

Vector-Borne Disease Section

2012 Annual Report



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

California Department of Public Health



2012

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

INFECTIOUS DISEASES BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CENTER FOR INFECTIOUS DISEASES

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH



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Preface

I am pleased to present to you the 2012 Annual Report for the Vector-Borne Disease Section (VBDS) of the California Department of Public Health (CDPH). VBDS staff conducted surveillance, prevention, and control of existing and emerging vector-borne diseases throughout California in 2012.

Hantavirus cardiopulmonary syndrome (HCPS) was detected in 10 California residents and two visitors in 2012. Ten of these cases were in individuals who had stayed in Yosemite National Park in June-July 2012, nine of whom stayed specifically in the “signature” tent cabins at Curry Village in Yosemite Valley; three of these cases were fatal. Visual inspection of these cabins revealed evidence of deer mouse infestations, particularly in the wall insulation. VBDS worked collaboratively with other CDPH programs, the National Park Service, and the U.S. Centers for Disease Control and Prevention to investigate the outbreak and mitigate further hantavirus exposure risk to park visitors and employees. The Yosemite hantavirus outbreak constitutes the largest outbreak of this disease in the United States since the first outbreak in the Four Corners Region in 1993.

West Nile virus (WNV) activity was detected in 43 California counties in 2012, with the highest number of cases (479) reported since 2005. The number of West Nile virus neuroinvasive disease cases (313) was the highest ever recorded in California, although fewer West Nile fever cases (158) were reported to CDPH than in 2004-2007. Nationally, WNV virus activity was also extensive, with over 5,600 cases reported.

Human cases of seven tick-borne diseases were reported in California in 2012, including Lyme disease, Rocky Mountain spotted fever, tick-borne relapsing fever, spotted fever group rickettsiosis, babesiosis, anaplasmosis, and ehrlichiosis. VBDS conducted tick surveillance and investigated many of the human cases to assess and subsequently reduce risk of exposure for other Californians. Public education efforts targeted individuals with occupational exposure to ticks; outreach materials included videos, narrated presentations, and posters.

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. In addition, VBDS consulted on a wide range of topics including climate change, typhus, tick-borne *Borrelia miyamotoi* and *Rickettsia philipii*, bed bugs, and ectoparasite management for the homeless population.

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

VBDS works with numerous local, state, and federal agencies, private and commercial organizations, and members of the medical community in its efforts to monitor, prevent, and control vector-borne diseases in California. Some of VBDS's key collaborators in 2012 are listed here.

Rodent-borne Diseases

El Dorado County Environmental Management Department; Fresno County Department of Agriculture; Lassen County Environmental Health; Los Angeles County Agricultural Commissioner/Weights and Measures; County of Los Angeles Public Health (PH), and Environmental Health (EH), Vector Management; Mariposa County Health Department; National Park Service (NPS); Placer County Agricultural Department; Placer County Animal Control; Riverside County Vector Control Program; Placer County Health and Human Services; San Bernardino County Vector Control Program; United States (US) Army Corps of Operating engineers; US Centers for Disease Control and Prevention (CDC); United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service, Wildlife Services; US Forest Service; Ventura County Environmental Health Services; West Valley Mosquito Vector Control Program.

Flea-borne Diseases

El Dorado County Environmental Management Department; Fresno County Department of Agriculture; Inyo County Environmental Health Services (EHS); Kern County Department of Public Health (DPH); Kern County EHS; Los Angeles County Agricultural Commissioner/Weights and Measures; County of Los Angeles PH and EH, Vector Management; Mono County HHS; Nevada County Public Health Department (PHD); Nevada County EHD; NPS; 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; USDA Animal and Plant Health Inspection Service, Wildlife Services; West Valley MVCD.

Tick-borne Diseases

Alameda County VCSD; Arizona Department of Health Services; Calaveras County EHD; California Office of Binational Border Health, CDPH; CDC, Rickettsial Zoonoses Branch, Division of Global Migration and Quarantine, and Division of Vector-Borne Infectious Diseases; Coachella Valley MVCD; Coconino County (Arizona) Health Department; Contra Costa County MVCD; Imperial County PHD; Lake County VCD; Marin County HHS; Marin-Sonoma County MVCD; Napa County MAD; NPS; Riverside County VCP; Rocky Mountain Laboratories, National Institutes of Health; San Benito County HHS; San Joaquin County MVCD; San Luis Obispo PHD; San Mateo MVCD; Santa Cruz County MVCD; Sacramento-Yolo County MVCD; Shasta County MVCD; US Army Center for Health Promotion and Preventative Medicine-West; Washington State Department of Health.

Mosquito-borne Diseases

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

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Program Overview

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

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

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Rodent-borne Diseases



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

Human disease surveillance

In 2012, hantavirus infection was diagnosed in ten California residents, seven of whom were part of an outbreak associated with Yosemite National Park.

Outbreak of Hantavirus Infection Associated with Yosemite National Park

In July and August 2012, the California Department of Public Health (CDPH) confirmed hantavirus infection in two California residents. Epidemiologic investigation revealed that both patients had visited Yosemite National Park (NP) in June 2012 and had lodged at “signature” tent cabins in the Boystown section of Curry Village. CDPH, in collaboration with the U.S. Centers for Disease Control and Prevention and the National Park Service, initiated an investigation to identify additional cases of hantavirus infection, evaluate factors associated with exposure, assess rodent activities and seroprevalence to SNV, and make recommendations for control and prevention. By October 30, 2012, nine cases of hantavirus infection were identified in residents of three states (California (7), Pennsylvania (1), and West Virginia(1)) who visited Yosemite NP, Curry Village between June 2 and July 23, 2012; three of these cases were fatal. All case-patients had lodged in “signature” tent cabins. Visual assessment of “signature” tent cabins revealed evidence of mouse infestation, particularly in the wall insulation. On August 28, 2012, all “signature” tent cabins were closed and dismantled.

Rodent surveillance conducted in August showed a 45% trap success for deer mice in Curry Village; serum antibodies to SNV were detected in 14% of those mice. Recommendations were provided for rodent mitigation and control in and around guest lodgings, as well as enhanced education of Yosemite NP visitors on hantavirus and rodent-borne disease prevention.

Sporadic hantavirus infection

In addition to the Yosemite outbreak cases above, three sporadic cases of confirmed hantavirus infection were reported to CDPH in 2012. The first case-patient was an adult who died soon after hospitalization. The case-patient had traveled to Placer County three weeks before onset of illness, and antibodies to SNV were detected in one deer mouse collected from a natural area near the patient’s lodgings in Placer County. The second case-patient was an adult who was hospitalized with respiratory support but survived. One deer mouse collected near the case-patient’s residence was positive for hanta virus DNA by polymerase chain reaction. The third case-patient was an adult who had extensive domestic and international travel during the six weeks preceding onset of illness, including hiking and camping in the Tuolumne Meadows area of Yosemite National Park. The patient experienced flu-like symptoms and mild respiratory signs and eventually recovered. Two deer mice collected near one of the Yosemite cabins where the case-patient stayed tested positive for serum antibodies to SNV. Recommendations for mitigating rodent entry into buildings and for cleaning rodent contamination were provided in all settings.

Rodent surveillance

In 2012, a total of 1,233 rodents of the genera *Neotoma* and *Peromyscus* were collected and tested for serum antibodies to SNV (Table 1). Of 1,184 *Peromyscus spp.* tested, 69 (5.8%) had antibodies to SNV. Seroprevalence was highest in *Peromyscus maniculatus*, the primary reservoir for SNV, at 8.9% (Table 1). At least one seroreactive *Peromyscus maniculatus* was detected in 12 of 17 California counties sampled in 2012 (Table 2). SNV has been detected in *P. maniculatus* from 30 of 42 counties sampled in the last 10 years with prevalence ranging from 5.0% to 38.5% (average 13%) over that time period (Table 2).

In addition, 19 out of 141 (13.5%) harvest mice (*Reithrodontomys megalotis*) and 3 out of 15 (20%) meadow voles (*Microtus californicus*) specimens demonstrated reactivity to SNV. Seropositivity in these rodents may represent spillover of SNV from neighboring rodents or infection with additional SNV-like hantaviruses (El Moro Canyon and Isla Vista, respectively), which cross react to the Sin Nombre assay. These strain variations have not been shown to be pathogenic to humans.

Table 1. Serologic evidence of hantavirus (Sin Nombre) infection in California rodents, 2003 - 2012

Species	Common name	2012			2003-2012		
		No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
<i>Neotoma spp.</i>	woodrats	49	1	2.0	889	27	3.0
<i>Peromyscus boylii</i>	brush mouse	60	0	0.0	1,939	51	2.6
<i>Peromyscus californicus</i>	parasitic mouse	168	4	2.4	1,187	21	1.8
<i>Peromyscus crinitus</i>	canyon mouse	0		0.0	208	8	3.8
<i>Peromyscus eremicus</i>	cactus mouse	79	1	1.3	2,603	106	4.1
<i>Peromyscus maniculatus</i>	deer mouse	675	60	8.9	7,280	950	13.0
<i>Peromyscus truei</i>	piñon mouse	4	0	0.0	353	7	2.0
<i>Peromyscus e. fraterculus</i>	northern Baja mouse	198	4	2.0	485	7	1.4
<i>Peromyscus sp.</i>	unspecified <i>Peromyscus</i>	0		0.0	61	3	4.9

Table 2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus* in California 2003-2012

County	2012			2003-2012		
	No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
Alameda	11	0	0.0	150	0	0.0
Alpine				49	6	12.2
Amador						
Butte				13	5	38.5
Calaveras				5	1	20.0
Colusa	2	0	0.0	2	0	0.0
Contra Costa				20	2	10.0
Del Norte						
El Dorado	49	11	22.4	788	186	23.6
Fresno				22	0	0.0
Glenn				5	0	0.0
Humboldt						
Imperial						
Inyo				31	7	22.6
Kern				6	1	16.6
Kings						
Lake						
Lassen	16	2	12.5	713	96	13.5
Los Angeles	1	0	0.0	14	1	7.1
Madera				42	10	23.8
Marin				18	1	5.6
Mariposa	84	10	11.9	89	11	12.4
Mendocino						
Merced						
Modoc	9	1	11.1	36	7	19.4
Mono	36	5	13.9	674	192	28.5
Monterey				20	1	5.0
Napa	5	1	20.0	50	9	18.0
Nevada	5	0	0.0	28	7	25.0
Orange	44	3	6.8	1,311	95	7.2
Placer	59	2	3.4	91	4	4.4
Plumas	5	1	20.0	104	26	25.0
Riverside	79	5	6.3	1,196	156	13.0
Sacramento						
San Benito				5	0	0
San Bernardino	11	0	0.0	393	20	5.1
San Diego	220	17	7.7	997	55	5.5
San Francisco				13	0	0
San Joaquin						
San Luis Obispo				2	0	0.0
San Mateo				49	4	8.2
Santa Barbara				58	12	20.7
Santa Clara				10	0	0.0
Santa Cruz				14	0	0.0
Shasta				35	4	11.4
Sierra				69	10	14.5
Siskiyou				48	8	16.7
Solano						
Sonoma						
Stanislaus						
Sutter				7	0	0
Tehama						
Trinity						
Tulare				4	0	0.0
Tuolumne	39	2	5.1	87	10	11.5
Ventura				6	2	33.3
Yolo				1	0	0
Yuba						
Douglas, NV				5	1	20.0
California	675	60	8.9	7,280	950	13.0

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Flea-borne Diseases



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

Human disease surveillance

Typhus

The number of reported confirmed and probable typhus cases in 2012 (62) is an increase compared to 2010 (44) and 2011 (43). The increase may be due to an expanded awareness of the disease by health practitioners and the general public due to enhanced follow-up and out-reach activities conducted by local agencies.

