), and four (57%) were male. Confirmed case-patients were residents of four counties: Kings, Mono (3), Orange (2), and Sacramento. Counties where case-patients (confirmed, probable, and suspect) were likely exposed in the three weeks prior to illness onset included Alpine, Fresno, Mono, San Bernardino, and Tulare.

Tick surveillance

Anaplasma phagocytophilum

In 2014, CDPH Vector-Borne Disease Section (CDPH-VBDS), in collaboration with Marin/Sonoma Mosquito Vector Control District, collected 45 adult, 17 nymphal, and 261 larval western blacklegged ticks (*Ixodes pacificus*)

Table 3.1: Reported confirmed Lyme disease cases by county of residence and onset year, California, 2010-2014

County	2010	2011	2012	2013	2014	TOTAL	Incidence per 100,000 person years
Alameda	1	3	4	0	1	9	0.12
Alpine	0	0	0	0	0	0	0.00
Amador	1	0	0	1	0	2	1.08
Butte	0	1	0	0	1	2	0.18
Calaveras	0	0	0	0	0	0	0.00
Colusa	0	0	0	0	0	0	0.00
Contra Costa	1	1	2	7	2	13	0.24
Del Norte	0	0	0	0	0	0	0.00
El Dorado	2	0	2	0	1	5	0.55
Fresno	1	1	4	1	0	7	0.15
Glenn	0	0	0	0	1	1	0.71
Humboldt	9	6	2	2	5	24	3.56
Imperial	0	0	0	0	0	0	0.00
Inyo	0	0	0	0	0	0	0.00
Kern	2	0	0	0	0	2	0.05
Kings	0	0	0	1	0	1	0.13
Lake	0	0	0	0	0	0	0.00
Lassen	0	0	0	0	0	0	0.00
Los Angeles	5	2	6	9	14	36	0.07
Madera	0	1	0	0	0	1	0.13
Marin	3	1	3	5	6	18	1.42
Mariposa	0	0	1	1	1	3	3.34
Mendocino	3	3	3	1	1	11	2.50
Merced	0	1	0	0	0	1	0.08
Modoc	0	0	0	0	0	0	0.00
Mono	1	0	0	1	0	2	2.78
Monterey	1	1	1	1	0	4	0.19
Napa	0	0	2	0	1	3	0.44
Nevada	3	5	3	0	0	11	2.26
Orange	5	6	0	0	0	11	0.07
Placer	0	0	3	1	0	4	0.23
Plumas	0	0	0	0	0	0	0.00
Riverside	0	3	1	2	1	7	0.06
Sacramento	0	1	1	0	0	2	0.02
San Benito	0	0	0	0	0	0	0.00
San Bernardino	0	1	1	1	0	3	0.03
San Diego	6	5	7	11	9	38	0.24
San Francisco	2	1	0	5	1	9	0.22
San Joaquin	0	0	0	1	1	2	0.06
San Luis Obispo	0	0	1	4	3	8	0.59
San Mateo	3	0	0	3	6	12	0.33
Santa Barbara	3	3	0	5	0	11	0.52
Santa Clara	6	10	4	7	3	30	0.33
Santa Cruz	8	10	4	4	7	33	2.49
Shasta	1	1	1	0	0	3	0.34
Sierra	0	0	0	1	0	1	6.29
Siskiyou	0	0	1	1	0	2	0.89
Solano	0	0	0	0	0	0	0.00
Sonoma	6	4	9	11	11	41	1.68
Stanislaus	0	0	0	0	0	0	0.00
Sutter	0	0	0	0	1	1	0.21
Tehama	0	0	0	0	0	0	0.00
Trinity	0	2	0	1	1	4	5.94
Tulare	0	0	1	0	0	1	0.04
Tuolumne	0	0	0	0	0	0	0.00
Ventura	1	0	1	3	0	5	0.12
Yolo	0	0	1	1	0	2	0.20
Yuba	0	0	2	0	0	2	0.55
California	**71**	**68**	**78**	**96**	**82**	**395**	**0.21**

from Marin County to test for the presence of *Anaplasma phagocytophilum*. Two (4.4%) adult western blacklegged ticks and two (11.8%) nymphs tested positive by real-time polymerase chain reaction (RT-PCR) at CDPH-VRDL. One nymphal western blacklegged tick was coinfected with *A. phagocytophilum* and *Borrelia burgdorferi*.

Borrelia spirochetes

Borrelia burgdorferi sensu lato

In 2014, local, state, and federal agencies collected 10,816 adult and 721 nymphal western blacklegged ticks from 25 counties to test for *B. burgdorferi*, the agent of Lyme disease. Collection and testing data for western blacklegged ticks are collated by CDPH-VBDS. Ticks were tested individually either by RT-PCR only or by direct fluorescent antibody (DFA) followed by RT-PCR (Table 3.2). From the 22 counties where ticks were tested individually, the overall prevalence of *B. burgdorferi* was 2.2% in adult ticks and 2.4% in nymphal ticks (Table 3.2). Ticks tested by local vector control agencies in pools were tested by RT-PCR (Table 3.3). In the five counties where adult ticks were tested in pools, the minimum infection prevalence (MIP -the number of positive pools divided by total ticks tested multiplied by 100) was 1.3% (Table 3.3).

Borrelia miyamotoi

In 2014, of the western blacklegged ticks collected, 7,251 adult and 721 nymphal ticks were tested for *B. miyamotoi*, a relapsing fever-type spirochete implicated in human disease in the eastern United States and Europe. Of the 2,265 individually tested ticks, 26 (1.1%) of the adults tested positive and 8 (1.1%) of the nymphs tested positive (Table 3.2). Of the 4,986 ticks tested in pools, 32 (0.6% MIP) tested positive (Table 3.3).

Rickettsia philipii

In 2014, CDPH-VBDS collected 268 adult, 17 nymphal, and 65 larval Pacific Coast ticks (*Dermacentor occidentalis*) from Alameda, Amador, Butte, Calaveras, Lake, Monterey, Nevada, San Joaquin, Santa Barbara, Shasta, and Sonoma counties for *Rickettsia philipii* testing. Other tick species tested included five adult American dog ticks (*Dermacentor variabilis*). Tick collections were often conducted in collaboration with the local vector control agency. All ticks were tested by RT-PCR at CDPH-VRDL. One adult Pacific Coast tick from the Los Padres National Forest, Santa Barbara County, tested positive for *R. philipii*. CDPH-VBDS, in collaboration with Lake County Vector Control District, conducted tick surveillance for *R. philipii* in response to a reported human case from Lake County. One *D. occidentalis* nymph was collected and tested negative.

Rickettsia rickettsii

In 2014, CDPH-VBDS conducted surveillance for *Rickettsia rickettsii*, the agent of Rocky Mountain spotted fever, in response to a reported human case from Imperial County. Ninety-nine adult and one nymphal brown dog tick (*Rhipicephalus sanguineus*) were collected and tested from Imperial County. One adult male brown dog tick tested positive for *R. rickettsii* by RT-PCR at CDPH-VRDL.

Francisella tularensis

In 2014, CDPH-VBDS, in collaboration with Napa County Mosquito Abatement District, conducted tick surveillance for *Francisella tularensis*, the agent of tularemia. Ticks collected from Napa County were from areas where potential tick exposure and previous human cases had been reported. Ticks were tested at the San Diego County Department of Environmental Health, Vector Control Laboratory by RT-PCR. Tested ticks included: 300 adult American dog ticks, and 3 adult Pacific Coast ticks. Two male American dog ticks tested positive for *F. tularensis*, type B.

Table 3.2. Infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* spirochetes in *Ixodes pacificus* ticks, California 2014

