
Marin/Sonoma

Mosquito and Vector Control

District



2024

Vector Surveillance Report

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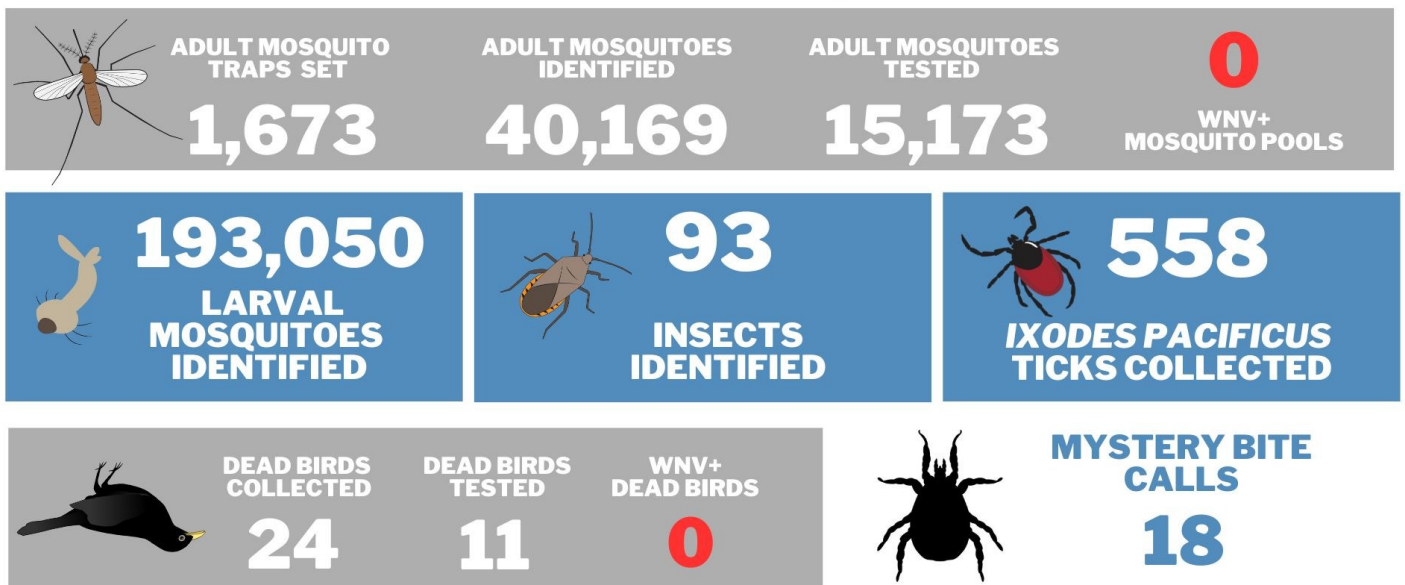
Laboratory Program Overview

Programs and Activities

The laboratory at the Marin/Sonoma Mosquito and Vector Control District (the District) contributes to the District’s mission of protecting the health and welfare of the communities it serves in many ways. This includes monitoring the species distribution and abundance of vectors and vector-borne diseases, evaluating the efficacy of mosquito control materials and equipment, and providing support for operations staff in surveillance and control. On a regular basis, laboratory staff are busy working on a number of projects and activities. Operations staff bring in larval samples daily for the laboratory to identify, helping the District to know where and when different species are active, and when it is time to institute source reduction and/or treat sources with a larvicide. Members of the public also submit photos and specimens of insects for laboratory staff to identify. This year the District processed 93 submissions. In addition, laboratory staff work closely with the District’s Rodent Control Specialist on unique cases involving mystery biting incidents, with particular attention to the tropical rat mite, as they can cause a significant issue for the public. The infographic below shows the extensive work completed by the laboratory in 2024.



MSMVCD LABORATORY 2024 BY THE NUMBERS



Laboratory Program Overview

Arbovirus Surveillance Program

The Marin/Sonoma Mosquito and Vector Control District (the District) maintains a multifaceted surveillance program for arboviruses, including West Nile virus (WNV), St. Louis encephalitis virus (SLEV), and western equine encephalitis virus (WEEV). The District utilizes active and passive surveillance techniques to detect and quantify the density of mosquito populations and the intensity of virus transmission in the region. This information is then used to predict areas of elevated disease risk and inform critical vector control interventions to effectively and efficiently protect human health.