Sixty-two cases of typhus fever were reported to the California Department of Public Health (CDPH) in 2012, as of June 2013. Fifty-two of these were classified as confirmed cases according to the CDPH working surveillance definition and 10 were probable. Fifty-one (82%) of the case-patients required hospitalization. Case-patients were residents of Los Angeles (26), Orange (35), and Santa Clara (1) counties. Typhus is considered endemic in parts of Orange and Los Angeles counties. The case-patient from Santa Clara County reported travel outside the United States during the incubation period.

Persons living in areas endemic for typhus should avoid contact with opossums and maintain proper flea control on pets.

Plague

No cases of plague in humans were reported in 2012.

Animal surveillance

Domestic pets

No cases of plague in domestic pets were reported in 2012.

Wild animals

The Vector-Borne Disease Section (VBDS) plague surveillance program received 858 test results in 2012 for 569 wild rodents and 289 carnivores from 30 California counties through December 2012 (Figure 1, Table 3). Thirty-five rodents and three carnivores (one raccoon and two black bears) from nine counties tested positive for serum antibodies to *Yersinia pestis*, and one rodent carcass tested positive for *Y. pestis* bacteria.

Squirrels tested for plague antibodies included: 229 California ground squirrels from ten counties, 23 Belding's ground squirrels from two counties, 16 Douglas squirrels from four counties, 9 golden-mantled ground squirrels from six counties, and 6 antelope ground squirrels from one county. Two hundred and twenty-nine chipmunks (*Tamias spp.*) from thirteen counties, 52 mice (*Peromyscus spp.*) from seven counties, 4 wood rats (*Neotoma spp.*) from three counties, and 1 long-tailed meadow vole were also tested.



Figure 1. Map of California counties where mammals were found to have evidence of *Yersinia pestis* infection, 2012

Plague antibodies were detected in 2 California ground squirrels (titers 1:32) from Palomar Mountain State Park, Cedar Grove Group Camp, in San Diego County; 1 lodgepole chipmunk (titer 1:32) from the upper-track residential area of Twin Falls, Inyo National Forest in Mono County, 4 ground squirrels from the eastern Sierra region of Inyo County (Jeffrey Campground; 1:128, 1:64, 1:64, 1:32), and 1 California ground squirrel (titer 1:256) from Fern Basin campground in the San Bernardino National Forest, San Bernardino County. Further north, plague antibody was detected in 24 of 90 (27%) of rodents tested from Martis Creek Recreational Area, Boca Lake Campground and Boca Spring Campground in the Tahoe National Forest, Nevada County. One yellow-pine chipmunk (1:512) from Martis Peak Lookout in Placer County and 2 from the Taylor Creek visitor center, U.S. Forest Service Lake Tahoe Basin Management Unit, El Dorado County, tested positive for plague antibodies (titers 1:256, 1:128). In addition, one chipmunk from Taylor Creek tested positive for *Y. pestis* bacteria.

Two hundred and eighty-nine carnivores were tested for plague antibody in 2012, including: 215 coyotes from seventeen counties, 32 black bears from twelve counties, 8 bobcats from five counties, 4 red foxes from two counties, 7 mountain lions from four counties, 7 raccoons from five counties, 7 gray foxes from three counties, and 9 striped skunks from two counties. One raccoon from the Beckwourth area of Plumas county tested positive (titer 1:32) for plague antibody and 2 black bears from Yosemite National Park also tested positive for plague antibody (titer 1:64 each). All other carnivores were negative for serum antibody to *Y. pestis*. Additionally, two Nuttall's Cottontails from two counties and three feral pigs from one county tested negative.

Table 3. VBDS plague surveillance results through December 2012¹

County Location	No. rodents tested	No. carnivores tested	Positive specimens		
			Species	Result	Month
Butte		4			
Calaveras	1				
El Dorado	61				
LTBMU, Tallac Historical Site			Chipmunk, YP	1:256	October
LTBMU, Talyor Creek Visitor Center			Chipmunk, YP	1:128	October
LTBMU, Taylor Creek Visitor Center			Chipmunk, YP	<i>Y. pestis</i>	September
Fresno	3	12			
Inyo	63				
Inyo NF, Four Jeffrey CG			CA G Sq	1:128	June
Inyo NF, Four Jeffrey CG			CA G Sq	1:64	June
Inyo NF, Four Jeffrey CG			BE G Sq	1:64	June
Inyo NF, Four Jeffrey CG			BE G Sq	1:32	June
Kern	9	11			
Lake		1			
Lassen	1	2			
Los Angeles		5			
Mariposa		11			
Yosemite National Park			Black Bear	1:64	October
Yosemite National Park			Black Bear	1:64	October
Mendocino		21			
Modoc	10	41			
Mono	44	1			
Inyo NF, Twin Falls Upper Tract Residences			Chipmunk, LP	1:32	August
Monterey		22			
Napa		8			
Nevada	122				
Martis Creek Reservoir: Alpine Meadows CG			Chipmunk, YP	1:1024	September
Martis Creek Reservoir: Alpine Meadows CG			Chipmunk, YP	1:128	September
Martis Creek Reservoir: Alpine Meadows CG			Chipmunk, YP	1:128	September
Martis Creek Reservoir: Alpine Meadows CG			Chipmunk, YP	1:256	September
Martis Creek Reservoir: Alpine Meadows CG			Chipmunk, YP	1:512	September
Martis Creek Reservoir: Alpine Meadows CG			Chipmunk, YP	1:512	September
Martis Creek Reservoir: Alpine Meadows CG			Chipmunk, YP	1:64	September
Martis Creek Reservoir: Alpine Meadows CG			Pine Squirrel	1:64	September
Martis Creek Reservoir: Alpine Meadows CG			Chipmunk, YP	1:64	September
Martis Creek Reservoir: Alpine Meadows CG			Chipmunk, YP	1:64	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:1024	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:128	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:128	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:128	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:256	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:32	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:32	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:32	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:512	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:512	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:64	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:64	September
Tahoe NF, Boca Lake CG			Chipmunk, YP	1:64	September
Tahoe NF, Boca Spring CG			Chipmunk, YP	1:64	September
Placer	6	1			
Martis Peak Lookout			Chipmunk, YP	1:512	September
Plumas	21	15			
Beckwourth, approximately 8 mi. NW			Raccoon	1:32	September
Riverside	89				
San Bernardino NF, Fern Basin CG			CA G Sq	1:256	September
San Benito		77			
San Bernardino	87	1			
San Diego	43				
Palomar Mtn SP, Cedar Grove Group CG			CA G Sq	1:32	August
Palomar Mtn SP, Cedar Grove Group CG			CA G Sq	1:32	August
San Luis Obispo		14			
Santa Barbara		9			
Shasta		2			
Sierra	1	5			
Siskiyou		22			
Sonoma		2			
Stanislaus	2	2			
Ventura	6				
Total	569	289			

Abbreviations: Chipmunk, YP: Yellow-pine chipmunk
 CA G Sq: California ground squirrel
 BE G Sq: Belding ground squirrel

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

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Tick-borne Diseases



At least seven tick-borne diseases have been documented in California. The goal of the Vector-Borne Disease Section is to reduce human morbidity from tick-borne diseases in California through ongoing surveillance of the disease-causing agents and vectors, investigation of human cases when necessary, management of tick populations as appropriate, and timely dissemination of findings and prevention messages to public health and vector control agencies, medical personnel, and the general public.

Human disease surveillance

Anaplasmosis

Four cases of anaplasmosis caused by *Anaplasma phagocytophilum* were reported to CDPH; two met the national surveillance case definition for a confirmed case, the other two met the definition for probable. Both confirmed case-patients were San Francisco residents who reported hiking in rural San Mateo County areas one week prior to disease onset. One of these patients additionally reported extensive hiking through Point Reyes National Seashore in Marin County prior to disease onset.

Babesiosis

Two confirmed cases of babesiosis caused by *Babesia microti* were reported to the California Department of Public Health (CDPH). The first case-patient was a San Mateo County resident who reported exposure to rural areas in Nantucket, Massachusetts (highly endemic for *B. microti*) within eight weeks prior to disease onset. The second case-patient was a Contra Costa County resident with no outdoor or travel history who had received multiple blood transfusions due to an unrelated illness, two and four weeks prior to disease onset. Blood donor investigation is on-going. Both case-patients survived the infection.

Ehrlichiosis

Two cases of ehrlichiosis caused by *Ehrlichia chaffeensis* were reported to CDPH. Both cases met national surveillance criteria for a probable case. Case-patients resided in San Diego and Monterey counties. Both case-patients reported travel to known areas of *E. chaffeensis* endemicity: one to Rhode Island (San Diego case-patient) and the other to Arkansas (Monterey case-patient).

Lyme disease

A total of 75 cases of Lyme disease were reported to the CDPH in 2012 (as of June 2013); 66 of these met the surveillance case definition criteria for a confirmed case, and nine were probable. Of the 66 confirmed cases, case-patients were residents of 27 counties (Table 4). The most cases (13) were reported from Sonoma County. Of 29 (44%) confirmed case-patients reporting travel history within the incubation period, 27 (93%) were exposed outside California. The most frequently reported region of likely exposure was the north eastern United States. Ten year incidence for Lyme disease by county is shown in Figure 2.

The median age of confirmed Lyme disease case-patients was 39 years (range, 2 to 83 years) and 35 (53%) were male. Of 39 case-patients for whom race was reported, 37 were white and 2 were Asian-Pacific Islander. Erythema migrans rash was identified in 36 (55%) case-patients, 22 (61%) of whom had onset of erythema migrans noted between May and September.

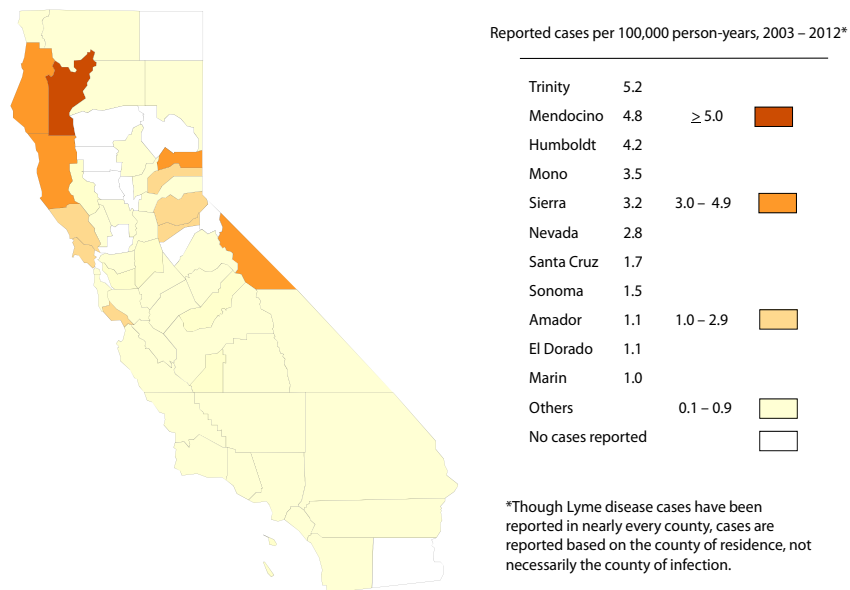


Figure 2. Incidence of Lyme disease, by county, California, 2003 - 2012

Spotted Fever Group Rickettsia

Four cases of Rocky Mountain spotted fever (RMSF) were reported to CDPH in 2012; one met the national surveillance case definition for confirmed, and three were classified as probable. The confirmed case-patient was a Solano County resident who presented in August to the local emergency department with fever, headache, myalgia, and rash on wrist, leg, and torso. The case-patient reported recent travel through rural Illinois where he received bites from fleas, chiggers, and mosquitoes; he saw ticks, but did not report any tick bites. The probable cases were residents of Placer, Sacramento, and Santa Cruz counties. Probable case-patient age ranges were 7 years to 76 years and two were male. All had a febrile illness associated with rash on arms, legs, and trunk, and were serologically positive to *Rickettsia rickettsi* at time of presentation but no follow-up serology could be obtained. Potential exposure areas included rural areas of Fresno, Placer, and Santa Cruz counties.