	No. Ticks Tested		Positive *B. burgdorferi*		Positive *B. miyamotoi*		
County Location	Adults	Nymphs	Adults (IP)[a]	Nymphs (IP)	Adults (IP)	Nymphs (IP)	Collected by
Amador							
Indian Grinding Rock SP	117	22	1 (0.9)			1 (4.6)	CDPH, VBDS
Tiger Creek Afterbay		4					CDPH, VBDS
Butte							
Bidwell Park	99		2 (2.0)				Butte MVCD
Lime Saddle Trail	18						Butte MVCD
Loafer Creek SRA	135	148	5 (3.7)		4 (3.0)		Butte MVCD
Oroville Wildlife Area	10						CDPH, VBDS
Calaveras							
Mokelumne Coast	63	12	1 (1.6)		1 (1.6)		CDPH, VBDS
Natural Bridge Park Trail	70		1 (1.4)		1 (1.4)		CDPH, VBDS
Contra Costa							
Crockett	16						CDPH, VBDS
Tilden RP		28					CDPH, VBDS
El Dorado							
Folsom SRA		29		3 (10.3)		1 (3.5)	CDPH, VBDS
Los Angeles							
Griffith Park	19	7					CDPH, VBDS
Marin							
China Camp SP	16	63		2 (3.2)		1 (1.6)	M/S MVCD; CDPH, VBDS
Marin Municipal Water District	49	21	1 (2.0)	4 (19.1)	1 (2.0)	1 (4.8)	M/S MVCD; CDPH, VBDS
Mount Tamalpais SP	13						M/S MVCD
Olompali SP	5	2					M/S MVCD
Point Reyes National Seashore	84	2		1 (50.0)			CDPH, VBDS
Mariposa							
Mariposa Reservoir	34	8					CDPH, VBDS
Monterey							
Garrapata SP	1	2					CDPH, VBDS
Limekiln SP	2						CDPH, VBDS
Los Padres NF		5					CDPH, VBDS
Pfeiffer Big Sur SP	3	27					CDPH, VBDS
Napa							
Bothe-Napa Valley SP	107		1 (0.9)		4 (3.7)		Napa MAD; CDPH, VBDS
Nevada							
Empire Mines SP	118	1	1 (0.9)		4 (3.4)		CDPH, VBDS
Englebright Lake	54		1 (1.9)				CDPH, VBDS
Grass Valley	24						CDPH, VBDS
Nevada County	122	2					CDPH, VBDS
South Yuba River SP	119		4 (3.4)				CDPH, VBDS
Sacramento							
American River Parkway	3	90		5 (5.6)			CDPH, VBDS
San Bernardino							
San Bernardino NF	55						CDPH, VBDS
San Joaquin							
Carnegie SRA	13	3					CDPH, VBDS
San Mateo							
Crystal Springs Reservoir	54						CDPH, VBDS
Rancho Corral de Tierra NP	1	2					CDPH, VBDS
Thornewood OPS		16					CDPH, VBDS
Santa Barbara							
Los Padres NF	70		1 (1.4)				CDPH, VBDS
Santa Cruz							
Quail Hollow		28					Santa Cruz MVCD
Skylark Camp		12					Santa Cruz MVCD
Shasta							
Adobe Rd	2						Shasta MVCD
Anderson River Park	23	7	5 (21.7)				Shasta MVCD; CDPH, VBDS
Benton Ranch	9		4 (44.4)				Shasta MVCD
Darrah Springs	4		1 (25.0)				Shasta MVCD
French Gulch	1						Shasta MVCD
Hirz Bay	35		3 (8.6)		1 (2.9)		Shasta MVCD
Horsetown	4						Shasta MVCD
Kapusta	1						Shasta MVCD
Keswick Dam Area	33						Shasta MVCD
Middle Creek	20		1 (5.0)				Shasta MVCD
Nora Lake	5						Shasta MVCD
Rhonda Rd, Anderson	16	6					Shasta MVCD; CDPH, VBDS
Shasta College	8						Shasta MVCD
Shasta Lake		10					CDPH, VBDS
Shasta Trinity NF	174		10 (5.8)		4 (2.3)		Shasta MVCD
Sulfur Creek Canyon	38						Shasta MVCD
Toyon	16		2 (12.5)		1 (6.3)		Shasta MVCD
Whiskeytown NRA	1	3					Shasta MVCD
Sonoma							
Annadel SP	22	7					M/S MVCD
Crane Creek RP	7						M/S MVCD
Foothill RP	16	5			2 (12.5)		M/S MVCD
Helen Putnam RP	1						M/S MVCD
Jack London SP	2						M/S MVCD
Shiloh Ranch RP	9	3					M/S MVCD
Sonoma Valley RP	7						M/S MVCD
Spring Lake RP	4						M/S MVCD
Sugarloaf Ridge SP	4	145		2 (1.4)		4 (2.8)	M/S MVCD
Stanislaus							
Patterson	49						CDPH, VBDS
Tuolumne							
Columbia SP	24				1 (4.2)		CDPH, VBDS
Yuba							
Tahoe NF	236	1	5 (2.1)		2 (0.9)		CDPH, VBDS
Total	**2,265**	**721**	**50 (2.2)**	**17 (2.4)**	**26 (1.1)**	**8 (1.1)**	

Table Legend

All tick testing is performed at the California Department of Public Health Vector-Borne Disease Section in a two-step process. Step 1 is a direct fluorescent antibody test (DFA) for the genus *Borrelia*; if DFA is positive, then followed by step 2, a mulitplex Real-Time Polymerase Chain Reaction (RT-PCR) for *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi*.

Abbreviations:

[a]IP - Infection Prevalence = number of positive ticks divided by ticks tested multiplied by 100.

Location:

NF, National Forest
NP, National Park
NRA, National Recreation Area
SRA, State Recreation Area
SP, State Park
RP, Regional Park
OSP, Open Space Preserve

Collected by:

CDPH-VBDS, California Department of Public Health, Vector-Borne Disease Section
MAD, Mosquito Abatement District
M/S MVCD, Marin/Sonoma Mosquito and Vector Control District
MVCD, Mosquito and Vector Control District.

Table 3.3. Minimum infection prevalence of *Borrelia burgdorferi* sensu lato and *Borrelia miyamotoi* in *Ixodes pacificus* ticks, California 2014

County Location	Adults (pools)	Positive *B. burgdorferi* Pools (MIP)[b]	Positive *B. miyamotoi* Pools (MIP)[b]	Collected by	Laboratory
Placer [a]					
Auburn	10 (4)	1 (10.0)		Placer MVCD	Placer MVCD
Auburn SRA	390 (83)	10 (2.6)		Placer MVCD	Placer MVCD
Folsom Lake SRA	167 (35)	3 (1.8)		Placer MVCD	Placer MVCD
Hiddlen Falls RP	51 (11)	0		Placer MVCD	Placer MVCD
Placer Nature Center	60 (14)	1 (1.7)		Placer MVCD	Placer MVCD
Steven's Trail	49 (11)	3 (6.1)		Placer MVCD	Placer MVCD
Sugar Pine Point Trail, Tahoe NF	158 (93)	6 (3.8)		Placer MVCD	Placer MVCD
Sacramento [a]					
Ancil Hoffman Park	33 (12)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
East Lake Natoma Trail	474 (96)	1 (0.2)		Sac/Yolo MVCD	Sac/Yolo MVCD
Folsom	39 (11)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
Gold Lake Drive	45 (12)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
Mississippi Bar	382 (81)	10 (2.6)		Sac/Yolo MVCD	Sac/Yolo MVCD
Negro Bar SP	437 (89)	19 (4.4)		Sac/Yolo MVCD	Sac/Yolo MVCD
Nimbus Dam Overlook	162 (33)	4 (2.5)		Sac/Yolo MVCD	Sac/Yolo MVCD
Snipes Pershing Park	716 (143)	7 (1.0)		Sac/Yolo MVCD	Sac/Yolo MVCD
Willow Creek	207 (45)	9 (4.4)		Sac/Yolo MVCD	Sac/Yolo MVCD
Santa Clara					
Almaden Quicksilver County Park	209 (108)	0	3 (1.4)	Santa Clara MVCD	Santa Clara MVCD
Alum Rock Park	198 (101)	1 (0.5)	1 (0.5)	Santa Clara MVCD	Santa Clara MVCD
Calero County Park	194 (98)	1 (0.5)	2 (1.0)	Santa Clara MVCD	Santa Clara MVCD
Foothills Park	244 (124)	2 (0.8)	2 (0.8)	Santa Clara MVCD	Santa Clara MVCD
Henry W. Coe SP	261 (134)	1 (0.4)	2 (0.8)	Santa Clara MVCD	Santa Clara MVCD
Lexington Dam	217 (112)	0	2 (0.9)	Santa Clara MVCD	Santa Clara MVCD
Mount Madonna County Park	227 (120)	0	2 (0.9)	Santa Clara MVCD	Santa Clara MVCD
Rancho San Antonio OSP	246 (127)	0	2 (0.8)	Santa Clara MVCD	Santa Clara MVCD
Santa Teresa County Park	198 (102)	0	0	Santa Clara MVCD	Santa Clara MVCD
Sierra Azul OSP	90 (47)	0	0	Santa Clara MVCD	Santa Clara MVCD
Steven Creek County Park	251 (133)	2 (0.8)	2 (0.8)	Santa Clara MVCD	Santa Clara MVCD
Uvas Canyon County Park	203 (103)	1 (0.5)	2 (1.0)	Santa Clara MVCD	Santa Clara MVCD
San Mateo					
Año Nuevo SP	151 (33)	0	0	San Mateo MVCD	San Mateo MVCD
Big Canyon Park	184 (38)	1 (0.5)	0	San Mateo MVCD	San Mateo MVCD
Laurelwood Park	154 (33)	1 (0.7)	1 (0.7)	San Mateo MVCD	San Mateo MVCD
Los Trancos OSP	238 (69)	5 (2.1)	1 (0.4)	San Mateo MVCD	San Mateo MVCD
Mills Canyon Wildlife Refuge	65 (16)	1 (1.5)	0	San Mateo MVCD	San Mateo MVCD
Pulgas Ridge OSP	220 (45)	0	1 (0.5)	San Mateo MVCD	San Mateo MVCD
Thornewood OSP	169 (34)	1 (0.6)	3 (1.8)	San Mateo MVCD	San Mateo MVCD
Waterdog Lake Park	495 (106)	7 (1.4)	2 (0.4)	San Mateo MVCD	San Mateo MVCD
Windy Hill OSP	296 (60)	2 (0.7)	2 (0.7)	San Mateo MVCD	San Mateo MVCD
Wunderlich County Park	476 (99)	6 (1.3)	2 (0.4)	San Mateo MVCD	San Mateo MVCD
Yolo [a]					
Cache Creek CG	19 (4)	0		Sac/Yolo MVCD	Sac/Yolo MVCD
Cache Creek, Blue Ridge Trail	166 (36)	1 (0.6)		Sac/Yolo MVCD	Sac/Yolo MVCD
Total	**8,551 (2,655)**	**107 (1.3)**	**32 (0.6)** [c]		