Since 2014, the District has conducted enhanced invasive mosquito surveillance efforts. The invasive species *Aedes aegypti* and *Aedes albopictus* have expanded their range throughout California, reaching closer to our county borders every year. These mosquitoes are aggressive daytime biters, and can make it virtually impossible to enjoy outdoor activities. They can also transmit diseases that our native mosquitoes cannot, making them a potential threat to public health. Neither species has been found in Marin or Sonoma counties, but we need your help! Call if you're being bitten by any mosquitoes, and make sure to let us know if it's during the daytime!

An innovative 3D printed adult mosquito trap

The District sets over 1,800 adult mosquito traps annually, utilizing carbon dioxide and a light source to attract adult mosquitoes. During the 2024 adult mosquito season, staff evaluated the effectiveness of the conventional traps compared with another commercially available trap, as well as 3D printed traps. Measurements and field studies determined that all the new traps functioned better than the original. Though comparable in functionality, the 3D printed trap cost significantly less than the others. The development of this innovative trap demonstrates a cost effective and efficient alternative to commercially available traps for adult mosquito surveillance.



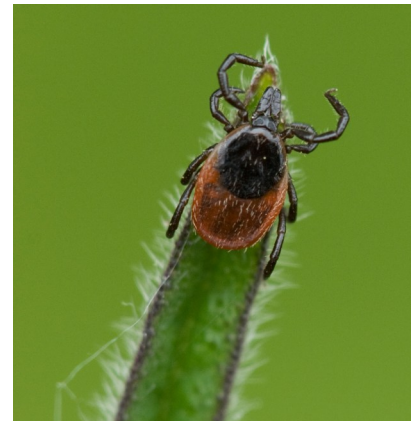
Laboratory Program Overview

Tick and Tick-Borne Disease

Surveillance Program

Throughout the year, District laboratory staff collect ticks of different species and life stages from trails in state, regional, and local parks and recreation areas around Marin and Sonoma counties. Ticks are collected by dragging a one meter square flannel flag on the ground and in the vegetation along trails. Collected specimens are identified and separated by species, sex, and life stages to be tested for pathogens when appropriate. The three main species collected by the District are *Dermacentor occidentalis* (the Pacific Coast tick), *Dermacentor variabilis* (the American dog tick), and *Ixodes pacificus* (the western black-legged tick).

Ixodes pacificus is the common tick species in the area that can transmit *Borrelia burgdorferi*, the bacterium that causes Lyme disease. Adults and nymphs of this species are tested for this pathogen, as well as *Borrelia miyamotoi*, which is a bacteria that causes a relapsing fever-type illness. This bacteria has been found in *I. pacificus* throughout the state, including in Marin and Sonoma counties. In 2022, California's first human case of disease linked to *B. miyamotoi* was identified in Marin County. *I. pacificus* also transmits the human pathogen *Anaplasma phagocytophilum*.



Ixodes pacificus female questing

In 2024, the Centers for Disease Control and Prevention determined that the American dog tick in California is a different species than in other parts of the United States. The new scientific name is *Dermacentor similis*.

Tick species of Marin and Sonoma counties



Dermacentor occidentalis

Pacific Coast tick



Dermacentor similis

American dog tick



Ixodes pacificus

Western black-legged tick



Arbovirus Surveillance

Arbovirus Surveillance Program

In 2024, 144 mosquito pools* from Marin County and 449 pools from Sonoma County were tested for WNV, SLEv, and WEEv. WNV was not detected in any mosquito pools tested in either county in 2024.

A total of 24 dead birds were collected, of which 11 were suitable for WNV testing. No birds from either county tested positive for WNV in 2024.

*Female mosquitoes of the same species collected in the same trap are pooled by species (up to 50 per tube) to be tested for the presence of WNV, SLEv, and WEEv.