Four cases of spotted fever group *Rickettsia* (SFG) confirmed as type *Rickettsia philipii* (formerly 364D) were reported to CDPH in 2012. Confirmation was by PCR of cutaneous ulcers (eschars) specimens and sequencing performed by the CDPH Viral and Rickettsial Disease Laboratory (VRDL). All case-patients were children 12 years or younger; two were male and two were female. Case-patients were residents of Orange (1), Contra Costa (2), and Monterey (1) counties. All cases occurred in August, and two children required hospitalization. In addition to eschar, case-patients presented with headache (3), lymphadenopathy (2), myalgia (1), and fever (4). Presumed acquisition of infection in most cases was near their home. One case-patient reported extensive travel. One case-patient reported a tick bite.

Tick-borne relapsing fever

Four cases of confirmed tick-borne relapsing fever (TBRF) were reported to CDPH in 2012. Case-patient ages ranged from 11 to 37 years and three were male. Case-patients were residents of three counties: Inyo, Mono (2), and Santa Cruz. All four case-patients were residents or visitors to Mono County in the three weeks prior to disease onset.

Table 4: Reported confirmed Lyme disease cases by county of residence, and onset year, California, 2003 - 2012

County	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Incidence per 100,000 person-years
Alameda	1	1	4	4	2	6	1	2	2	4	0.18
Alpine	0	0	0	0	0	0	0	0	0	0	0.00
Amador	0	0	0	1	2	0	0	1	0	0	1.08
Butte	2	2	0	1	0	2	2	0	0	0	0.41
Calaveras	0	0	0	0	0	0	0	0	0	0	0.00
Colusa	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	4	0	4	0	0	1	0	1	2	2	0.13
Del Norte	2	0	0	0	0	0	0	0	0	0	0.71
El Dorado	1	2	4	4	1	2	2	1	0	2	1.05
Fresno	0	0	0	1	0	2	0	1	0	5	0.10
Glenn	0	0	0	0	0	0	0	0	0	0	0.00
Humboldt	5	7	11	4	8	5	4	7	3	4	4.30
Imperial	0	0	0	0	0	0	0	0	0	0	0.00
Inyo	0	0	0	1	0	0	0	0	0	0	0.54
Kern	1	0	2	1	5	2	1	2	0	0	0.16
Kings	0	0	0	0	0	0	1	0	0	0	0.07
Lake	1	1	1	0	1	0	0	0	0	0	0.62
Lassen	2	0	0	0	0	0	0	0	0	0	0.59
Los Angeles	5	2	8	12	10	6	3	6	6	0	0.06
Madera	0	0	0	0	0	0	0	0	1	0	0.07
Marin	3	0	2	7	2	2	1	3	1	3	0.95
Mariposa	0	1	0	0	0	0	0	0	0	1	1.11
Mendocino	5	2	1	1	7	10	8	2	3	3	4.77
Merced	0	0	0	0	0	0	0	0	1	0	0.04
Modoc	0	0	0	0	0	0	0	0	0	0	0.00
Mono	3	1	0	0	0	0	0	1	0	0	3.47
Monterey	1	1	0	0	1	0	0	0	1	1	0.12
Napa	0	1	1	0	2	0	1	0	1	1	0.51
Nevada	4	1	3	2	5	1	2	2	6	1	2.77
Orange	2	0	1	2	1	1	0	5	5	0	0.06
Placer	0	3	2	0	1	1	1	0	1	2	0.31
Plumas	0	0	0	0	0	0	0	0	0	0	0.00
Riverside	2	2	2	0	0	1	4	0	4	0	0.07
Sacramento	4	3	3	2	2	0	1	1	1	1	0.08
San Benito	1	0	0	0	0	0	0	0	0	0	0.18
San Bernardino	2	0	0	0	0	1	0	0	2	0	0.02
San Diego	3	3	7	10	5	3	10	3	9	5	0.19
San Francisco	2	1	9	3	6	3	1	1	1	1	0.34
San Joaquin	0	0	0	0	0	0	0	0	0	1	0.01
San Luis Obispo	0	0	1	0	0	2	0	0	0	1	0.15
San Mateo	5	1	3	2	1	2	1	2	0	0	0.23
Santa Barbara	4	0	0	0	3	1	0	1	3	0	0.28
Santa Clara	4	0	3	8	2	1	2	4	10	5	0.22
Santa Cruz	4	2	1	6	4	3	6	5	10	3	1.66
Shasta	0	2	2	0	0	0	0	1	1	1	0.39
Sierra	0	0	0	0	0	0	0	0	0	1	3.15
Siskiyou	0	0	0	0	0	0	0	0	1	1	0.45
Solano	0	0	0	0	0	0	0	0	0	0	0.00
Sonoma	9	0	11	3	11	8	7	6	5	13	1.50
Stanislaus	0	0	1	0	0	1	1	0	0	0	0.06
Sutter	0	0	0	0	0	0	0	0	0	0	0.00
Tehama	0	0	0	0	0	0	0	0	0	0	0.00
Trinity	0	4	3	0	0	0	0	0	0	0	5.20
Tulare	2	0	0	0	1	0	0	0	0	1	0.09
Tuolumne	0	1	1	0	0	0	0	0	0	0	0.37
Ventura	0	2	1	0	5	2	0	0	0	1	0.13
Yolo	0	1	0	2	0	0	0	0	0	1	0.20
Yuba	0	0	0	0	0	0	0	1	0	1	0.28
California	84	47	92	77	88	69	60	59	80	66	0.19

Tick surveillance

Borrelia spirochetes

In 2012, local, state, and federal agencies collected 9,036 western black-legged ticks (*Ixodes pacificus*) in 24 counties; collection and testing data were collated by the Vector-Borne Disease Section (VBDS). Of the collected ticks, 2,644 western blacklegged ticks (*I. pacificus*) from 23 counties were tested for *Borrelia burgdorferi* (the agent that causes Lyme disease) and related *Borrelia* by either direct fluorescent antibody assay (DFA) for *Borrelia* species, and polymerase chain reaction (PCR) or real-time polymerase chain reaction (RT-PCR) for *Borrelia burgdorferi*. RT-PCR was used to test ticks for *Borrelia miyamotoi*, a tick-borne bacteria recently identified from infected humans in the eastern United States. Table 5 summarizes the testing results for *B. burgdorferi* sensu lato and *B. miyamotoi* spirochetes. A multi-year summary of Lyme disease and tick surveillance in California has recently been posted on the www.cdph.ca.gov website. (Click "Diseases and Conditions" then "Tick-Borne Diseases".)

In 2012, VBDS biologists from southern California investigated four current or historical exposure sites for tick-borne relapsing fever (TBRF) caused by *Borrelia hermsii*. At one site in the Angeles National Forest, none of the 11 rodents captured by VBDS and serologically tested by the National Institutes of Allergy and Infectious Disease - Rocky Mountain Laboratories were positive for antibodies to *B. hermsii*. VBDS biologists investigated three additional exposure sites in the Mammoth Lakes Inyo National Forest area. At a private resort implicated as an exposure site for previously reported cases in 2002 and 2007 as well as in 2012, attempts were made to locate soft ticks both visually and by use of CO₂ (dry ice) baited traps. No ticks were found. At a public cabin resort site, VBDS inspected cabins for presence of soft ticks and rodent activity. No ticks were found but ample evidence of rodent activity was visible. A privately-owned rented cabin site was also investigated by VBDS for presence of ticks and rodents. The site had numerous chipmunks and evidence of rodent activity including owner-reported presence of a snap-trapped chipmunk in the home interior. No soft ticks were found. At all site investigations, property owners/care-takers were given the CDPH TBRF brochure and advised to seal up and exclude rodents from structure interiors and wall voids. It was also recommended that they seek the professional advice from private structural pest control operators for potential acaricide treatment of the exposure sites.

Rickettsia philipii

In 2012, VBDS collected 19 adult, 206 nymphal, and 17 larval Pacific Coast ticks (*Dermacentor occidentalis*) from eight counties for *Rickettsia philipii* testing. Tick collection in Lake County was done in collaboration with Lake County Vector Control District. All ticks were tested by PCR at the CDPH Viral and Rickettsial Disease Laboratory. One nymph from Clear Lake, Lake County was positive for *R. philipii*.

Francisella tularensis

In 2012, VBDS, in collaboration with Napa County Mosquito Abatement District, conducted surveillance for *Francisella tularensis*, the agent that causes tularemia, in ticks collected from Napa County in areas where human cases with suggested tick-bite exposure had been historically reported. *F. tularensis* type B was detected in three of 193 (1.6%) adult American dog ticks (*Dermacentor variabilis*).

Although *Rickettsia philipii* can be detected in both adult and nymphal Pacific Coast ticks, the nymphal stage is thought to be the primary vector to humans because infections occur most often during the summer months when the nymphs, but rarely adults, are active. Nymphal Pacific Coast ticks also have been the only species and life stage found on two human cases where the tick was recovered. CDPH-VBDS continues to conduct surveillance for *R. philipii* in humans and ticks to better characterize the epidemiology of the disease.