[a] Tested by polymerase chain reaction

[b] MIP - Measure of prevalence. MIP (minimum infection prevalence) is

[c] 4,986 adult ticks tested for *Borrelia miyamotoi*

Abbreviations:

Location: CG, Campground; NF, OSP, Open Space

Laboratory: MVCD, Mosquito and Vector Control District

4 Mosquito-borne Diseases

Mosquito-borne diseases under surveillance in California include the endemic arboviral diseases caused by West Nile virus, western equine encephalitis virus, and St. Louis encephalitis virus, as well as the travel-associated diseases caused by *Plasmodium* spp. (malaria), dengue, and chikungunya 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 Viral and Rickettsial Disease Laboratory (CDPH-VRDL), 19 local county public health laboratories, 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 CDPH-VRDL for further testing with a plaque reduction neutralization test (PRNT) or reverse transcriptase-polymerase chain reaction (RT-PCR). Additional WNV infections were identified through testing performed at blood donation centers.

In 2014, a total of 801 symptomatic and 91 asymptomatic infections with WNV were identified, a 106% increase in infections compared to 2013 (Table 4.1). Of the 801 clinical cases, 561 (70%) were classified as West Nile neuroinvasive disease (i.e., encephalitis, meningitis, or acute flaccid paralysis) and 240 (30%) were classified as non-neuroinvasive disease. Case-patients were residents of 31 counties and 520 (65%) were male. Incidence was highest (35.3 cases per 100,000 persons) in Glenn County (Table 4.1, Figure 4.1). The median age for West Nile fever cases was 59 years (range, 5 to 89 years) and neuroinvasive cases was 59 years (range, 3 months to 94 years). The median age of the 31 WNV-associated fatalities was 74 years (range, 20 to 94 years). Dates of symptom onset ranged from March 14 to November 30, 2014.

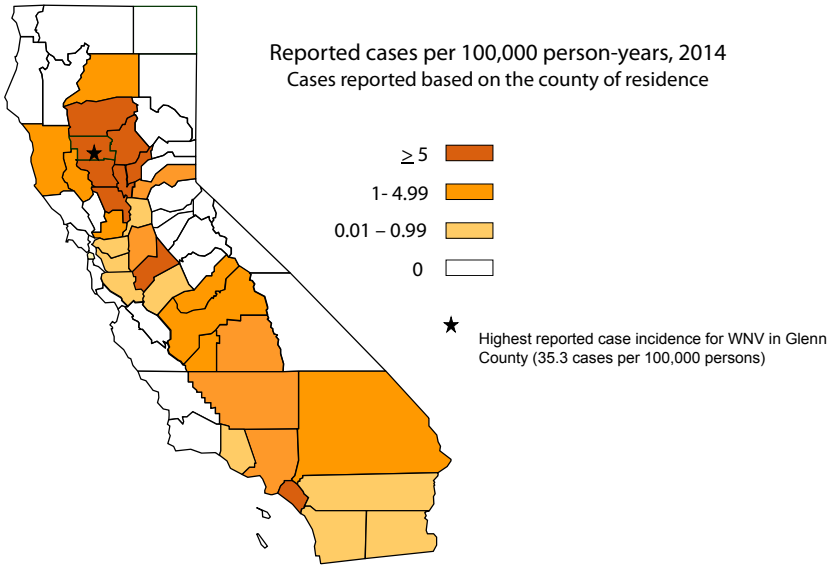

Figure 4.1. Incidence of reported human cases of West Nile virus, by county, California 2014

No cases of western equine encephalitis virus (WEEV) or St. Louis encephalitis virus (SLEV) infection were identified in California residents in 2014.

Malaria

Ninety-two confirmed cases of malaria were reported to CDPH in 2014. Case-patients were residents of 27 California counties and 59 (64%) were male. The median

Table 4.1. Reported WNV human cases by county of residence, California, 2005-2014

County	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2014 incidence per 100,000 person-years	10 year incidence per 100,000 person-years
Alameda	1	1	0	1	0	1	0	2	0	1	0.06	0.04
Alpine	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Amador	3	0	0	0	0	0	1	0	0	0	0.00	1.11
Butte	24	31	16	6	2	1	3	10	24	24	10.80	6.34
Calaveras	2	0	0	1	0	0	0	0	0	0	0.00	0.67
Colusa	2	4	2	1	0	0	0	3	2	3	13.85	7.85
Contra Costa	11	8	3	4	5	4	3	4	5	5	0.46	0.48
Del Norte	0	0	0	0	0	0	0	0	0	0	0.00	0.00
El Dorado	1	2	0	1	1	0	1	0	1	0	0.00	0.38
Fresno	59	11	17	3	13	23	9	24	8	43	4.46	2.18
Glenn	13	12	7	1	0	2	1	7	9	10	35.27	21.87
Humboldt	1	0	0	0	0	0	0	0	0	0	0.00	0.07
Imperial	1	1	3	0	0	0	0	1	0	1	0.55	0.39
Inyo	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Kern	67	49	140	2	18	15	18	25	25	11	1.26	4.24
Kings	32	1	7	2	3	1	1	3	1	4	2.66	3.66
Lake	0	2	0	0	0	0	0	1	0	1	1.55	0.62
Lassen	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Los Angeles	40	13	36	156	20	4	58	163	151	253	2.52	0.89
Madera	18	0	2	0	1	7	2	3	3	3	1.95	2.53
Marin	0	1	0	0	0	0	0	0	2	0	0.00	0.12
Mariposa	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Mendocino	0	0	2	0	0	0	0	0	0	1	1.12	0.34
Merced	25	4	4	1	4	1	1	13	0	1	0.38	2.04
Modoc	0	2	0	0	0	0	0	0	0	0	0.00	2.17
Mono	0	1	0	0	0	0	0	0	0	0	0.00	0.71
Monterey	0	0	0	0	1	0	0	1	0	0	0.00	0.05
Napa	0	1	1	0	0	0	0	0	1	0	0.00	0.22
Nevada	4	1	0	0	0	0	0	0	0	0	0.00	0.51
Orange	17	6	9	71	4	1	10	42	10	263	8.45	1.39
Placer	35	8	4	6	0	3	1	12	6	7	1.91	2.24
Plumas	1	0	0	0	0	0	0	0	0	0	0.00	0.52
Riverside	103	4	17	62	3	0	7	19	35	14	0.61	1.16
Sacramento	163	15	25	13	0	12	4	29	11	10	0.69	1.94
San Benito	0	0	0	0	0	0	0	0	0	0	0.00	0.00
San Bernardino	33	3	4	36	2	5	4	33	13	21	1.01	0.74
San Diego	1	1	15	35	4	0	0	1	0	11	0.34	0.21
San Francisco	2	0	0	0	0	1	0	1	1	0	0.00	0.06
San Joaquin	34	8	10	12	10	6	5	13	8	9	1.27	1.62
San Luis Obispo	0	1	0	0	0	0	0	0	0	0	0.00	0.04
San Mateo	1	0	0	0	0	0	0	0	0	0	0.00	0.01
Santa Barbara	2	0	0	1	0	0	1	0	1	0	0.00	0.12
Santa Clara	5	5	4	1	0	0	1	0	2	10	0.54	0.15
Santa Cruz	0	0	0	0	0	0	1	0	0	0	0.00	0.04
Shasta	1	4	9	1	0	0	0	1	1	2	1.11	1.06
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	5	8	1	1	0	0	0	2	1	5	1.18	0.54
Sonoma	1	0	1	0	0	0	0	0	0	0	0.00	0.04
Stanislaus	84	11	21	17	14	12	11	26	17	33	6.27	4.68
Sutter	9	12	3	0	0	0	0	8	10	8	8.36	5.22
Tehama	4	6	4	4	0	0	1	4	5	4	6.28	5.02
Trinity	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Tulare	56	6	10	5	4	12	11	7	5	21	4.57	2.98
Tuolumne	1	0	0	0	0	0	0	0	0	0	0.00	0.19
Ventura	1	3	1	0	0	0	0	7	2	1	0.12	0.18
Yolo	11	27	2	1	2	0	0	10	6	15	7.27	3.59
Yuba	6	5	0	0	1	0	3	4	13	6	8.14	5.16
Total WNV disease	**880**	**278**	**380**	**445**	**112**	**111**	**158**	**479**	**379**	**801**	**2.09**	**1.05**
Asymptomatic Infections[a]	55	14	29	53	17	20	18	48	54	91		
Total WNV infections	**935**	**292**	**409**	**498**	**129**	**131**	**176**	**527**	**433**	**892**	**2.33**	**1.15**

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

age was 28 years (range,1 to 76 years). Of 80 cases for which the *Plasmodium* species was determined, 50 were *P. falciparum*, 22 *P. vivax*, 5 *P. malariae*, and 3 *P. ovale*. Eighty-five patients reported compatible travel history to malaria-endemic areas including Africa (65), Asia (16), and South America (4). Exposure information for seven case patients was not available.