County	Species	# of Pools
Marin	<i>Culex erythrothorax</i>	67
	<i>Culex pipiens</i>	21
	<i>Culex stigmatosoma</i>	22
	<i>Culex tarsalis</i>	34
Sonoma	<i>Culex erythrothorax</i>	141
	<i>Culex pipiens</i>	48
	<i>Culex stigmatosoma</i>	128
	<i>Culex tarsalis</i>	132

WNV detection 2004 - 2023				
Year	Humans	Dead Birds	Mosquito Pools*	Sentinel Chickens
2004	0	72	1	0
2005	1	92	0	0
2006	1	29	5	0
2007	1	23	1	0
2008	0	12	2	0
2009	0	N/A	0	0
2010	0	N/A	0	0
2011	0	N/A	2	0
2012	0	28	3	1
2013	2	46	5	3
2014	0	43	12	3
2015	1	14	12	0
2016	0	13	2	N/A
2017	0	6	1	N/A
2018	0	0	1	N/A
2019	0	0	0	N/A
2020	0	1	0	N/A
2021	0	1	2	N/A
2022	0	1	0	N/A
2023	1	18	6	N/A
2024	0	0	0	N/A

N/A indicates that testing was not conducted

West Nile Virus Dead Bird Hotline

The California Department of Public Health runs a hotline that residents from any county in the state can call when they find a dead bird. If you find one, please let them know! When birds are the right species in the right conditions, the District can have them tested for WNV. Visit westnile.ca.gov for more info.



Executive Summary

Tick and Tick-Borne Disease

Surveillance Program

In 2024, staff from the District visited seven parks in 13 sampling events, resulting in 515 *Ixodes pacificus* adults and 47 *I. pacificus* nymphs collected for testing. A multiplex real-time polymerase chain reaction (PCR) assay was used to test these ticks for two bacteria: *Borrelia burgdorferi* (the causative agent of Lyme disease) and *Borrelia miyamotoi* (a related bacterium that can cause a relapsing fever-type illness). Nymphal ticks were tested individually, while adult ticks were pooled by collection date, location, and sex. A maximum of five ticks were placed in each pool. In previous years, nymphal ticks were tested in pools as well. Therefore overall infection prevalences for both counties are presented below as Minimum Infection Prevalence (MIP).

Minimum Infection Prevalence (MIP) = (number of positive tick pools/total ticks tested)*100

Ixodes pacificus testing for *Borrelia burgdorferi*: 2008 - 2024

County	Total Adults Tested	Minimum Infection Prevalence	Total Nymphs Tested	Minimum Infection Prevalence
Marin	7,953	2.10%	2,622	4.08%
Sonoma	9,506	1.53%	2,675	4.07%
Overall	17,459	1.79%	5,297	4.08%

Ixodes pacificus testing for *Borrelia miyamotoi*: 2016 - 2024

County	Total Adults Tested	Minimum Infection Prevalence	Total Nymphs Tested	Minimum Infection Prevalence
Marin	2,951	1.08%	1,012	0.99%
Sonoma	3,178	0.72%	832	1.08%
Overall	6,129	1.00%	1,844	1.03%

2024 Overview

Marin County: Nine pools of adults tested positive for *Borrelia burgdorferi*. One pool of adults and one nymph tested positive for *Borrelia miyamotoi*.

Sonoma County: One pool of adults tested positive for *Borrelia burgdorferi*. Four pools of adults tested positive for *Borrelia miyamotoi*.

Visit our website at www.msosquito.org/tick-surveillance for detailed information about cumulative tick collections at specific parks.



2024 Adult Tick Testing

Tick and Tick-Borne Disease

Surveillance Program

County	Park/Trail	Adults Tested (Pools)	<i>Borrelia burgdorferi</i>		<i>Borrelia miyamotoi</i>	
			Pos. Pools	MIP	Pos. Pools	MIP
Marin	Bald Hill Open Space Preserve	74 (16)	2	2.70%	1	1.35%
	Connector to Sky Ranch Trail	30 (7)	1	3.33%	0	0.00%
	Yolanda Trail	44 (9)	1	2.28%	1	2.28%
	Gary Giacomini Open Space Preserve	21 (6)	1	4.76%	0	0.00%
	Willis Evans Trail	21 (6)	1	4.76%	0	0.00%
	Marin Municipal Water District	16 (4)	2	12.5%	0	0.00%
	Sunnyside Trail	16 (4)	2	12.5%	0	0.00%
	Mount Tamalpais State Park	140 (28)	4	2.86%	0	0.00%
	Alice Eastwood Trail	110 (22)	3	2.73%	0	0.00%
	Panoramic Trail	30 (6)	1	3.33%	0	0.00%
Total	251 (54)	9	3.59%	1	0.40%	
Sonoma	Hood Mountain Regional Park	62 (14)	0	0.00%	1	1.61%
	Lower Johnson Ridge Trail	62 (14)	0	0.00%	1	1.61%
	Shiloh Ranch Regional Park	192 (41)	1	0.052%	3	1.56%
	Big Leaf Trail	192 (41)	1	0.052%	3	1.56%
	Sugarloaf State Park	10 (4)	0	0.00%	0	0.00%
	Canyon Trail	1 (1)	0	0.00%	0	0.00%
	Hillside Trail	8 (2)	0	0.00%	0	0.00%
	Pony Gate Trail	1 (1)	0	0.00%	0	0.00%
Total	264 (59)	1	0.38%	4	1.52%	