Table 5. Minimum infection prevalence or infection prevalence* of *Borrelia burgdorferi sensu lato* and *Borrelia miyamotoi* spirochetes in *Ixodes pacificus* ticks, California 2012**

County Location	No. Ticks Tested		Positive <i>B. burgdorferi</i>		Positive <i>B. miyamotoi</i>		Collected by	Laboratory
	Adults (pools)	Nymphs (pools)	Adults [†] (MIP/IP)*	Nymphs [†] (MIP/IP)	Adults [†] (MIP/IP)	Nymphs [†] (MIP/IP)		
Amador								
Lake Pardee	9	0	0		0		CDPH, VBDS	CDPH, VBDS
Butte								
Loafer Creek SRA	58	8	1 (1.7)	0	1 (1.7)		CDPH, VBDS	CDPH, VBDS
Calaveras								
Campo Seco	30	0	0		0		CDPH, VBDS	CDPH, VBDS
Mokelumne Hill	111	0	0		0		CDPH, VBDS	CDPH, VBDS
Paloma	10	0	0		0		CDPH, VBDS	CDPH, VBDS
Colusa								
Stonyford PA, Mendocino NF	2	0	0		0		CDPH, VBDS	
Dixie Glade CG, Mendocino NF	3	0	0		0		CDPH, VBDS	
Contra Costa								
Tilden RP	0	22		0		0	CDPH, VBDS	CDPH, VBDS
Wildcat Canyon RP	0	12		0		0	CDPH, VBDS	
El Dorado								
Folsom Lake SRA	0	237		37 (15.6) ^a			CDPH/VBDS	Sac/Yolo MVCD
Humboldt								
Humboldt Redwoods SP	7	0	0		0		CDPH, VBDS	CDPH, VBDS
Richardson Grove SP	13	2	0	0	0	0	CDPH, VBDS	CDPH, VBDS
Lake								
Clear Lake SP	0	74		1 (1.4)		0	Lake County VCD	CDPH, VBDS
Lakeport	0	12		0		0	Lake County VCD	CDPH, VBDS
Middle Creek CG, Mendocino NF	0	72		1 (1.4)		0	CDPH, VBDS	CDPH, VBDS
Middletown	0	14		0		0	Lake County VCD	CDPH, VBDS
Los Angeles								
San Dimas Canyon Park	2	0	0		0		CDPH, VBDS	CDPH, VBDS
Marin								
China Camp SP	427(93)	135(17)	12 (2.8) ^b	1 (0.7) ^b			M/S MVCD	M/S MVCD
China Camp SP	46	0	2 (4.3)		0		CDPH, VBDS	CDPH, VBDS
Marin Municipal Water District	481 (114)	427 (93)	10 (2.1) ^b	26 (4.8) ^b			M/S MVCD	M/S MVCD
Mt Tamalpais SP	36 (12)	20 (4)	0 ^b	0 ^b			M/S MVCD	M/S MVCD
Mendocino								
Hell Hole Trail, Mendocino NF	29	17	0	0	0	0	CDPH, VBDS	CDPH, VBDS
Napa								
Bothe-Napa Valley SP	1	44	0	0	0	1 (2.3)	Napa MAD	CDPH, VBDS
Orange								
Crystal Cove SP	56	0	0		0		CDPH, VBDS	CDPH, VBDS
Lazy W	1	0	0		0		CDPH, VBDS	CDPH, VBDS
Placer								
Auburn SRA	132	0	13 (9.8) ^b				Placer MVCD	Placer MVCD
Folsom Lake SRA	22	0	0 ^a				Placer MVCD	Placer MVCD
Hidden Falls RP	36	0	4 (11.1) ^a				Placer MVCD	Placer MVCD
Horseshoe Bar Preserve	48	1	4 (8.3) ^a	0 ^a			Placer MVCD	Placer MVCD
Meadow Vista Staging Area	3	0	0 ^a				Placer MVCD	Placer MVCD
Placer Nature Center	27	0	4 (14.8) ^a				Placer MVCD	Placer MVCD
Steven's Trail	35	0	12 (34.3) ^a				Placer MVCD	Placer MVCD
Sugar Pine Point Trail, Tahoe NF	30	0	1 (3.3) ^a				Placer MVCD	Placer MVCD
Riverside								
Idyllwild	11	0	0		0		Riverside EH	CDPH, VBDS
Sacramento								
Ancil Hoffman Park	22 (7)	0	0 ^a				Sac/Yolo MVCD	Sac/Yolo MVCD
Cache Creek	338 (73)	2	0 ^a	0			Sac/Yolo MVCD	Sac/Yolo MVCD
East Lake Natoma Trail	87 (20)	0	0 ^a				Sac/Yolo MVCD	Sac/Yolo MVCD
Gold Lake Drive	9 (6)	0	0 ^a				Sac/Yolo MVCD	Sac/Yolo MVCD
Folsom Zoo	9 (2)	0	0 ^a				Sac/Yolo MVCD	Sac/Yolo MVCD
Mississippi Bar	251 (55)	1	5 (2.0) ^a	0 ^a			Sac/Yolo MVCD	Sac/Yolo MVCD
Mississippi Bar	0	93		21 (22.6) ^a			CDPH/VBDS	Sac/Yolo MVCD
Negro Bar SP	291 (63)	0	1 (0.3) ^a				Sac/Yolo MVCD	Sac/Yolo MVCD
Nimbus Dam Overlook	82 (19)	0	5 (6.1) ^a				Sac/Yolo MVCD	Sac/Yolo MVCD
Snipes Pershing Park	227 (48)	0	0 ^a				Sac/Yolo MVCD	Sac/Yolo MVCD
Willow Creek	125 (30)	0	4 (3.2) ^a				Sac/Yolo MVCD	Sac/Yolo MVCD
San Benito								
Fremont Peak SP	25	3	0	0	0	0	CDPH, VBDS	CDPH, VBDS
San Mateo								
Belmont OSP	205	0	0		0		San Mateo MVCD	CDPH, VBDS
Crystal Springs Reservoir	41	0	0		0		San Mateo MVCD	CDPH, VBDS
Jasper Ridge	26	0	0		1 (3.8)		CDPH, VBDS	CDPH, VBDS
Portola Valley Ranch	654	0	2 (0.3)		17 (2.6)		San Mateo MVCD	CDPH, VBDS
Russian Ridge OSP	35	0	0		0		CDPH, VBDS	CDPH, VBDS
Windy Hill OSP	64	0	2 (3.1)		1 (1.6)		CDPH, VBDS	CDPH, VBDS
Santa Clara								
Henry Coe SP	0	8		0		0	CDPH, VBDS	CDPH, VBDS
Santa Cruz								
Ben Lomond	10	37	0	0	0	0	CDPH, VBDS	CDPH, VBDS
Davenport	0	12		0		0	Santa Cruz MVCD	CDPH, VBDS
Pogonip City Park	0	31		0		0	CDPH, VBDS	CDPH, VBDS
Solano								
Lynch Canyon OSP	3	0	0		0		CDPH, VBDS	CDPH, VBDS
Rockville Hills RP	21	0	0		0		CDPH, VBDS	CDPH, VBDS
Sonoma								
Annadel SP	305 (62)	268 (34)	12(3.9) ^b	22 (8.2) ^b			M/S MVCD	M/S MVCD
Bennett Valley	47	0	0		0		CDPH, VBDS	CDPH, VBDS
Foothill RP	0	8 (3)		0 ^b			M/S MVCD	M/S MVCD
Hood Mountain RP	1	18 (5)	0 ^b	1 (5.6) ^b			M/S MVCD	M/S MVCD
Jack London SP	169 (40)	66 (11)	6 (3.6) ^b	2 (3.0) ^b			M/S MVCD	M/S MVCD
Ragel Ranch RP	0	5 (1)		0 ^b			M/S MVCD	M/S MVCD
Shiloh Ranch RP	0	25 (4)		1 (4.0) ^b			M/S MVCD	M/S MVCD
Spring Lake RP	94 (20)	55 (6)	2 (2.1) ^b	2 (3.6) ^b			M/S MVCD	M/S MVCD
Sugarloaf Ridge SP	92 (22)	280 (38)	0 ^b	15 (5.4) ^b			M/S MVCD	M/S MVCD
Stanislaus								
Del Puerto Canyon	54	0	0		0		CDPH, VBDS	CDPH, VBDS
Patterson	34	0	0		0		CDPH, VBDS	CDPH, VBDS
Total	4987	2009	102 (2.0)	130 (6.4)	20 (1.3)	1 (0.2)		

*MIP/IP - Measure of prevalence. MIP (minimum infection prevalence) used when ticks are pooled for testing and is equal to the number of positive pools divided by the number of ticks pooled multiplied by 100. IP (infection prevalence) is used when ticks are not pooled for testing and is equal to number of positive ticks divided by ticks tested multiplied by 100.

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

[†]If tested in pools, number positive represents the number of positive pools. If tested individually, number positive represents number of positive individual ticks

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

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

Abbreviations:

Location: NF, National Forest OSP, Open Space Preserve SP, State Park
 NP, National Park PA, Picnic Area SRA, State Recreation Area
 Laboratory: CDPH, VBDS, California Department of Public Health, Vector-Borne Disease Section
 MAD, Mosquito Abatement District M/S MVCD, Marin/Sonoma Mosquito & Vector Control District
 MVCD, Mosquito and Vector Control District VCD, Vector Control District

4

Mosquito-borne Diseases



Mosquito-borne diseases under surveillance in California include the endemic arboviral diseases caused by West Nile virus, western equine encephalomyelitis virus, and St. Louis encephalitis virus, as well as the travel-associated diseases caused by *Plasmodium* spp. (malaria) and dengue virus. Endemic arbovirus surveillance is performed under the California Arbovirus Surveillance program, a cooperative effort of multiple state and local entities.

Human disease surveillance

West Nile virus

Serological diagnosis of human infection with West Nile virus (WNV) and other arboviruses was performed at the CDPH Viral and Rickettsial Disease Laboratory (VRDL) and 26 local county public health laboratories. Local laboratories tested for WNV using an IgM or IgG immunofluorescent assay (IFA) and/or an IgM enzyme immunoassay (EIA). Specimens with inconclusive results were forwarded to the VRDL for confirmation or further testing with a plaque reduction neutralization test (PRNT). Additional WNV infections were identified through testing performed at blood donation centers.

A total of 479 symptomatic and 48 asymptomatic infections with WNV were identified in 2012, the third highest year since detection of WNV in humans in California in 2003 (Table 6). Of the 479 clinical cases, 158 (33%) were classified as West Nile fever, 313 (65%) were West Nile neuroinvasive disease (i.e. encephalitis, meningitis, or acute flaccid paralysis), and eight were of unknown clinical presentation. Case-patients were residents of 31 counties and 280 (58%) were male. Incidence was highest (24.9 cases per 100,000 persons) in Glenn County (Figure 3). The median ages for West Nile fever and neuroinvasive cases were 52 years (range, 1 to 94 years) and 58 years (range, 2 to 93 years), respectively. The median age of the 20 WNV-associated fatalities was 82 years (range, 47 to 91 years). Dates of symptom onset ranged from May 23 – December 9, 2012.

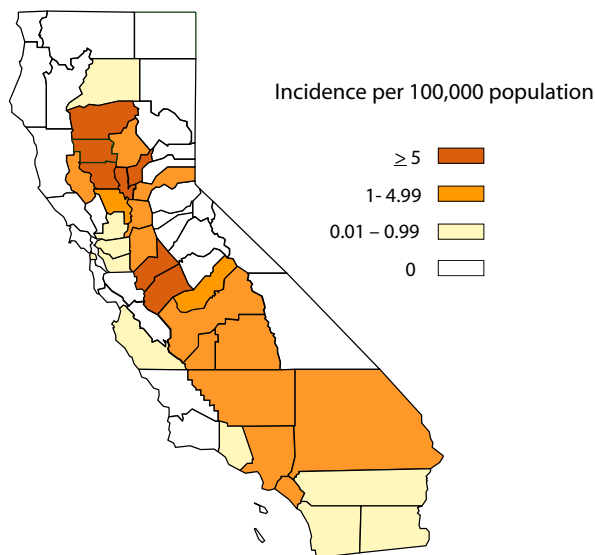


Figure 3. Incidence of human cases of West Nile virus, by county, California 2012

No cases of western equine encephalomyelitis (WEEV) or St. Louis encephalitis (SLEV) were identified in California residents in 2012.

Malaria

Ninety-two confirmed cases of malaria were reported to CDPH in 2012. Case-patients were residents of 26 California counties and 59 (64%) were male. The median age was 35 years old (range, 2-81 years). Of 85 cases for which the *Plasmodium* species was determined, 45 were *P. falciparum*, 32 *P. vivax*, 5 *P. malariae*, and 1 *P. ovale*. Ninety case patients reported travel history within the past three years to malaria-endemic areas including Africa (52), Asia (32), Caribbean (3), and Central America (3). Exposure for two case patients could not be identified.

Dengue

Seventy cases of dengue were reported to CDPH in 2012 (as of June 2013); nine of these met the criteria for a confirmed case and 61 were probable. Case-patients were residents of 19 California counties, 40 (57%) were male, and mean age was 39 years old (range, 5-76 years). All case-patients reported travel to dengue-endemic areas including Asia (30), Central America (14), the Caribbean (12), India (9), North America (2), and South America (2). No locally acquired cases were reported.