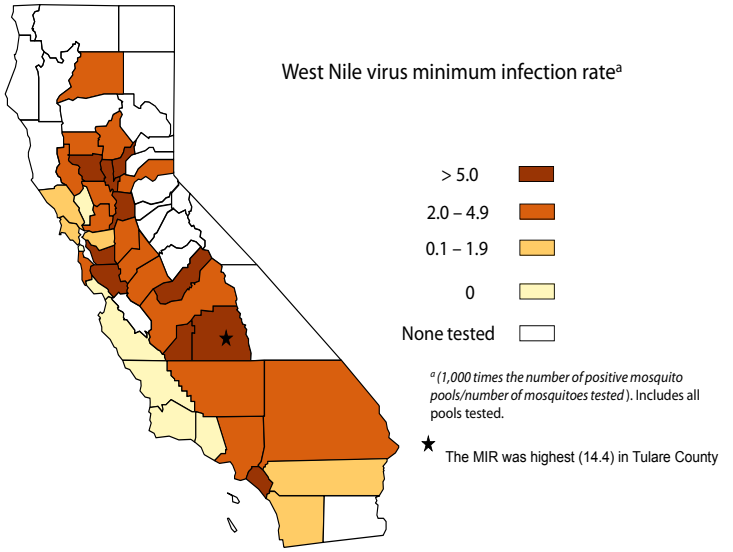

Figure 4.2. West Nile Virus minimum infection rate of *Culex* spp. mosquitoes, California, 2014

Dengue

One hundred thirty-three cases of dengue were reported to CDPH in 2014; 24 of these met the criteria for a confirmed case and109 were probable. Case-patients were residents of 21 California counties, 67 (50%) were female, and the median age was 45 years (range, 5 to 76 years). All case-patients reported travel to dengue-endemic areas including Mexico (34), Asia (34), Central America (29), India (21), the Caribbean (5), South America (7), and Africa (3). No locally acquired cases were reported.

Chikungunya

One hundred forty-one human cases of chikungunya were reported to CDPH in 2014; 70 of these met the criteria for a confirmed case and 71 were probable. Case-patients were residents of 23 California counties, 88 (62%) were female, and the median age was 50 years (range, 3 to 83 years). All case-patients reported travel to chikungunya-endemic or outbreak areas including Latin America (107), the Caribbean (28), and Asia (6).

Chikungunya is an arboviral disease first described from east Africa in the 1950s. In December 2013, the first case of locally transmitted chikungunya was identified in the Americas, resulting in an outbreak totaling over a million suspect cases and 26,000 confirmed cases. In February 2014, cases of chikungunya in California residents who had visited areas where the virus had been detected began to be reported to local health departments. Chikungunya was made nationally notifiable effective January 2015.

Mosquito surveillance

A total of 825,722 mosquitoes (31,549 pools) collected in 37 counties were tested at the University of California, Center for Vectorborne Diseases (CVEC) or at one of eight local agencies by a real-time (TaqMan) reverse transcriptase-polymerase chain reaction (qRT-PCR) for SLEV, WEEV, and/or WNV viral RNA. Three local agencies also tested an additional 19,890 mosquitoes (936 pools) for WNV using a commercial rapid assay-RAMP® (Rapid Analyte Measurement Platform, Response Biomedical Corp) (Table 4.2).

West Nile virus was detected in 3,340 mosquito pools from 30 counties; 3,305 were positive by RT-PCR and 35 were positive by RAMP only (Tables 4.2, 4.6). Statewide, the minimum infection rate (MIR) - defined as the number of infected mosquito pools divided by the number of mosquitoes tested multiplied by 1,000 - of WNV in all mosquitoes tested was 3.9; the MIR was highest (14.4) in Tulare County (Table 4.2, Figure 4.2). Since 2003, the MIR of WNV in California has ranged from a low of 0.08 (2003) to a high of 3.9 (2014). West Nile virus was identified from six *Culex* species (*Cx. erythrothorax, Cx. pipiens, Cx. quinquefasciatus, Cx. stigmatosoma, Cx. tarsalis, Cx. thriambus*) and *Aedes aegypti* (Table 4.3). In 2014, the first detection of WNV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in

Table 4.2. Results of testing mosquitoes for West Nile (WNV) virus, California 2014

County	No. mosquitoes	No. mosquito pools tested[a]	WNV positive pools[a]	WNV Minimum Infection Rate[b]
Alameda	2,573	214	16	6.2
Alpine	0			
Amador	0			
Butte	9,391	196	40	4.3
Calaveras	0			
Colusa	350	7	1	2.9
Contra Costa	17,181	626	25	1.5
Del Norte	0			
El Dorado	0			
Fresno	31,782	794	138	4.3
Glenn	2,195	45	8	3.6
Humboldt	0			
Imperial	0			
Inyo	0			
Kern	27,970	733	111	4.0
Kings	14,766	497	150	10.2
Lake	28,028	760	71	2.5
Lassen	0			
Los Angeles	93,060	2,627	356	3.8
Madera	5,891	212	37	6.3
Marin	2,723	199	3	1.1
Mariposa	0			
Mendocino	0			
Merced	4,979	234	11	2.2
Modoc	0			
Mono	0			
Monterey	1,188	26	0	0.0
Napa	3,108	117	0	0.0
Nevada	0			
Orange	67,084	2,649	499	7.4
Placer	29,283	1,807	77	2.6
Plumas	0			
Riverside	107,890	3,132	91	0.8
Sacramento	93,068	5,350	487	5.2
San Benito	0			
San Bernardino	46,787	1,956	97	2.1
San Diego	2,643	89	1	0.4
San Francisco	196	9	0	0.0
San Joaquin	55,214	2,250	239	4.3
San Luis Obispo	622	18	0	0.0
San Mateo	3517	435	15	4.3
Santa Barbara	12,451	300	0	0.0
Santa Clara	3,911	436	30	7.7
Santa Cruz	5,724	267	0	0.0
Shasta	11,633	508	33	2.8
Sierra	0			
Siskiyou	0			
Solano	2,336	111	11	4.7
Sonoma	14,292	735	9	0.6
Stanislaus	55,897	1,696	176	3.1
Sutter	10,180	275	52	5.1
Tehama	0			
Trinity	0			
Tulare	21,611	817	311	14.4
Tuolumne	0			
Ventura	2,099	45	0	0.0
Yolo	50,659	2,196	221	4.4
Yuba	3,330	117	24	7.2
Total	**845,612**	**32,485**	**3,340**	**3.9**

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

[b] Minimum Infection Rate = (No. pools positive/No. mosquitoes tested) X 1000

Table 4.3. Results of mosquito testing by species for West Nile virus (WNV), California 2014

Mosquito Species	No. Pools Tested	No. Mosquitoes	WNV Positive	Minimum Infection Rate[a]
***Culex* species**				
Cx. boharti	2	2	0	0.0
Cx. erythrothorax	1,809	68,401	23	0.3
Cx. pipiens	8,901	170,894	788	4.6
Cx. quinquefasciatus	8,567	252,016	1,426	5.7
Cx. stigmatosoma	597	7,270	26	3.6
Cx. tarsalis	11,904	331,302	1,071	3.2
Cx. thriambus	87	798	3	3.8
unknown	44	997	0	0.0
All *Culex*	**31,911**	**831,680**	**3,337**	**4.0**
***Anopheles* species**				
An. franciscanus	10	68	0	0.0
An. freeborni	98	2,326	0	0.0
An. hermsi	21	392	0	0.0
All *Anopheles*	**129**	**2,786**	**0**	**0.0**
***Aedes* species**				
Ae. aegypti[b]	60	1729	2	1.2
Ae. albopictus[b]	1	2	0	0.0
Ae. dorsalis	32	1,302	0	0.0
Ae. melanimom	5	122	0	0.0
Ae. sierrensis	1	17	0	0.0
Ae. squamiger	6	157	0	0.0
Ae. taeniorhynchus	1	32	0	0.0
Ae. vexans	41	1,306	0	0.0
Ae. washinoi	17	552	0	0.0
All *Aedes*	**164**	**5,219**	**2**	**0.4**
Other species				
Coquillettidia perturbans	2	44	0	0.0
Culiseta incidens	200	4,337	0	0.0
Culiseta inornata	46	386	0	0.0
Culiseta particeps	20	510	0	0.0
Unknown	13	650	1	1.5
All other	**281**	**5,927**	**1**	**0.2**

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

[b] Also tested and negative for dengue and chikungunya virus

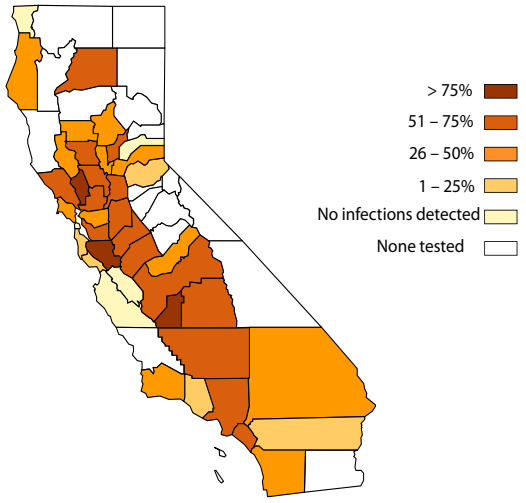

Figure 4.3. Prevalence of West Nile virus infection in dead birds, California, 2014

San Bernardino County on April 15. The last detection of WNV in mosquitoes was from a *Cx. quinquefasciatus* pool collected in Los Angeles County on November 18.