Minimum Infection Prevalence (MIP) = (number of positive tick pools/total ticks tested)*100

indicates site/trail not previously sampled



2024 Nymphal Tick Testing

Tick and Tick-Borne Disease

Surveillance Program

County	Park/Trail	Nymphs Tested	<i>Borrelia burgdorferi</i>		<i>Borrelia miyamotoi</i>	
			Pos. Pools	MIP	Pos. Pools	MIP
Marin	Bald Hill Open Space Preserve	1	0	0.00%	0	0.00%
	Connector to Sky Ranch Trail	1	0	0.00%	0	0.00%
	Yolanda Trail	0	n/a	n/a	n/a	n/a
	Gary Giacomini Open Space Preserve	42	0	0.00%	1	2.38%
	Willis Evans Trail	42	0	0.00%	1	2.38%
	Marin Municipal Water District	0	n/a	n/a	n/a	n/a
	Sunnyside Trail	0	n/a	n/a	n/a	n/a
	Mount Tamalpais State Park	4	0	0.00%	0	0.00%
	Alice Eastwood Trail	4	0	0.00%	0	0.00%
	Panoramic Trail	0	n/a	n/a	n/a	n/a
Total	47	0	0.00%	1	2.13%	
Sonoma	Hood Mountain Regional Park	0	n/a	n/a	n/a	n/a
	Lower Johnson Ridge Trail	0	n/a	n/a	n/a	n/a
	Shiloh Ranch Regional Park	0	n/a	n/a	n/a	n/a
	Big Leaf Trail	0	n/a	n/a	n/a	n/a
	Sugarloaf State Park	0	n/a	n/a	n/a	n/a
	Canyon Trail	0	n/a	n/a	n/a	n/a
	Hillside Trail	0	n/a	n/a	n/a	n/a
	Pony Gate Trail	0	n/a	n/a	n/a	n/a
Total	0	n/a	n/a	n/a	n/a	

Infection Prevalence (IP) = (number of positive ticks/total ticks tested)*100

indicates site/trail not previously sampled



Tick Safety Tips

Tick and Tick-Borne Disease

Surveillance Program

Before entering tick habitat, take the following precautions

- Consider applying an effective tick repellent to exposed skin that has one of the following EPA-registered active ingredients: DEET, picaridin, IR3535, oil of lemon eucalyptus (OLE), or para-menthane-diol (PMD).
- Consider pretreating clothing/personal outdoor equipment with a product labeled for tick protection, such as permethrin.
- It is important to read repellent and permethrin product labels carefully before applying.
- Wear light-colored clothing (making it easier to spot ticks).
- Wear long pants, long sleeves, and long socks whenever possible. This makes it more difficult for ticks to get to your skin.

While in tick habitat

- Stay on trails. Adult ticks are typically more abundant on uphill sides of trails.
- Avoid contact with nymphal habitats, including leaf litter, downed logs, and tree trunks.
- Periodically check people and animals for ticks.

After exiting tick habitat

- Check people and animals for ticks, promptly removing any that might be on clothing or skin.
- Tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks.
- Shower after coming indoors and carefully check for ticks.
- Properly remove any attached ticks immediately.

How to properly remove a tick

- Ideally, use tweezers to grasp the head of the tick as close to the skin as possible.
- Pull upward with steady, even pressure. DO NOT twist or jerk the tick; this can cause the mouthparts to break off and remain in the skin. If this happens, remove the mouthparts with tweezers. If you are unable to remove the mouthparts easily with clean tweezers, leave it alone and let the skin heal.
- After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water.
- Never crush a tick with your fingers. Dispose of a live tick by putting it in alcohol, placing in a sealed bag/container, wrapping it tightly in tape, or flushing it down the toilet.
- If redness or pain develops at the tick site, consult your physician.