The Asian Tiger mosquito (*Aedes albopictus*), a vector of dengue, continues to be detected in Los Angeles County in 2012. Local agencies have enhanced dengue surveillance by ensuring collection of convalescent samples from probable cases which contributed to the increase in confirmed cases from none in 2010 and 2011 to 9 in 2012.

Table 6. Reported WNV human cases by county of residence, California, 2003-2012

County	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Incidence per 100,000 person-years
Alameda	0	0	1	1	0	1	0	1	0	2	0.04
Alpine	0	0	0	0	0	0	0	0	0	0	0.00
Amador	0	0	3	0	0	0	0	0	1	0	1.06
Butte	0	7	24	31	16	6	2	1	3	10	4.52
Calaveras	0	0	2	0	0	1	0	0	0	0	0.66
Colusa	0	0	2	4	2	1	0	0	0	3	5.56
Contra Costa	0	0	11	8	3	4	5	4	3	4	0.40
Del Norte	0	0	0	0	0	0	0	0	0	0	0.00
El Dorado	0	0	1	2	0	1	1	0	1	0	0.33
Fresno	0	11	59	11	17	3	13	23	9	24	1.81
Glenn	0	3	13	12	7	1	0	2	1	7	16.27
Humboldt	0	0	1	0	0	0	0	0	0	0	0.07
Imperial	1	1	1	1	3	0	0	0	0	1	0.45
Inyo	0	0	0	0	0	0	0	0	0	0	0.00
Kern	0	59	67	49	140	2	18	15	18	25	4.64
Kings	0	0	32	1	7	2	3	1	1	3	3.26
Lake	0	1	0	2	0	0	0	0	0	1	0.62
Lassen	0	1	0	0	0	0	0	0	0	0	0.29
Los Angeles	1	306	40	13	36	156	20	4	58	163	0.81
Madera	0	0	18	0	2	0	1	7	2	3	2.17
Marin	0	0	0	1	0	0	0	0	0	0	0.04
Mariposa	0	0	0	0	0	0	0	0	0	0	0.00
Mendocino	0	0	0	0	2	0	0	0	0	0	0.23
Merced	0	1	25	4	4	1	4	1	1	13	2.09
Modoc	0	0	0	2	0	0	0	0	0	0	2.06
Mono	0	0	0	1	0	0	0	0	0	0	0.70
Monterey	0	0	0	0	0	0	1	0	0	1	0.05
Napa	0	0	0	1	1	0	0	0	0	0	0.15
Nevada	0	0	4	1	0	0	0	0	0	0	0.50
Orange	0	62	17	6	9	71	4	1	10	42	0.73
Placer	0	1	35	8	4	6	0	3	1	12	1.99
Plumas	0	0	1	0	0	0	0	0	0	0	0.50
Riverside	1	109	103	4	17	62	3	0	7	19	1.47
Sacramento	0	3	163	15	25	13	0	12	4	29	1.85
San Benito	0	0	0	0	0	0	0	0	0	0	0.00
San Bernardino	0	187	33	3	4	36	2	5	4	33	1.50
San Diego	0	2	1	1	15	35	4	0	0	1	0.19
San Francisco	0	0	2	0	0	0	0	1	0	1	0.05
San Joaquin	0	2	34	8	10	12	10	6	5	13	1.45
San Luis Obispo	0	1	0	1	0	0	0	0	0	0	0.07
San Mateo	0	0	1	0	0	0	0	0	0	0	0.01
Santa Barbara	0	0	2	0	0	1	0	0	1	0	0.09
Santa Clara	0	1	5	5	4	1	0	0	1	0	0.09
Santa Cruz	0	0	0	0	0	0	0	0	1	0	0.04
Shasta	0	5	1	4	9	1	0	0	0	1	1.18
Sierra	0	0	0	0	0	0	0	0	0	0	0.00
Siskiyou	0	0	0	0	0	0	0	0	0	0	0.00
Solano	0	0	5	8	1	1	0	0	0	2	0.41
Sonoma	0	0	1	0	1	0	0	0	0	0	0.04
Stanislaus	0	0	84	11	21	17	14	12	11	26	3.79
Sutter	0	0	9	12	3	0	0	0	0	8	3.34
Tehama	0	10	4	6	4	4	0	0	1	4	5.16
Trinity	0	0	0	0	0	0	0	0	0	0	0.00
Tulare	0	3	56	6	10	5	4	12	11	7	2.55
Tuolumne	0	0	1	0	0	0	0	0	0	0	0.18
Ventura	0	2	1	3	1	0	0	0	0	7	0.17
Yolo	0	1	11	27	2	1	2	0	0	10	2.68
Yuba	0	0	6	5	0	0	1	0	3	4	2.62
Total WNV disease	3	779	880	278	380	445	112	111	158	479	0.97
Asymptomatic infections ^a	0	51	55	14	29	53	17	20	18	48	
Total WNV infections	3	830	935	292	409	498	129	131	176	527	1.05

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

Mosquito surveillance

A total of 933,980 mosquitoes (32,992 pools) collected in 38 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 (Table 7). Four local agencies also tested an additional 8,544 mosquitoes (386 pools) for WNV using a commercial rapid assay-RAMP® (Rapid Analyte Measurement Platform, Response Biomedical Corp).

West Nile virus was detected in 2,849 mosquito pools from 28 counties; 2,815 were positive by RT-PCR (Table 7) and 34 were positive by RAMP only (included in Table 11). Statewide, the minimum infection rate (MIR) - defined as 1,000 times the number of infected mosquito pools divided by the number of mosquitoes tested - of WNV in all mosquitoes tested was 3.0; the MIR was highest (7.9) in Sacramento County (Figure 4). Since 2003, the MIR of WNV in California has ranged from a low of 0.08 (2003) to a high of 3.0 (2012). West Nile virus was identified from five *Culex* species (*Cx. erythrothorax*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. stigmatosoma*, *Cx. tarsalis*) and one other species (*Aedes vexans*) (Table 8).

Table 7. Results of PCR testing of mosquitoes for West Nile (WNV) virus, California 2012

County	No. mosquitoes tested ^a	No. mosquito pools tested	WNV positive pools ^a	WNV Minimum Infection Rate, by PCR only ^b
Alameda	1,860	84	0	0.00
Alpine	0			
Amador	0			
Butte	8,643	176	27	3.12
Calaveras	0			
Colusa	0			
Contra Costa	8,801	286	4	0.45
Del Norte	0			
El Dorado	0			
Fresno	40,341	1,085	143	3.54
Glenn	1,635	33	4	2.45
Humboldt	0			
Imperial	3,026	63	4	1.32
Inyo	398	11	0	0.00
Kern	117,304	3,081	571	4.87
Kings	27,754	754	102	3.68
Lake	17,080	462	23	1.35
Lassen	0			
Los Angeles	116,787	3,286	339	2.90
Madera	4,594	155	14	3.05
Marin	3,082	412	0	0.00
Mariposa	0			
Mendocino	0			
Merced	4,858	234	4	0.82
Modoc	0			
Mono	0			
Monterey	690	15	0	0.00
Napa	3,257	139	1	0.31
Nevada	0			
Orange	35,375	1,530	69	1.95
Placer	36,536	1,742	108	2.96
Plumas	0			
Riverside	166,985	4,526	131	0.78
Sacramento	61,365	4,660	487	7.94
San Benito	0			
San Bernardino	33,540	1,393	58	1.73
San Diego	2,480	96	0	0.00
San Francisco	247	6	0	0.00
San Joaquin	30,369	1,502	169	5.56
San Luis Obispo	1,471	38	0	0.00
San Mateo	344	22	0	0.00
Santa Barbara	7,921	209	0	0.00
Santa Clara	3,288	237	3	0.91
Santa Cruz	1,687	109	0	0.00
Shasta	21,766	680	17	0.78
Sierra	0			
Siskiyou	0			
Solano	2,939	100	3	1.02
Sonoma	25,149	1,294	3	0.12
Stanislaus	71,075	1,783	197	2.77
Sutter	11,071	270	19	1.72
Tehama	0			
Trinity	0			
Tulare	20,954	758	144	6.87
Tuolumne	0			
Ventura	2,008	47	2	1.00
Yolo	33,983	1,626	154	4.53
Yuba	3,317	88	15	4.52
Total	933,980	32,992	2,815	3.01

^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

The first and last detections of WNV in mosquitoes in 2012 were from *Cx. tarsalis* pools collected in Riverside County on March 28 and December 4, respectively.

Animal surveillance

Chicken

In 2012, 39 local mosquito and vector control agencies in 33 counties maintained 197 sentinel chicken flocks (Table 9). Blood samples were collected from chickens every other week and tested for antibodies to SLEV, WNV, and WEEV by an EIA at the CDPH Vector-Borne Disease Section (VBDS) Laboratory. Positive samples were confirmed at the VBDS laboratory by IFA and western blot, or by PRNT as needed.

Out of 19,048 chicken blood samples that were tested, 540 seroconversions to WNV were detected among 112 flocks in 22 counties (Table 9, 11). Statewide, 34.2% 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 2012, the first WNV seroconversion was detected in Riverside County on May 29, and the last seroconversion was detected in Los Angeles County on November 19.

Dead bird and dead squirrel

In 2012, the WNV hotline and website received 20,798 dead bird reports from the public in 57 counties (Table 10). Dead bird carcasses were

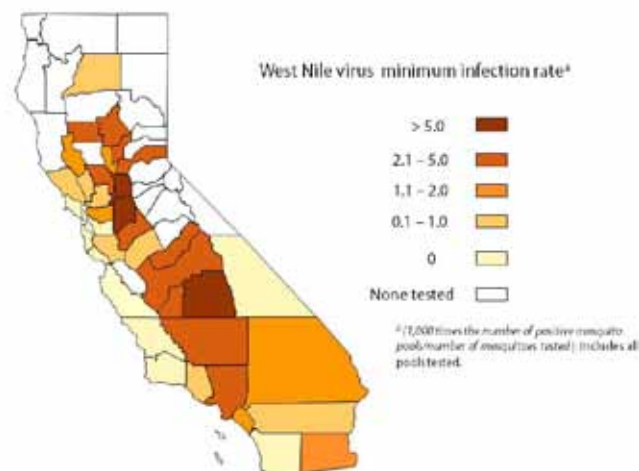


Figure 4. West Nile Virus minimum infection rate of mosquitoes, California, 2012

Table 8. Results of mosquito testing by species for West Nile virus (WNV), California 2012