Animal Surveillance

Chicken

In 2014, 38 local mosquito and vector control agencies in 32 counties maintained 178 sentinel chicken flocks (Table 4.4). Blood samples were collected from chickens every other week and tested for antibodies to SLEV, WNV, and WEEV by an EIA at CDPH Vector-Borne Disease Section (CDPH-VBDS) laboratory or at one of two local agencies. Positive samples were confirmed at CDPH-VBDS laboratory by IFA or western blot. Samples with inconclusive results were tested by PRNT at CDPH-VRDL.

Out of 15,148 chicken blood samples that were tested, 443 seroconversions to WNV were detected among 97 flocks in 23 counties (Tables 4.4, 4.6). Statewide, 34.1% 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% (2012). In 2014, the first WNV seroconversion was detected in Los Angeles County on January 2, and the last seroconversion was detected in Riverside County on November 24.

Dead bird

In 2014, the WNV hotline and website received 14,701 dead bird reports from the public in 56 counties (Table 4.5). Oral swabs from dead bird carcasses were tested either at CVEC by RT-PCR or at one of nine local agencies by RT-PCR or RAMP®. Of the 4,087 carcasses deemed suitable for testing, WNV was detected in 2,442 (60%) carcasses from 36 counties, 2,262 by RT-PCR and 180 by RAMP® (Tables 4.5, 4.6, 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 2014, the first WNV positive dead bird was an American crow reported from San Joaquin County on January 17, and the last WNV positive dead bird was an American crow reported from San Mateo County on December 17.

Table 4.4. Results of testing sentinel chickens for West Nile (WNV) virus, California 2014

County	No. flocks	No. chickens[a]	No. WNV positive flocks	WNV positive sera
Alameda	3	21	1	1
Alpine	0			
Amador	0			
Butte	7	77	7	37
Calaveras	1	10	0	0
Colusa	1	10	1	9
Contra Costa	5	55	3	15
Del Norte	0			
El Dorado	0			
Fresno	0			
Glenn	1	10	1	9
Humboldt	0			
Imperial	0			
Inyo	0			
Kern	0			
Kings	0			
Lake	2	12	1	5
Lassen	0			
Los Angeles	48	307	28	146
Madera	0			
Marin	1	6	0	0
Mariposa	0			
Mendocino	0			
Merced	7	42	6	11
Modoc	0			
Mono	0			
Monterey	2	20	0	0
Napa	1	11	0	0
Nevada	4	21	1	2
Orange	0			
Placer	0			
Plumas	0			
Riverside	22	151	9	43
Sacramento	3	18	3	10
San Benito	1	10	0	0
San Bernardino	17	88	8	32
San Diego	2	20	1	2
San Francisco	0			
San Joaquin	0			
San Luis Obispo	0			
San Mateo	3	26	0	0
Santa Barbara	5	50	0	0
Santa Clara	7	48	3	5
Santa Cruz	2	20	0	0
Shasta	7	50	4	12
Sierra	0			
Siskiyou	0			
Solano	3	34	3	23
Sonoma	1	6	1	3
Stanislaus	2	16	2	12
Sutter	6	42	6	31
Tehama	3	30	3	13
Trinity	0			
Tulare	1	8	1	4
Tuolumne	0			
Ventura	5	48	0	0
Yolo	3	18	2	9
Yuba	2	14	2	9
Total	**178**	**1,299**	**97**	**443**

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

Invasive mosquito surveillance

Aedes aegypti, also known as the yellow fever mosquito, was detected in 2013 in Madera, Fresno, and San Mateo counties. In 2014, additional detections were made in Tulare, Kern, Los Angeles, and San Diego counties. *Aedes albopictus*, also known as the Asian tiger mosquito, continued to be detected in Los Angeles County since its discovery in 2011. The size of the area infested with *Ae. albopictus* expanded to include 14 cities. *Aedes notoscriptus*, a mosquito native to Australia and the southwest Pacific, was detected for the first time in California and the United States in Los Angeles County in August 2014. All three invasive mosquito species are container breeders. *Aedes aegypti* and *Ae. albopictus* are primary worldwide vectors of dengue, chikungunya, and other arboviruses. A total of 1,729 *Ae. aegypti* and 2 *Ae. albopictus* were tested for West Nile, dengue and chikungunya viruses; two *Ae. aegypti* were positive for WNV (Table 4.3).

Target-specific surveillance tools used for detecting presence (eggs) and capturing adult *Aedes* mosquitoes included the use of ovicups, Biogents Sentinel traps, and autocidal gravid ovitraps developed by the United States Centers for Disease Control and Prevention, Dengue Branch. Enhanced surveillance also included door-to-door property inspections. Local community education and outreach were used to mobilize residents and business owners to protect themselves against mosquito bites, report mosquitoes suspected of being invasive species, and help eliminate potential invasive mosquito larval sources on their properties. Chemical control applications were evaluated for efficacy against immature stages and adult mosquitoes.

Table 4.5. Dead birds reported, tested[a], and positive for West Nile virus, California, 2014

County	Reported	Tested	Positive	(%)
Alameda	856	166	96	(57.8)
Alpine	1	0		
Amador	19	0		
Butte	181	45	22	(48.9)
Calaveras	16	0		
Colusa	15	6	4	(66.7)
Contra Costa	1352	114	44	(38.6)
Del Norte	1	1	0	
El Dorado	129	36	7	(19.4)
Fresno	302	12	9	(75.0)
Glenn	10	8	4	(50.0)
Humboldt	21	4	2	(50.0)
Imperial	1	0		
Inyo	2	0		
Kern	82	4	3	(75.0)
Kings	26	3	3	(100)
Lake	98	43	18	(41.9)
Lassen	0			
Los Angeles	1,546	155	99	(63.9)
Madera	36	10	5	(50.0)
Marin	150	16	6	(37.5)
Mariposa	3	0		
Mendocino	30	0		
Merced	128	12	8	(66.7)
Modoc	1	0		
Mono	3	0		
Monterey	50	6	0	
Napa	117	13	12	(92.3)
Nevada	47	11	0	
Orange	415	684	431	(63.0)
Placer	257	152	40	(26.3)
Plumas	4	0		
Riverside	141	15	1	(6.7)
Sacramento	1,705	535	294	(55.0)
San Benito	18	1	0	
San Bernardino	220	36	17	(47.2)
San Diego	159	150	39	(26.0)
San Francisco	91	4	0	
San Joaquin	363	93	53	(57.0)
San Luis Obispo	32	0		
San Mateo	460	141	21	(14.9)
Santa Barbara	34	7	2	(28.6)
Santa Clara	3193	1097	925	(84.3)
Santa Cruz	151	34	1	(2.9)
Shasta	39	10	6	(60.0)
Sierra	0			
Siskiyou	6	0		
Solano	357	48	33	(68.8)
Sonoma	552	59	37	(62.7)
Stanislaus	429	71	47	(66.2)
Sutter	104	43	19	(44.2)
Tehama	19	0		
Trinity	4	0		
Tulare	132	58	40	(69.0)
Tuolumne	8	0		
Ventura	144	38	7	(18.4)
Yolo	375	116	71	(61.2)
Yuba	66	30	16	(53.3)
Totals	**14,701**	**4,087**	**2,442**	**(60.0)**