Mosquito Species	No. Pools Tested	No. Mosquitoes	WNV+	Minimum Infection Rate ^a
Culex species				
<i>Cx. apicalis</i>	3	3	0	0.00
<i>Cx. boharti</i>	4	4	0	0.00
<i>Cx. erythrorhox</i>	2,067	79,688	13	0.16
<i>Cx. pipiens</i>	7,488	143,234	598	4.17
<i>Cx. quinquefasciatus</i>	9,769	305,220	1,132	3.71
<i>Cx. restuans</i>	7	252	0	0.00
<i>Cx. stigmatosoma</i>	715	8,951	22	2.46
<i>Cx. tarsalis</i>	12,515	384,426	1,070	2.78
<i>Cx. thriambus</i>	68	148	0	0.00
unknown	9	116	0	0.00
All Culex	32,645	922,042	2,835	3.07
Anopheles species				
<i>An. franciscanus</i>	4	64	0	0.00
<i>An. freeborni</i>	80	2,086	0	0.00
<i>An. hermsi</i>	61	1,189	0	0.00
<i>An. punctipennis</i>	1	50	0	0.00
unknown	1	25	0	0.00
All Anopheles	147	3,414	0	0.00
Aedes species				
<i>Ae. dorsalis</i>	6	203	0	0.00
<i>Ae. melanimos</i>	16	519	0	0.00
<i>Ae. nigromaculis</i>	1	12	0	0.00
<i>Ae. sierrensis</i>	6	91	0	0.00
<i>Ae. squamiger</i>	5	179	0	0.00
<i>Ae. vexans</i>	35	1,080	3	2.78
<i>Ae. washinoi</i>	12	351	0	0.00
All Aedes	81	2,435	3	1.23
Other species				
<i>Culiseta incidens</i>	300	6,103	0	0.00
<i>Culiseta inornata</i>	20	232	0	0.00
<i>Culiseta particeps</i>	34	748	0	0.00
Unknown	151	7,550	10	1.32
All other	505	14,633	11	0.75

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

tested either at CVEC by RT-PCR, or at one of 24 local agencies by RT-PCR, RAMP or VecTest (Medical Analysis Systems, Inc., Camarillo, CA). Of the 4,467 carcasses deemed suitable for testing, WNV was detected in 2,150 (48%) carcasses from 47 counties; 1,644 tested as acute infections (recent within current surveillance season) from 39 counties, and 506 tested as chronic infections (exposed at an undeterminable time in the past) from 44 counties (Table 10, 11, Figure 5). Since 2003, the prevalence of WNV positive dead birds has ranged from a low of 5% (2003) to a high of 56% (2004). Of the acute infections, 1,453 were confirmed positive by RT-PCR, 142 by RAMP, and 49 by VecTest. In 2012, the first WNV positive dead bird (acute infection) was a house finch reported from Sacramento County on January 18, and the last WNV acute positive dead bird was an American crow reported from Santa Clara County on December 27.

Table 9. Results of testing sentinel chickens for West Nile (WNV) virus, California 2012

County	No. flocks	No. chickens ^a	No. WNV positive flocks	WNV positive sera
Alameda	0			
Alpine	0			
Amador	0			
Butte	7	77	6	45
Calaveras	1	10	0	0
Colusa	1	10	1	6
Contra Costa	5	50	2	7
Del Norte	0			
El Dorado	0			
Fresno	0			
Glenn	1	11	1	8
Humboldt	0			
Imperial	1	10	1	10
Inyo	0			
Kern	10	100	9	74
Kings	0			
Lake	2	12	2	4
Lassen	0			
Los Angeles	48	308	32	135
Madera	0			
Marin	1	6	0	0
Mariposa	0			
Mendocino	0			
Merced	7	42	5	14
Modoc	0			
Mono	0			
Monterey	2	20	0	0
Napa	0			
Nevada	2	20	0	0
Orange	0			
Placer	8	48	3	8
Plumas	0			
Riverside	22	188	13	63
Sacramento	9	69	7	36
San Benito	1	10	0	0
San Bernardino	16	108	11	45
San Diego	2	20	0	0
San Francisco	0			
San Joaquin	0			
San Luis Obispo	0			
San Mateo	1	10	0	0
Santa Barbara	5	50	0	0
Santa Clara	7	49	0	0
Santa Cruz	2	20	0	0
Shasta	7	62	3	6
Sierra	0			
Siskiyou	0			
Solano	3	36	1	2
Sonoma	3	18	1	1
Stanislaus	2	16	2	8
Sutter	5	50	5	38
Tehama	3	30	0	0
Trinity	0			
Tulare	2	20	2	11
Tuolumne	0			
Ventura	5	49	1	2
Yolo	4	28	2	4
Yuba	2	20	2	13
Total	197	1,577	112	540

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

In 2012, 686 dead squirrels were reported through the WNV Hotline; 184 carcasses were tested and WNV RNA was detected by RT-PCR in 23 (12.5%) carcasses from seven counties (Table 11). These included 15 fox squirrels (*Sciurus niger*), 2 eastern gray squirrels (*S. carolinensis*), 1 western gray squirrel (*S. griseus*), 2 California ground squirrels (*Otospermophilus beecheyi*), and 3 were of unknown species.

Horses

Serum or brain tissue specimens from approximately 180 horses displaying neurological signs were tested for WNV at the California Animal Health & Food Safety Laboratory (CAHFS). West Nile virus infection was detected in 22 horses from 13 counties (Table 11); 21 of these horses were unvaccinated. Eight of the horses died or were euthanized as a result of their infection.

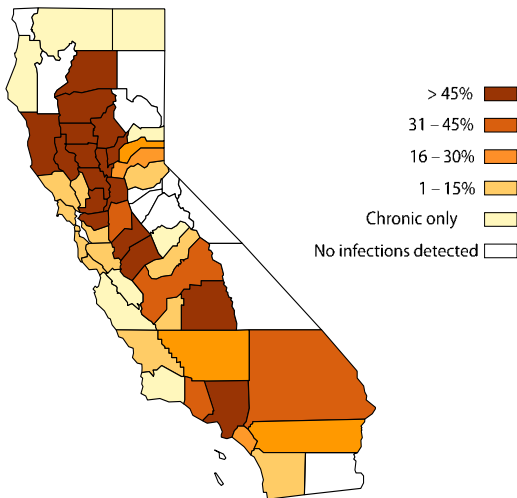


Figure 5. Prevalence of acute West Nile virus infection in dead birds, California, 2012

Table 10. Dead birds reported, tested^a, and positive for West Nile virus, California 2012

County	Reported	Tested	Positive-acute (%)	Positive-chronic (%)
Alameda	591	118	15 (12.7)	23 (19.45)
Alpine	2	2	0	0
Amador	37	0	0	0
Butte	530	111	53 (47.7)	21 (18.9)
Calaveras	43	2	0	0
Colusa	52	8	5 (62.5)	0
Contra Costa	1816	106	66 (62.3)	8 (7.5)
Del Norte	0	0	0	0
El Dorado	377	99	5 (5.1)	21 (21.2)
Fresno	410	60	25 (41.7)	8 (13.3)
Glenn	57	28	16 (57.1)	10 (35.7)
Humboldt	12	4	0	1 (25.0)
Imperial	4	0	0	0
Inyo	7	0	0	0
Kern	368	58	14 (24.1)	9 (15.5)
Kings	67	13	2 (15.4)	4 (30.8)
Lake	97	22	10 (45.5)	0
Lassen	6	0	0	0
Los Angeles	3,309	557	271 (48.7)	69 (12.4)
Madera	58	13	2 (15.4)	5 (38.5)
Marin	191	10	1 (10.0)	3 (30.0)
Mariposa	7	1	0	1 (100)
Mendocino	66	12	6 (50.0)	2 (16.7)
Merced	391	60	42 (70.0)	4 (6.7)
Modoc	7	4	0	1 (25.0)
Mono	2	0	0	0
Monterey	125	29	0	7 (24.1)
Napa	82	9	1 (11.1)	6 (66.7)
Nevada	79	16	3 (18.8)	8 (50.0)
Orange	306	353	92 (26.1)	17 (4.8)
Placer	506	320	60 (18.8)	33 (10.3)
Plumas	13	0	0	0
Riverside	351	32	5 (15.6)	4 (12.5)
Sacramento	3,621	960	466 (49.0)	58 (6.0)
San Benito	20	4	0	2 (50.0)
San Bernardino	592	120	39 (32.5)	25 (20.8)
San Diego	192	111	1 (0.90)	0
San Francisco	118	19	1 (5.3)	7 (36.8)
San Joaquin	888	145	58 (40.0)	13 (9.0)
San Luis Obispo	131	16	1 (6.3)	3 (18.8)
San Mateo	383	54	5 (9.3)	17 (31.5)
Santa Barbara	71	13	0	5 (38.5)
Santa Clara	868	164	20 (12.2)	3 (1.8)
Santa Cruz	185	39	1 (2.6)	16 (41.0)
Shasta	163	69	36 (52.2)	5 (7.2)
Sierra	2	1	0	1 (100)
Siskiyou	10	2	0	1 (50.0)
Solano	564	49	28 (57.1)	2 (4.1)
Sonoma	398	55	8 (14.5)	16 (29.1)
Stanislaus	776	112	51 (45.5)	22 (19.6)
Sutter	167	43	29 (67.4)	2 (4.7)
Tehama	112	11	5 (45.5)	1 (9.1)
Trinity	4	0	0	0
Tulare	310	110	54 (49.1)	13 (11.8)
Tuolumne	19	1	0	0
Ventura	494	103	38 (36.9)	18 (17.5)
Yolo	591	201	98 (48.8)	10 (5.0)
Yuba	150	18	11 (61.1)	1 (5.6)
Totals	20,798	4,467	1,644 (36.8)	506 (11.3)

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

Table 11. Infections with West Nile virus in California, 2012

County	Dead		Mosquito	Sentinel	Dead	
	Humans ^a	Birds	Pools	Chickens	Squirrels	Horses
Alameda	2	15	0	0	1	0
Alpine	0	0	0	0	0	0
Amador	0	0	0	0	0	0
Butte	10	53	27	45	2	1
Calaveras	0	0	0	0	0	1
Colusa	3	5	0	6	0	0
Contra Costa	4	66	19	7	0	0
Del Norte	0	0	0	0	0	0
El Dorado	0	5	0	0	0	0
Fresno	29	25	147	0	0	3
Glenn	9	16	4	8	0	1
Humboldt	1	0	0	0	0	0
Imperial	1	0	4	10	0	0
Inyo	0	0	0	0	0	0
Kern	28	14	571	74	0	2
Kings	3	2	102	0	0	0
Lake	1	10	23	4	0	0
Lassen	0	0	0	0	0	0
Los Angeles	179	271	339	135	15	0
Madera	3	2	14	0	0	1
Marin	0	1	0	0	0	0
Mariposa	0	0	0	0	0	0
Mendocino	0	6	0	0	0	0
Merced	13	42	4	14	0	1
Modoc	0	0	0	0	0	0
Mono	0	0	0	0	0	0
Monterey	1	0	0	0	0	0
Napa	0	1	1	0	0	0
Nevada	0	3	0	0	0	0
Orange	48	92	69	0	0	0
Placer	12	60	108	8	0	0
Plumas	0	0	0	0	0	0
Riverside	19	5	133	63	0	0
Sacramento	32	466	487	36	1	2
San Benito	0	0	0	0	0	0
San Bernardino	37	39	58	45	0	0
San Diego	2	1	0	0	0	0
San Francisco	1	1	0	0	0	0
San Joaquin	15	58	169	0	0	2
San Luis Obispo	0	1	0	0	0	0
San Mateo	0	5	0	0	0	0
Santa Barbara	0	0	0	0	0	0
Santa Clara	0	20	3	0	2	0
Santa Cruz	0	1	0	0	0	0
Shasta	1	36	17	6	1	5
Sierra	0	0	0	0	0	0
Siskiyou	0	0	0	0	0	0
Solano	2	28	3	2	0	0
Sonoma	0	8	3	1	0	0
Stanislaus	28	51	210	8	0	1
Sutter	8	29	19	38	0	0
Tehama	4	5	0	0	0	0
Trinity	0	0	0	0	0	0
Tulare	9	54	144	11	0	0
Tuolumne	0	0	0	0	0	0
Ventura	7	38	2	2	0	0
Yolo	11	98	154	4	1	1
Yuba	4	11	15	13	0	1
State Totals	527	1,644	2,849	540	23	22

^aIncludes asymptomatic infections detected through blood bank screening

The statewide WNV minimum infection rate in mosquitoes and the sentinel chicken seroconversion rate were higher in 2012 than in any other year since surveillance began for WNV in California in 2000.

5

U.S. Forest Service Cost-Share Agreement



In 1992, the Vector-Borne Disease Section entered into a Challenge Cost-Share Agreement with the Pacific Southwest Region of the United States Department of Agriculture Forest Service (USFS) to maintain cooperative surveillance and control of vector-borne diseases within the National Forests. This report highlights some of the vector-borne disease monitoring, risk assessment, risk reduction, and education of personnel, concessionaires, and the public that the Vector-Borne Disease Section and local collaborators conducted at the 18 National Forests in California in 2012.

Angeles National Forest

VBDS biologists conducted tick-borne relapsing fever (TBRF) surveillance at a long-term lease summer camp that was the reported potential exposure site of a suspect pediatric case of the disease. None of the 11 rodents sampled was positive for serum antibodies to *Borellia hermsii*, causative agent of TBRF. Ten *Peromyscus spp.* mice samples submitted for Sin Nombre virus (SNV) testing were all negative for serum antibodies to SNV, the virus that causes hantavirus cardiopulmonary syndrome (HCPS). Biologists conducted a visual assessment of plague risk at Table Mountain Campground and determined rodent control measures implemented by the campground concessionaire earlier in the year were successful.

None of the 188 California ground squirrels (*Otospermophilus beecheyi*) from 16 Forest sites sampled and tested for plague by the Los Angeles County Public Health Vector Control and Management Program was positive for serum antibodies to *Yersinia pestis*, the causative agent for plague. The Los Angeles County Agricultural Commissioner's Office conducted general flea control at 57 Forest recreational sites.

Cleveland National Forest

Upon request, VBDS biologists conducted hantavirus surveillance at the Santiago Peak Communications site. None of the nine *Peromyscus spp.* mice or 23 other rodents captured was positive for antibodies to SNV. In addition, biologists visually evaluated the Santiago Peak Communications site for hantavirus risk and gave risk reduction recommendations to the Forest Safety Officer; the site was cleaned under VBDS observation. Biologists conducted plague surveillance at Fry Creek and Observatory campgrounds where none of the 25 samples tested was positive for antibodies to *Y. pestis*. VBDS staff also notified the Forest Safety Officer of positive plague results on adjoining State property from surveillance conducted in collaboration with San Diego County Vector Control Program. The San Diego program also provided VBDS with test results from surveillance conducted on ticks and rodents from Forest lands (data included in Table 12).

Eldorado National Forest

Eleven out of 49 (22%) deer mice (*Peromyscus maniculatus*), sampled at Leek Springs Fire Lookout and Lumberyard Fire Station were positive for serum antibodies to SNV. Nine rodent samples tested negative for antibodies to *Y. pestis*. Plague caution signs were posted at recreational locations in the Pacific Ranger District and along the State Highway 88 corridor. Vector-borne disease issues were discussed with Visitor Center staff and the American Land and Leisure concessionaire manager at the Crystal Basin Visitor Center.

Inyo National Forest

VBDS biologists followed up at the reported exposure site of a Forest Service employee who contracted hantavirus cardiopulmonary syndrome (HCPS) in May 2012. The case investigation on the Mammoth Lakes Ranger District included sylvatic rodent trapping as well as serological testing and virus sequencing in collaboration with the Viral and Rickettsial Diseases Laboratory at CDPH. Five of 38 (13%) deer mice from

Convict Lake restrooms and the Fort Morse Pack Station tested positive for serum antibodies to SNV. Staff assisted Forest and Regional leadership with identifying special risk factors particular to Inyo National Forest staff and the Forest implemented a respiratory protection program for employees involved in cleaning seasonally closed facilities.

Biologists also conducted surveillance activities for plague and investigated tick-borne relapsing fever cases associated with properties adjacent to or leased from the Forest with recommendations to reduce risk given to residents/owners associated with the cases. Routine plague surveillance detected serum antibodies to *Y. pestis* in 4 of 23 (17%) rodents tested from Four Jeffrey Campground and 1 of 17 (6%) Lodgepole chipmunks (*Tamias speciosus*) tested from Upper Falls Tract housing. Follow-up surveillance from an additional 40 rodent samples did not uncover any additional positive specimens at Four Jeffrey and there were no reports or evidence of animal die-offs noted by the campground concessionaire. Plague surveillance was also conducted at Sherwin Creek campground. None of 27 rodents sampled was positive for serum antibodies to *Y. pestis*.

Upon request, the Forest Safety Officer was provided with safety brochures on the primary vector-borne diseases found in the eastern Sierra and a 45 minute safety presentation titled "Vector-Borne Diseases on the Inyo National Forest" was presented to staff at the Forest-wide Safety Meeting in Bishop. High-use campgrounds were also visited and the concessionaires were provided with hantavirus and plague safety brochures.

Klamath National Forest

VBDS Biologists visited the Forest headquarters in Yreka to speak with staff and deliver educational brochures covering Lyme disease, hantavirus, plague and tick-borne relapsing fever as well as wallet-sized tick ID and bed bug inspection cards. None of the 22 carnivores tested from lands adjacent to the Forest was positive for serum antibodies to *Y. pestis*.

Lake Tahoe Basin Management Unit

Plague surveillance was conducted at Taylor Creek and Tallac Historic Sites in response to a chipmunk carcass that tested positive for *Y. pestis* from Camp Richards. Serological testing showed two yellow-pine chipmunks (*Tamias amoenus*) out of 45 rodents sampled, were positive for serum antibodies to *Y. pestis*. Areas were marked with plague warning signs and VBDS biologists reviewed a Lake Tahoe Basin Management Unit generated press release concerning the plague risk in the area. Biologists

also conducted a visual hantavirus risk assessment at the Myers facility's associated historic buildings and discussed risk reduction recommendations with the Safety Officer and renovation manager during the walk-through.

Lassen National Forest

The Eagle Lake and Hat Creek Ranger Districts were contacted by VBDS staff to ensure adequate educational brochures were available for staff and visitors. In addition, a VBDS biologist met with the Eagle Lake District Ranger and offered assistance to the District's new Recreation staff. Biologists visited several campgrounds in the Districts to ensure plague caution signs were posted. A rodent carcass submitted for testing was negative by culture for plague bacteria.

Los Padres National Forest

VBDS biologists conducted plague surveillance at Chuchupate Campground in collaboration with Ventura County Environmental Health staff. None of the six California ground squirrels tested positive for antibodies to *Y. pestis*. Additionally, none of the 23 carnivores tested from lands adjacent to the Forest was positive for plague antibodies. Biologists also visited the Mt. Pinos and Santa Barbara District offices to educate staff of VBDS services and distribute VBDS educational brochures and tick wallet cards. Staff also discussed hantavirus and plague awareness with the Paradise Campground concessionaire.

Mendocino National Forest

Adult and nymphal ticks were collected by biologists from various campgrounds and public access areas on the Forest. One nymphal tick tested positive by PCR for *Borrelia burgdorferi*, causative agent for Lyme disease. Hantavirus risk assessments were conducted at the Stonyford Ranger Station, Eel River and Elk Creek Work Stations. Additionally, VBDS conducted hantavirus surveillance at the Stonyford Work Center where a Pest Control Operator conducts rodent control. None of the three *Peromyscus spp.* mice captured and tested was positive for serum antibodies to SNV. Each location visited received risk reduction recommendations and the staff at the Eel Creek Work Station was instructed on more efficient rodent trapping methods. An impromptu vector-borne disease education session was held for the 15 firefighters present at the District Office and District personnel were provided with public education and vector-borne disease prevention brochures.

Modoc National Forest

Hantavirus risk assessment and surveillance were conducted at the Buck Creek Guard Station

where one of four (25%) deer mice was positive for serum antibodies to SNV. Test results and risk reduction recommendations were communicated to the Warner Mountain Ranger District safety representative. VBDS biologists also conducted plague and hantavirus surveillance at Lassen Creek and Plum Valley Campgrounds where none of the 13 rodents sampled was positive for serum antibodies to *Y. pestis* or SNV. Public Health Biologists also participated in the Forest's safety training seminar, advised staff on proper disinfection and clean-up techniques to avoid rodent-borne diseases, and provided the Forest and Ranger Districts with plague caution placards and vector-borne disease educational brochures for distribution to staff and visitors.

Plumas National Forest

Rodent-borne disease surveillance for hantavirus and plague was conducted at several locations on the Beckwourth Ranger District. Results from all surveillance events were communicated to the responsible Forest and/or District staff. At Cottonwood and Frenchman Lake Campgrounds, one of six (17%) deer mice was positive for serum antibodies to SNV and none of the 37 sciurid rodents sampled was positive for antibody to *Y. pestis*. Fleas from these animals were kept for comparison with previous samples collected during the 1990s. Laufman Fire Station was re-surveyed as part of a regional hantavirus evaluation for 2012. Two of 20 (10%) rodents were positive for serum antibodies to SNV. Two additional plague surveillance efforts at Cottonwood Spring Group Camp found no evidence of plague in the four and nine rodents sampled respectively; fleas from these animals were also retained for comparison to samples obtained from the 1990s.

VBDS biologists assessed Black Mountain Lookout and Crocker Guard Station for hantavirus risk and discussed rodent exclusion in response to requests and as a follow-up to repairs and recommended rodent-proofing measures from previous visits. Written recommendations were submitted by email to Forest staff.

San Bernardino National Forest

Tick, hantavirus, and plague surveillance were conducted at the Forest lands listed below in collaboration with the Riverside County Department of Environmental Health Vector Control Program and San Bernardino County Mosquito and Vector Control Program. From 81 *Peromyscus* samples submitted over the year, one deer mouse and one cactus mouse from Rouse Hill Road tested positive for serum antibodies to SNV. One carnivore and a total of 90 rodent plague samples were tested from Applewhite, Green Valley Lake, Jenk's Lake, Marion Mountain, Fern Basin, Boulder Basin, and Stone Creek Campgrounds. Of these 91 samples, one California ground squirrel, submitted by the Riverside County program from Fern Basin Campground, tested positive for serum antibodies to *Y. pestis*. The Forest Safety Officer and District staff was notified by email. This was the first plague positive California ground squirrel in the San Jacinto Ranger District in over ten years. Upon request, VBDS biologists identified a *Dermacentor andersoni* tick submitted by the San Jacinto District Ranger and bat bugs submitted by a Forest employee. Safety presentations were given by VBDS biologists to San Jacinto and Front County Ranger District staff at various locations. Safety and disease prevention materials and brochures were provided to all Ranger Districts.

Sequoia National Forest

Staff at the Kern River Ranger District requested VBDS conduct a hantavirus risk assessment and surveillance at the Kernville Work Center and Fire Station. Biologists conducted a walk-through of the facilities and made verbal recommendations to the responsible parties. No mice were captured in the 50 Sherman traps set in and around the location, indicating the private Pest Control Operator was having success in reducing rodent numbers. As requested, biologists evaluated hantavirus risk at Cannell Meadow and the Oak Flat Lookout and made verbal recommendations to the maintenance staff. Plague surveillance was conducted at Tillie Creek Campground where none of the eight California ground squirrels captured was positive for serum antibodies to *Y. pestis*. The 11 carnivore samples tested from lands adjacent to the Forest were also negative. Plague caution placards were posted at campgrounds and day use sites along the Kern River, and the District Ranger was briefed on vector-borne diseases and the safety training opportunities offered under the Cost-Share Agreement.