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

Table 4.6. Infections with West Nile virus in California, 2014

County	Humans[a]	Dead Birds	Mosquito Pools	Sentinel Chickens
Alameda	1	96	16	1
Alpine	0	NT	NT	NT
Amador	0	NT	NT	NT
Butte	25	22	40	37
Calaveras	0	NT	NT	0
Colusa	3	4	1	9
Contra Costa	7	44	25	15
Del Norte	0	0	NT	NT
El Dorado	0	7	NT	NT
Fresno	54	9	138	NT
Glenn	10	4	8	9
Humboldt	0	2	NT	NT
Imperial	1	NT	NT	NT
Inyo	0	NT	NT	NT
Kern	14	3	111	NT
Kings	6	3	150	NT
Lake	1	18	71	5
Lassen	0	NT	NT	NT
Los Angeles	277	99	356	146
Madera	3	5	37	NT
Marin	0	6	3	0
Mariposa	0	NT	NT	NT
Mendocino	1	NT	NT	NT
Merced	1	8	11	11
Modoc	0	NT	NT	NT
Mono	0	NT	NT	NT
Monterey	0	0	0	0
Napa	0	12	0	0
Nevada	0	0	NT	2
Orange	279	431	499	NT
Placer	9	40	77	NT
Plumas	0	NT	NT	NT
Riverside	15	1	91	43
Sacramento	10	294	487	10
San Benito	0	0	NT	0
San Bernardino	30	17	97	32
San Diego	13	39	1	2
San Francisco	1	0	0	NT
San Joaquin	10	53	239	NT
San Luis Obispo	0	NT	0	NT
San Mateo	0	21	15	0
Santa Barbara	0	2	0	0
Santa Clara	15	925	30	5
Santa Cruz	0	1	0	0
Shasta	3	6	33	12
Sierra	0	NT	NT	NT
Siskiyou	0	NT	NT	NT
Solano	5	33	11	23
Sonoma	0	37	9	3
Stanislaus	38	47	176	12
Sutter	9	19	52	31
Tehama	4	NT	NT	13
Trinity	0	NT	NT	NT
Tulare	24	40	311	4
Tuolumne	0	NT	NT	NT
Ventura	1	7	0	0
Yolo	15	71	221	9
Yuba	7	16	24	9
State Totals	**892**	**2,442**	**3,340**	**443**

[a]Includes asymptomatic infections detected through blood bank screening

NT= no samples tested

The number of reported human West Nile virus neuroinvasive disease cases was higher in 2014 than in any other year since WNV was first detected in California in 2003.

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 (Region 5) of the United States Department of Agriculture Forest Service (USFS). The agreement maintains 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 2014. Surveillance results are summarized in Table 5.1.

Angeles National Forest

Adult tick surveillance yielded no ticks after one hour of flagging at South Fork and Big Rock Campgrounds. California Department of Public Health, Vector-Borne Disease Section (CDPH-VBDS) biologists conducted hantavirus surveillance and facility evaluations at Valyermo Fire Station and Mojave Work Center per consultation with the Forest Safety Officer. None of the eight trapped rodents tested positive for antibodies to Sin Nombre virus (SNV), the causative agent of hantavirus pulmonary syndrome (HPS). Facility evaluations and recommendations were submitted to the Forest Safety Officer, District Ranger, and responsible District staff. In addition, vector-borne disease prevention and educational brochures were distributed and discussions about hantavirus risk reduction were held on-site with station and work center staff. Plague surveillance was conducted at Table Mountain Campground and in collaboration with the Los Angeles County Vector Management Program (LACVMP) at numerous recreational sites throughout the Forest. None of the 15 California ground squirrels (*Otospermophilus beecheyi*) at Table Mountain Campground or the 129 ground squirrels from 14 recreational sites throughout the Forest was positive for antibodies to *Yersinia pestis*, the causative agent for plague. None of four carnivores from lands adjacent to the Forest tested positive for serum antibodies to plague.

CDPH-VBDS and LACVMP staff attended a Forest-wide safety committee meeting to discuss improving interagency communication and cooperation on plague surveillance and control in the Forest. The Los Angeles County Agricultural Commissioner's Office conducted general flea control at 59 Forest recreational sites. CDPH-VBDS informed the Forest Safety Officer of a possible western gray squirrel die-off reported by a Mount Wilson Observatory researcher.

Cleveland National Forest

CDPH-VBDS biologists conducted adult tick surveillance along Maple Springs Trail in Silverado Canyon. Twenty-seven *Ixodes pacificus* and 64 *Dermacentor occidentalis* ticks were collected over three surveillance events. Testing by San Diego County Department of Environmental Health, Vector Control (SDCEH) found none of 16 *I. pacificus* ticks positive for *Borrelia burgdorferi*, causative agent for Lyme disease, from a site at Palomar Observatory. The SDCEH found one *O. beecheyi* from Fry Creek Campground positive for serum antibodies to *Y. pestis*. The remaining 137 rodents tested by SDCEH were negative as were the 7 *O. beecheyi* collected from Blue Jay Campground and tested by CDPH-VBDS in collaboration with Orange County Mosquito and Vector Control District. In addition, two carnivore samples tested from locations adjacent to the Forest were also negative for serum antibodies to plague. Positive test results were communicated to appropriate Ranger District, Forest, and Region leadership.

Table 5.1. Testing results for selected vector-borne disease agents in U.S. National Forests, California, 2014

National Forest	Hantavirus (*Peromyscus* mice)		*Yersinia pestis* (rodents)		*Yersinia pestis* (carnivores)[a]		*Borrelia* spp. (*Ixodes* ticks)		*Bartonella washoensis*[b] (rodents)		*Bartonella washoensis*[b] (fleas)	
	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested
Angeles	0	7	0	144	0	4			8	8	0	50
Cleveland			1	145	0	2	0	16	9	13		
Eldorado	0	4	1	26	0	2			15	15		
Inyo			0	76					11	19	1	22
Klamath					0	19						
Lake Tahoe BMU			1	36								
Lassen	0	26	0	9	0	2						
Los Padres	1	3	0	29	1	5	1	75	4	16	2	45
Mendocino					0	3	0	5				
Modoc					2	13						
Plumas					2	11						
San Bernardino	0	11	0	46			0	201	45	61	38	100
Sequoia	0	4	0	14								
Shasta-Trinity					0	1	14	184				
Sierra					1	9						
Stanislaus			0	7	0	5						
Tahoe	0	11	0	102	1	4	7	270				
Total, all forests	**1**	**66**	**3**	**634**	**7**	**80**	**22**	**751**	**92**	**132**	**41**	**217**

[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] *Bartonella washoensis* samples collected 2013 and tested by the United States Centers for Disease Control and Prevention 2014

CDPH-VBDS informed Forest and District leadership of a California Health Alert Network notification concerning the detection of invasive *Aedes aegypti* mosquitoes in San Diego County.

Eldorado National Forest

Hantavirus surveillance and a facility evaluation were conducted at the Dew Drop Fire Station. None of the four deer mice collected and tested was positive for serum antibodies to SNV. Hantavirus risk reduction recommendations were submitted to the Amador District Ranger, Forest Safety Officer, and Region leadership. Upon request, a facility evaluation was also conducted at Lumberyard Fire Station. Risk reduction recommendations were submitted to the appropriate District, Forest, and Region leadership. Plague surveillance was conducted at Fashoda, Northwind, and Strawberry Point campgrounds. Of the 26 rodents sampled, 1 long-eared chipmunk (*Tamias quadrimaculatus*) from Northwind Campground was positive for serum antibodies to *Y. pestis* but no evidence of an epizootic was found. Test results were communicated to the District Ranger and Forest Safety Officer. One golden-mantled ground squirrel (*Callospermophilus lateralis*) carcass was submitted from Silver Lake Campground; improper shipment precluded plague testing and the Amador District Wildlife Biologist, District Ranger, and Forest Safety Officer were notified of improper shipment. Two carnivore samples submitted for testing were negative for serum antibodies to *Y. pestis*. Plague Caution signs were posted and vector-borne disease education and prevention materials were distributed to campground hosts on the Amador and Pacific Ranger Districts. CDPH-VBDS biologists contacted by phone and/or in person the Supervisor's Office, all Ranger Districts, and Ice House Reservoir Visitor Center to provide information about the availability of vector-borne disease prevention training, facility evaluations, and disease prevention brochures and materials.

Inyo National Forest

Adult tick surveillance was conducted at Upper and Lower Gray's Meadow campgrounds and a site near the Mount Whitney Fish Hatchery. Twenty-five *D. occidentalis* ticks were collected from Upper Gray's Meadow Campground and none from the other sites. Ticks collected by the public during recreational activities on and adjacent to the Forest were submitted to the Inyo/Mono County Health Officer for identification. These ticks were identified to species (*D. occidentalis*, *D. variabilis* and *D. andersoni*) by a CDPH-VBDS biologist.

One *C. lateralis* trapped during plague surveillance in Mammoth Lakes yielded five *I. sculptus* adult ticks. Tick-borne relapsing fever cases were reported from four private homes on or immediately adjacent to Forest lands. Plague surveillance was conducted at Four Jeffrey, New Shady Rest, Saddlebag Lake, and Sherwin Creek campgrounds. None of the 76 rodents tested positive for serum antibodies to *Y. pestis*. Testing results were communicated to the Forest Safety officer and District Rangers. Visual assessments for plague activity were also conducted at Old Shady Rest, McGee Creek, and Red's Meadow area campgrounds. Plague Caution signs and brochures were provided to the Mono County Environmental Health Department for posting and distribution throughout the Forest.

CDPH-VBDS biologists provided disease prevention brochures and spoke with available campground hosts regarding plague and hantavirus risk in the Forest. A CDPH-VBDS biologist presented a safety talk to employees and volunteers at the Annual All-Forest Safety Meeting in Bishop, and upon request, provided the Forest Safety Officer with information about Valley Fever (coccidioidomycosis) and links to disease information on CDPH website.