Shasta-Trinity National Forest

Adult tick surveillance was conducted at Pollard Gulch, Nelson Point, and Oak Grove Campgrounds where people may easily come in contact with ticks. VBDS biologists collected 17, 20, and 16 western blacklegged ticks (*Ixodes pacificus*) respectively from these locations. VBDS staff ensured that areas were posted with tick warning signs. Neither of two carnivore samples from adjacent lands was positive for antibodies to *Y. pestis*.

VBDS staff visited the Shasta Lake Ranger Station, discussed hantavirus and Lyme disease concerns with District staff and provided educational and safety brochures and tick cards for distribution to USFS personnel and visitors to the Forest.

Sierra National Forest

Twelve carnivores sampled from lands adjacent to the Forest were all negative for antibodies to *Y. pestis*. The Batterson Work Station was evaluated for hantavirus and tick-borne relapsing fever risk at the request of the Forest Safety Officer (FSO). A Public Health Biologist from VBDS gave on-site verbal recommendations for rodent reduction and exclusion and submitted a written report to the FSO and Region Safety Officer. In addition, a presentation on hantavirus and Lyme disease was given to approximately 20 District personnel, and VBDS reviewed public safety recommendations made by Forest staff.

Six Rivers National Forest

VBDS contacted the Forest and supplied informational brochures on vector-borne diseases found in California for distribution to staff and visitors to the Forest.

Stanislaus National Forest

A Douglas' squirrel (*Tamiasciurus douglasii*) carcass was recovered from the Boy Scouts of America (BSA) Camp Wolfboro long-term lease facility on the Calaveras Ranger District and tested negative for plague but positive for tularemia. VBDS staff notified the Forest Safety Officer and District personnel and gave safety recommendations to Camp staff. Neither of the two carnivores tested was positive for serum antibodies to *Y. pestis*. Recreational sites throughout the Forest were posted with plague caution placards and educational and safety brochures on vector-borne diseases were distributed to Forest Headquarters and Ranger Districts as well as campground concessionaires. VBDS contacted Forest leadership and Ranger Districts to offer vector-borne disease prevention and safety presentations and gave presentations to Calaveras Ranger District staff and BSA staff at Camp Wolfboro.

Tahoe National Forest

Public health biologists conducted plague and hantavirus surveillance at Martis Peak Lookout where one of six (17%) deer mice was positive for serum antibodies to SNV and one of five (20%) rodents was positive for serum antibodies to *Y. pestis*. Recommendations for rodent exclusion and risk reduction were provided to responsible District staff. Separately, two rodent carcasses submitted from Logger Campground and near Martis Peak Lookout, tested negative for plague. Plague surveillance was conducted at Boca Lake, Boca Springs, and Prosser Family and Group Campgrounds. Fourteen of 95 (15%) rodents were serologically positive for *Y. pestis* at Boca Lake and Boca Springs Campgrounds. Appropriate Forest and District Safety staff were notified of the positive plague results. Plague caution placards were posted at campgrounds on the Sierraville and Yuba River Ranger Districts.

Humboldt-Toiyabe (R4)

Plague caution signs were posted at campgrounds and trailheads. Tick ID cards along with vector-borne disease prevention and educational brochures were distributed to campground hosts.

Other R5 Activities

VBDS biologists provided Regional staff with information on hantavirus safety and cleanup procedures at remote communications sites, and reviewed a hantavirus information sheet sent to R5 Forest Supervisors. Staff met with the R5 liaison and Safety Officer to review past activities and plan future activities beneficial to both parties in accordance with the Cost-Share Agreement. VBDS provided a link to VBDS produced videos on tick safety and trapping deer mice in USFS facilities. Centers for Disease Control and Prevention first aid information for tick and rattlesnake bites, as well as pesticide usage and quarterly reports, were also provided to Region leadership.

Table 12. Testing results for selected vector-borne disease agents in U.S. National Forests, California 2012

National Forest	Hantavirus (<i>Peromyscus</i> mice)		<i>Yersinia pestis</i> (rodents)		<i>Yersinia pestis</i> (carnivores) ^a		<i>Borrelia</i> spp. (<i>Ixodes</i> ticks)	
	Positive	Tested ^b	Positive	Tested ^b	Positive	Tested	Positive	Tested
Angeles	0	10	0	188	0	5		
Cleveland	0	22	0	121			0	6
Eldorado	11	49	0	9				
Inyo	5	38	5	107				
Klamath					0	22		
Lake Tahoe BMU			3	46				
Lassen			0	1				
Los Padres			0	6	0	23		
Mendocino	0	3			0	22	1	123
Modoc	1	9	0	13				
Plumas	3	36	0	50				
San Bernardino	2	81	1	90	0	1		
Sequoia			0	8	0	11		
Shasta-Trinity					0	2		
Sierra					0	12		
Stanislaus			0	1	0	2		
Tahoe	1	6	15	102	0	5		
Total, all forests	23	254	24	742	0	105	1	129

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

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

6

Vector Control Technician Certification Program



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

To become certified in a control category, applicants must pass the Core section and at least one Specialty section of the examination. Each applicant to the examination pays a fee for each section requested on the application. The Core section consists of questions about the safe and effective use of pesticides. Specialty sections of the examination include the Biology and Control of Mosquitoes in California, Arthropods of Public Health Significance in California, and Vertebrates of Public Health Importance in California (Table 13). Successful examinees are issued a gold certification card that is valid for up to two years in the qualified categories specified on the card. To maintain full certification status in subsequent two-year cycles, Certified Technicians must pay annual renewal fees and fulfill minimum continuing education requirements. The California Department of Public Health (CDPH), Vector-Borne Disease Section (VBDS) approved 79 continuing education events in 2012. Successful examinees who 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 2012, 1,247 Vector Control Technicians employed at 116 local or state public health agencies held 2,934 certificates (Table 14). The agencies include special districts, departments of county government, departments of city government, the University of California, and CDPH. Of these agencies, 82 are signatory to a cooperative agreement with CDPH.

Table 13. Results of certification examinations administered in 2012.

Exam section	No. Exams Given	No. Passed (%)
Core	106	70 (66)
Mosquito Control	108	55 (51)
Terrestrial Invertebrate Control	69	44 (64)
Vertebrate Vector Control	59	46 (78)
Totals	342	215 (63)

In 2012, 828 individuals employed at 82 agencies held full certification status. In addition, 418 employees from 63 agencies held limited status. Many agencies employ technicians with both full and limited status.

In 2010, CDPH developed a new Certification and Training database website that combined the CDPH Access database and the Mosquito and Vector Control of California Intranets website. The new site allows Vector Control Technicians to view their certification records and the approved Vector Control continuing education courses. This website is <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 14. Vector Control Technician certificates in effect as of December 2012

Certification Category	No. Certificates		
	Full Status	Limited Status	Total
Mosquito Control	809	265	1,074
Terrestrial Invertebrate Vector Control	655	223	878
Vertebrate Vector Control	660	323	983
Totals	2,124	811	2,934

7

Outreach, Public Information Materials, Publications



Vector-Borne Disease Section staff present information on vector-borne diseases at scientific conferences, continuing education workshops, university courses, and training sessions. Research projects in which Vector-Borne Disease Section staff were a principal or collaborating investigator are published in the peer-reviewed scientific literature.

Presentations

In 2012, Vector-Borne Disease Section (VBDS) staff gave 47 presentations and training sessions as shown in Table 15.

Public Information Materials

In 2012, new public education materials as listed below were created and distributed. In addition, eight documents were revised or updated. All public education materials are available from the VBDS webpage: <http://www.cdph.ca.gov/programs/vbds/Pages/default.aspx>

- Reporting a Dead Bird (video)
- California Rodent-borne Disease Report, July-December 2012; Winter 2012
- California Plague Report, Summer 2012; Winter 2012
- Ticks in the Workplace (fact sheet)
- Protect Yourself from Ticks Where You Work (poster)
- Alert and Guidance for Physicians with Patients Presenting with Concerns or Symptoms of Hantavirus Pulmonary Syndrome after Visit to Yosemite National Park
- Trapping Deer Mice in USFS Facilities (video)
- Rodents and Hantavirus brochure (Spanish)
- What You Need to Know About Bed Bugs (wallet card)

The new Reporting a Dead Bird video posted on the CDPH YouTube website was viewed over 3,700 times in 2012.

Table 15: Presentations provided by Vector-Borne Disease Section staff, 2012

Subject Area	Number of Talks	Audiences
Vector-borne Diseases, General	12	California Conference of Communicable Disease Controllers; Calaveras Search and Rescue; CalTrans; Kern County Environmental Health Group; Mariposa County Agricultural Commissioner's Office; MVCAC; UC Davis
Ticks and Tick-borne Diseases	13	CDPH; Santa Cruz County Health Department; Humboldt-Del Norte Medical Consortium; Kaiser Pediatric Infectious Disease Physicians; MVCAC; UC Davis; USFS
Mosquitos and Mosquito-borne Diseases	2	MVCAC; Environmental Health Department, Riverside County
Rodent-borne Diseases	8	Boyscouts of America; CalTrans; Girl Scouts of America; MVCAC; Southern California Vector Educational Cooperative and REHS; USFS
Other Vectors, Public Health Pests, and Miscellaneous	12	California Environmental Health Association; Public Works Department; MVCAC; Southern California Vector Control Environmental Taskforce; UC Berkeley; UC Davis

Abbreviations:

- CalTrans: California Department of Transportation
- CDPH: California Department of Public Health
- MVCAC: Mosquito and Vector Control Association of California
- REHS: Registered Environmental Health Specialist
- UC: University of California
- USFS: United States Forest Service

Publications

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Eremeeva ME, Karpathy SE, Krueger L, Hayes EK, Williams AM, Zaldivar Y, Benett S, Cummings R, Tilzer A, Velten RK, Kerr N, Dasch GA and Hu R. Two pathogens and one disease: Detection and identification of flea-borne *Rickettsiae* in areas endemic for murine typhus in California. *Journal of Medical Entomology* 2012; 49: 1485-1494.

Feiszli, T; Padgett, K; Park, B; Eldridge, B; Fang, Y; Reisen, WK; Jean-Yen, C; Foss, L and Kramer, V. Surveillance for Mosquito-borne Encephalitis Virus Activity in California, 2011. *Proceedings and Papers of the 80th Annual Conference of the Mosquito and Vector Control Association of California*, 2012.

Fritz CL, Kriner P, Garcia D, Padgett KA, Espinosa A, Chase R, Hu R, Messenger SL. Tick Infestation and Spotted-Fever Group *Rickettsia* in Shelter Dogs, California, 2009. *Zoonoses and Public Health* 2012; 59: (1): 4-7.

Hu R. Vectorial capacity of the brown dog tick (*Rhipicephalus sanguineus*) for *Rickettsiae*. *Proceedings and Papers of the 80th Annual Conference of the Mosquito and Vector Control Association of California* 2012; 80: 50.

Lane RS and Hu R. Tick-borne disease symposium: An introduction. *Proceedings and Papers of the 80th Annual Conference of the Mosquito and Vector Control Association of California* 2012; 80: 37.

Metzger ME and Hu R. Asian tiger mosquito (*Aedes albopictus*) symposium: An introduction. *Proceedings and Papers of the 80th Annual Conference of the Mosquito and Vector Control Association of California* 2012; 80: 24.

Metzger ME and Hu R. History of *Aedes albopictus* introductions into California. *Proceedings and Papers of the 80th Annual Conference of the Mosquito and Vector Control Association of California* 2012; 80: 25.

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