Klamath National Forest

The Forest Safety Officer was contacted by email with information regarding CDPH-VBDS services provided under the Cost-Share Agreement as well as links to CDPH-VBDS website for more detailed vector-borne disease prevention and safety information. None of the 19 carnivores from lands adjacent to the Forest tested positive for serum antibodies to *Y. pestis*.

Lake Tahoe Basin Management Unit

One shadow chipmunk (*Tamias senex*) of five rodents from Fallen Leaf Campground tested positive for serum antibodies to *Y. pestis* but no environmental evidence of a plague epizootic was found. Additional rodent plague sampling was conducted at Tallac Historical Site and Taylor Creek Visitor Center. None of 28 samples from these sites was positive for serum antibodies to *Y. pestis*. Rodent carcasses submitted separately from Meeks Bay Campground (2) and Tallac Historical Site (1) tested negative for *Y. pestis* and *Francisella tularensis* (causative agent of tularemia) by culture at CDPH Microbial Diseases Lab. All test results were communicated to the Management Unit (MU) Supervisor, Safety Officer, responsible MU staff, and the El Dorado County Environmental Health Officer. Plague Caution signs were posted and visual assessments for plague activity were conducted at Bayview, Fallen Leaf, and Meeks Bay campgrounds, Pope and Baldwin beaches, and the Tallac Historical Site and Visitor Center. An abundance of adult and juvenile golden-mantled ground squirrels at Meeks Bay Campground and reports of dead rodents suggested a potential plague risk at that location. Campground hosts were provided information on rodent carcass collection and submission protocols.

A CDPH-VBDS biologist met with the MU Supervisor and presented "Vector-borne Diseases Associated with High Sierra Cabins" to Lake Tahoe Basin MU tract home owners. The Supervisor's office was contacted early in the year to inform staff of the availability of disease prevention training for employees and concessionaires, facility evaluations, and vector-borne disease prevention brochures and materials.

Lassen National Forest

Hantavirus and plague surveillance was conducted at the Mineral Work Station in collaboration with the Shasta Mosquito and Vector Control District. None of the 26 rodents

sampled for hantavirus and none of 9 rodents sampled for plague was positive for serum antibodies to SNV and *Y. pestis,* respectively. Test results were communicated to the District Ranger. Two carnivores from lands adjacent to the Forest also tested negative for plague. Upon request, a CDPH-VBDS biologist conducted a hantavirus risk assessment at the Ranger District facility. Written recommendations were submitted to and discussed with the District Ranger and given to the Forest Engineer and other responsible parties. Plague Caution signs and vector-borne disease prevention and educational brochures were provided to the Almanor and Eagle Lake Ranger Districts during visits. The Forest Safety Officer was contacted by email and given information about CDPH-VBDS services provided under the Cost-Share Agreement.

Los Padres National Forest

CDPH-VBDS biologists and collaborators from Mosquito and Vector Management District of Santa Barbara County (MVMDSBC) conducted adult tick surveillance at locations on the Santa Barbara Ranger District. One (1.4%) of 70 adult *I. pacificus*, collected from Romero Canyon Trail, was positive for *B. burgdorferi*. Additional nymphal and adult tick surveillance was conducted on the Monterey and Ojai Ranger Districts. One of three deer mice (*Peromyscus maniculatus*) from Mount Pinos Campground tested positive for serum antibodies to SNV. Upon request, hantavirus risk assessment and plague surveillance were conducted at the Apache Saddle Station barracks. A report with facility risk reduction recommendations was provided to the District Ranger, Forest Safety Officer, and interested parties at Region 5. None of three *O. beecheyi* was positive for serum antibodies to plague. Plague surveillance was also conducted at campgrounds on the Ojai, Mount Pinos, and Santa Barbara Ranger Districts in collaboration with Ventura County Environmental Health Division and MVMDSBC. None of the 26 collected rodents tested positive for serum antibodies to *Y. pestis*. A CDPH-VBDS biologist notified the affected Ranger District when one of five carnivores from lands adjacent to the Forest was found positive for serum antibodies to plague. VBDS biologists posted Plague Caution signs and provided campground hosts with vector-borne disease information and prevention brochures. CDPH-VBDS biologists also met with the Forest Safety Officer, gave a safety presentation, and provided Ranger Districts with vector-borne disease prevention materials and brochures.

Mendocino National Forest

CDPH-VBDS collected five adult *I. pacificus* ticks from the Little Stoney Day Use Area. None was positive for *B. burgdorferi*. Three carnivore samples from lands adjacent to the Forest tested negative for serum antibodies to *Y. pestis*. The Forest Safety Officer was contacted and given information regarding the services CDPH-VBDS provides the Forest under the Cost-Share Agreement and sent links to CDPH-VBDS website for more detailed disease prevention and safety information.

Modoc National Forest

Two (15%) of 13 carnivores sampled from lands adjacent to the Forest were positive for serum antibodies to *Y. pestis*, indicating some level of plague activity in or near the Forest. A CDPH-VBDS biologist visually assessed Rush Creek Campground for evidence of plague activity and posted the campground with a Plague Caution sign. The Forest Safety Officer was sent information regarding CDPH-VBDS services provided under the Cost-Share Agreement, including links to more detailed disease prevention and safety information.

Plumas National Forest

Plague testing on carnivores from lands adjacent to the Forest showed serum antibodies to *Y. pestis* in 2 of 11 animals. Upon request, a biologist reviewed and provided comments to Oakland Camp's rodent exclusion program and conducted a hantavirus facility evaluation; results of which were submitted to the Forest and Region Safety Officers. The Forest Safety Officer was contacted and given information regarding the services CDPH-VBDS provides the Forest under the Cost-Share Agreement and sent links to CDPH-VBDS website for more detailed disease prevention and safety information. Plague Caution signs and/or vector-borne disease prevention brochures and materials

were delivered to the Forest Safety Officer and Beckwourth Ranger District.

San Bernardino National Forest

CDPH-VBDS biologists conducted tick, hantavirus, and plague surveillance in collaboration with the Riverside County Department of Environmental Health Vector Control Program and San Bernardino County Mosquito and Vector Control Program at numerous locations around the Forest. None of the 201 adult *I. pacificus* ticks collected at locations on the Front Country Ranger District was positive for *B. burgdorferi*.

Of the 11 *Peromyscus* mice tested for serum antibodies to SNV, none was positive. Plague surveillance conducted on the Mountaintop and San Jacinto Ranger Districts yielded no plague positive rodents from the 46 sampled and tested by CDPH-VBDS. Plague Caution signs were delivered to the Mountaintop Ranger District for posting at recreation sites by District staff. Visual assessments for plague epizootic activity were conducted at campgrounds on the Front Country Ranger District and Plague Caution signs were posted where needed. Upon request, VBDS biologists gave a vector-borne disease safety presentation to the City Creek Fire Station staff. Vector-borne disease prevention brochures were provided to the Big Bear Discovery Center for public distribution. The Forest Safety Officer was contacted regarding vector-borne disease prevention and safety training for Forest staff and notified when surveillance activities were planned for the Forest.

Sequoia National Forest

CDPH-VBDS conducted a field investigation in response to two confirmed, three probable, and two clinically compatible cases of tick-borne relapsing fever (TBRF) acquired at a cabin rented to the public on the Western Divide Ranger District. Four different families were affected over a five-week period. The cabin was closed for further use and recommendations for risk reduction were delivered to the Forest Supervisor, District Ranger, and interested parties at Region 5. Hantavirus and plague surveillance was conducted opportunistically at the site. Four rodents were tested for SNV and 11 were tested for *Y. pestis*. None was positive. Additional plague surveillance at Tillie Creek and Kennedy Meadows campgrounds yielded no positive plague samples in the three rodents sampled and tested. Plague Caution signs were posted and visual assessments of epizootic plague activity were conducted at numerous campgrounds and recreation sites along the Kern River. Safety talks were given upon request at the Western Divide and Kern River Ranger Districts and vector-borne disease prevention and informational brochures and tick wallet cards were delivered to the District offices in Springville and Kernville.

Shasta-Trinity National Forest

Adult tick surveillance was conducted at locations on the Shasta Lake and Yolla Bolla Ranger Districts in collaboration with Shasta County Mosquito and Vector Control District. Of 184 *I. pacificus* ticks tested, 9 (4.0%) were positive for *Borrelia burgdorferi* and 5 (2.7%) were positive for *B. miyamotoi*. Positive ticks came from collections at Hirz Bay Campground and Pollard Flat. Upon request, a hantavirus risk evaluation was conducted at the Harrison Gulch Ranger Station. Risk reduction recommendations were submitted to the District Ranger and responsible District staff. The Forest Safety Officer was emailed with information regarding CDPH-VBDS services provided under the Cost-Share Agreement and given links to CDPH-VBDS website for more detailed disease prevention and safety information. A single carnivore sampled from lands adjacent to the Forest was negative for serum antibodies to *Y. pestis*.

Sierra National Forest

CDPH-VBDS biologists conducted a TBRF case investigation at a long-term lease cabin on Huntington Lake. Risk reduction recommendations, including rodent exclusion and acaracide treatment, were given to the occupants; the Forest Safety Officer was notified of the findings. One of nine carnivore samples from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*. Biologists delivered TBRF, hantavirus, and plague brochures to the High Sierra Ranger District office. The Forest Safety Officer was

contacted regarding disease prevention training opportunities, facility evaluations, and availability of vector-borne disease prevention brochures and materials.

Six Rivers National Forest

The Forest Safety Officer was provided information regarding CDPH-VBDS services under the Cost-Share Agreement and links to CDPH-VBDS website for more detailed disease prevention and safety information. Upon request, safety presentations were given to the management staff at the Supervisor's Office and Forest employees at the Willow Ranger District. Topics covered included tick-bite prevention and tick removal, and hantavirus prevention and risk reduction. Vector-borne disease prevention and educational brochures and materials were delivered to the Gasquet Ranger District where tick-borne disease and mouse infestation issues were discussed with staff.

Stanislaus National Forest

Plague surveillance was conducted at Baker and Deadman campgrounds on the Summit Ranger District. None of the seven rodent samples tested positive for serum antibodies to *Y. pestis*. Test results were communicated to the District Ranger and Forest Safety Officer. Five carnivores sampled from lands adjacent to the Forest were also negative for serum antibodies to plague. Plague Caution signs were posted and visual assessments of epizootic plague activity were conducted at numerous campgrounds on the Calaveras and Summit Ranger Districts. Campground hosts were given vector-borne disease prevention pamphlets and education materials.

All Ranger Districts and the Supervisor's Office were contacted and informed of disease prevention training opportunities, hantavirus risk evaluations, and availability of vector-borne disease prevention brochures and materials. Upon request, safety talks covering hantavirus, flea, and tick-borne diseases were presented to staff at the Calaveras and Mi-Wok Ranger Districts. Vector-borne disease prevention materials and brochures were delivered to the Forest Headquarters, all Ranger Districts, the Pinecrest Ranger Station, and Boy Scouts of America Camp Wolfboro.

Tahoe National Forest

With assistance from Yuba River Ranger District staff, *I. pacificus* ticks were collected from Bullard's Bar Reservoir. Seven (2.6%) of 270 ticks tested positive for *Borrelia*. Upon request, a CDPH-VBDS biologist conducted a hantavirus facility evaluation at Big Bend Fire Station. A report with facility risk reduction recommendations was provided to the District Ranger, Forest Safety Officer, and interested parties at Region 5. Biologists conducted hantavirus and plague surveillance at Diablo Campground. None of the 11 deer mice and none of the 20 chipmunks tested positive for serum antibodies to SNV and *Y. pestis*, respectively. The Forest Supervisor and District Rangers were notified of the test results. Additional plague surveillance was conducted at Berger Creek, Boca Reservoir, Pack Saddle, and Stampede Reservoir campgrounds. All 82 rodents from these sites tested negative for serum antibodies to plague. One of four carnivores from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*. All test results were communicated to the Forest Supervisor and responsible District Rangers. Plague Caution signs were distributed for posting by campground hosts and concessionaires.

All Ranger Districts and the Forest Safety Officer were contacted by phone, email, or in person by CDPH-VBDS biologists and informed of the services provided under the Cost-Share Agreement. Vector-borne disease prevention and educational materials were mailed or provided upon request for distribution to staff and the public. Safety presentations were given to staffs at the Truckee and Yuba River Ranger Districts. Upon request, West Nile virus and mosquito bite prevention materials were provided to the American River Ranger District. Campgrounds were visited to ensure appropriate disease prevention information was available to the public. A CDPH-VBDS biologist discussed hantavirus prevention in depth with the Forest Safety Officer.

Other Region 5 Activities

CDPH-VBDS provided the Regional staff with information on public health pesticide usage on Region 5 lands, annual and quarterly reports on activities conducted under the Cost-Share Agreement, and updated CDPH-VBDS biologist contact lists by county for each Forest. A pre-season safety letter emphasizing plague awareness and protocols for submitting dead rodents for plague testing was sent to the Region 5 liaison and Health and Safety Officer for distribution throughout the Region. A CDPH-VBDS biologist gave a brief presentation discussing the importance of and services provided by the Cost-Share Agreement at the annual meeting of Safety Officers in Arcadia, and an update was provided to the same group during a teleconference later in the year. CDPH-VBDS biologists developed and implemented a standardized hantavirus facility evaluation form for use in documenting and relaying hantavirus risk reduction recommendations to USFS leadership and informed the Region of a peer reviewed article regarding the Yosemite National Park hantavirus outbreak. The Region and Forest Safety Officers were reminded of an occupational tick bite prevention project, "Protect Yourself from Ticks Where You Work", with all materials and necessary instructions provided by CDPH-VBDS. Upon request from the Region 5 Health and Safety Officer, vector-borne disease prevention and educational materials were sent for the 2014 Annual Safety Officer meeting. Edits to a tick bite prevention bulletin for distribution to all USFS Regions and links to hantavirus information and prevention materials were provided. CDPH-VBDS continues to host an annual meeting with Region representatives to review activities and plan future goals.

In 2014, the US Centers for Disease Control and Prevention provided *Bartonella washoensis* testing results from California ground squirrels and their fleas collected in 2013 and 2014 in conjunction with plague surveillance in several Forests. *Bartonella* testing was done as a preliminary prevalence assessment (Table 5.1).

Bartonella washoensis has been implicated as a human pathogen in two patients from Nevada and California in 1995 and 2008 respectively. California ground squirrels (*Otospermophilus beecheyi*) have been implicated as reservoir hosts and the ground squirrel flea (*Oropsylla montana*) as the flea vector.

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 California Department of Public Health 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 to promote 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 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 Vector-Borne Disease Section (CDPH-VBDS) approved 220 continuing education events in 2014. 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 2014, 1,200 vector control technicians employed at 112 local public health agencies and CDPH-VBDS held 2,845 certificates (Table 6.2). The agencies include special districts, departments of county government, departments of city government, the University of California, and CDPH-VBDS. Of these agencies, 77 are signatory to a cooperative agreement with CDPH-VBDS.

In 2014, 833 individuals employed at 77 agencies maintained valid licenses. In addition, 377 employees from 56 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 6.1. Results of certification examinations administered in 2014.

Exam section	No. Exams Given	No. Passed (%)
Core	125	99 (79)
Mosquito Control	124	79 (64)
Terrestrial Invertebrate Control	86	51 (59)
Vertebrate Vector Control	71	45 (63)
Totals	**406**	**274 (67)**

Table 6.2. Vector Control Technician certificates in effect as of December 2014

	No. Certificates		
Certification Category	**Full Status**	**Limited Status**	**Total**
Mosquito Control	808	243	1,051
Terrestrial Invertebrate Vector Control	638	210	848
Vertebrate Vector Control	640	306	946
Totals	**2,086**	**759**	**2,845**

7 Public Information Materials, Publications

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

Public Information Materials

In 2014, new public education materials as listed below were created and distributed. To find information on a specific vector or disease, go to http://cdph.ca.gov and enter a term in the "search" box. All public education materials are available from the California Department of Public Health Vector-Borne Disease Section webpage: http://cdph.ca.gov/programs/vbds/Pages/default.aspx.

- Hoja Informativa Sobre *Aedes aegypti* – Mosquito de la Fiebre Amarilla (May 2014, fact sheet)
- Guidance for Surveillance of and Response to Invasive *Aedes* Mosquitoes and Locally Acquired Exotic Mosquito-Borne Infections Transmitted by These Mosquitoes in California (May 2014, response plan)
- We Need YOUR Help to Eliminate the *Aedes aegypti* Mosquito (May 2014, brochure and flyer)
- Key Characteristics for Larval *Aedes* species (May 2014, picture key)
- Chikungunya (May 2014, fact sheet)
- Preventing Hantavirus Pulmonary Syndrome in the Workplace (May 2014, poster)
- Ticks and Tick-Borne Disease Publications from VBDS (August 2014, resource document)
- Human Flea-Borne Typhus Cases in California (August 2014, resource document)
- Category A, B, C, and D Review Webinars (November 2014, training videos)
- The Biology and Control of Mosquitoes in California (November 2014, PowerPoint show)
- Information for Clinicians: *Aedes aegypti* and *Aedes albopictus* Mosquitoes in California and Reporting Patients with Suspected Dengue or Chikungunya to Public Health (December 2014, resource document)

The Guidance for Invasive *Aedes* Surveillance and Response in California was distributed electronically to all vector control agencies throughout the state.

Publications*

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*Bolded names are members of VBDS staff

California Department of Public Health, Vector-Borne Disease Section, 1616 Capitol Avenue, MS 7307, P.O. Box 997377, Sacramento, CA 95899-7377
VBDS@cdph.ca.gov, 916-552-9730, www.cdph.ca.gov/programs/vbds