
Marin/Sonoma Mosquito and Vector Control District



2021 Vector Surveillance Report

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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 both 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 direct critical vector control interventions to effectively and efficiently protect human health.

Since 2014, the District has conducted enhanced surveillance to detect invasive *Aedes* mosquito species. In addition to larval and adult surveillance for the invasive *Aedes aegypti* and *Aedes albopictus*, the District also investigates travel-related cases of chikungunya, dengue, and Zika viruses. All traps set around cases are checked for the presence of adult *Aedes* mosquitoes. All adult female *Culex* species mosquitoes collected in these areas are tested for all three viruses, though there is no evidence that local *Culex* spp. can transmit these viruses. As of 2021, no invasive *Aedes* mosquitoes have been identified in Marin or Sonoma counties.

Why should we care about invasive *Aedes*?

The District has been around for over 100 years, and as vector control specialists we manage 23 native species of mosquitoes in Marin and Sonoma counties. So what's so special about invasive *Aedes*? They are very aggressive biters, preferring to bite humans during the day. This can make it virtually impossible to enjoy the outdoors. They also lay their eggs in all different types of containers; from plant saucers to buckets to discarded plastic bottles, and even in plants themselves! Bromeliads are a perfect hiding spot for the immature mosquitoes. Most importantly, these mosquitoes can transmit viruses that our native mosquitoes can't, making them a potential threat to public health. The District will continue to survey all areas where these species might be found, but we need your help! Call or visit our website to let us know if you're being bitten by mosquitoes, and make sure to let us know if it's during the daytime!



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 bacteria 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. To date, no human cases of *B. miyamotoi* have been reported in California, but the bacteria has been found in *I. pacificus* ticks throughout the state, including in Marin and Sonoma counties. *I. pacificus* also transmits the human pathogen *Anaplasma phagocytophilum*. In 2021, the District collaborated with state health to test a subset of ticks for this bacteria.

Tick-Safe Landscaping Tips

Did you know there are ways to make your own yard less desirable for ticks? Follow these tips to create a tick-safe yard through landscaping:

- Keep your lawn and decorative plants trimmed and well maintained.
- Remove leaf and grass litter from your yard.
- Create a tick barrier at the edge of your property by putting down a 3-foot gravel or wood chip border between your lawn and any unmaintained or overgrown natural areas that you may live next to.
- Move yard furniture and swing sets away from the edges of the yard to more open and sunny areas.

For more tips on keeping you and your family safe from ticks, visit www.msquito.org/tick-safe-landscaping-tips

EXECUTIVE SUMMARY

Arbovirus Surveillance Program

In 2021, 91 mosquito pools* from Marin County and 422 pools from Sonoma County were tested for WNV, SLEv, and WEEv. WNV was detected in two mosquito pools in Sonoma County. No virus was detected in mosquito pools from Marin County.

A total of 17 dead birds were reported in 2021, of which 11 were suitable for WNV testing. One bird from Santa Rosa in Sonoma County tested positive for WNV. No birds from Marin County were positive.

*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.

Mosquito pools by species	
Marin County	
Species	Number of Pools
<i>Culex erythrothorax</i>	58
<i>Culex pipiens</i>	7
<i>Culex stigmatosoma</i>	12
<i>Culex tarsalis</i>	14
Total	91
Sonoma County	
Species	Number of Pools
<i>Culex erythrothorax</i>	165
<i>Culex pipiens</i>	82
<i>Culex stigmatosoma</i>	59
<i>Culex tarsalis</i>	116
Total	422

WNV detection 2004—2021				
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

#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 and in the right condition, 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 2021, staff from the District sampled trails in state parks, regional parks, and the Marin Municipal Water District (MMWD) lands. A total of 45 sampling events occurred at 11 locations, resulting in 829 adult *Ixodes pacificus* and 310 *I. pacificus* nymphs being collected for testing. Each park was visited up to six times between January and December. 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. Up to five ticks were placed in each pool.

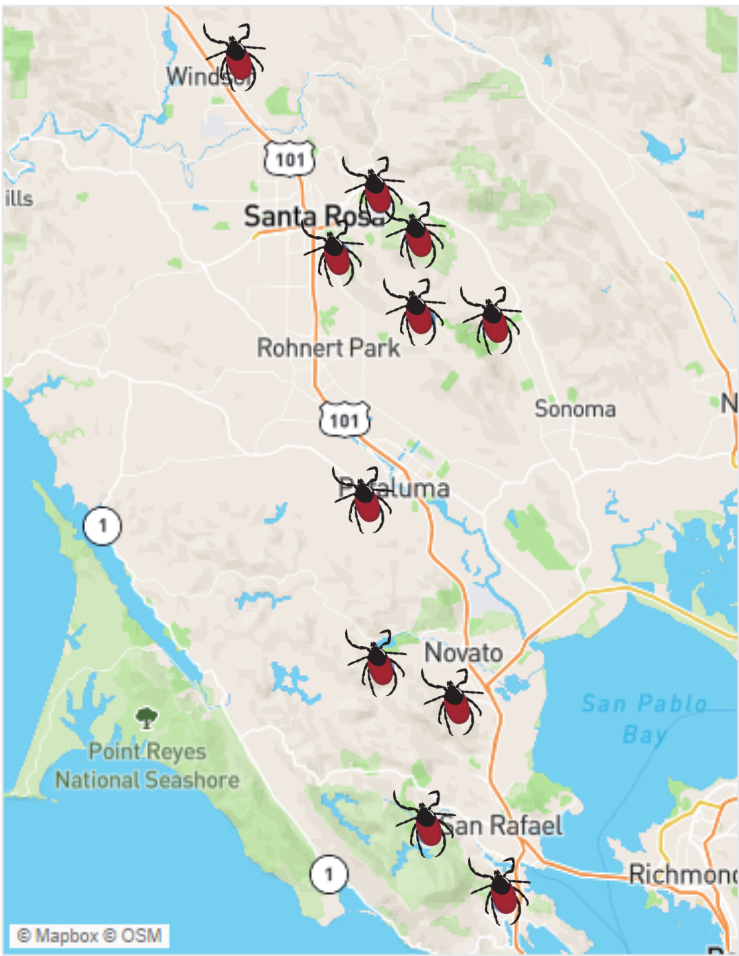
2021 Overview



Parks Sampled in 2021

Five pools of adult ticks and 10 nymphs from Marin County, and three pools of adult ticks from Sonoma County tested positive for *Borrelia burgdorferi* (pages 6/7). No nymphs from Sonoma County tested positive for *B. burgdorferi*.

Six pools of adult ticks and two nymphs from Marin County, and two pools of adult ticks and two nymphs from Sonoma County tested positive for *Borrelia miyamotoi* (pages 6/7).



2021 ADULT TICK TESTING

Tick and Tick-Borne Disease Surveillance program

Of the 829 adult *Ixodes pacificus* ticks tested in 2021, eight pools tested positive for *Borrelia burgdorferi*, giving an overall minimum infection prevalence (MIP)* of 0.97% for Marin and Sonoma counties. The 10-year MIP for adult ticks in these counties is 1.82%. Eight adult tick pools tested positive for *B. miyamotoi* in 2021, for a MIP of 0.97%.

Marin County parks and recreation areas had five *B. burgdorferi* positive pools out of 306 total adult ticks tested, for a MIP of 1.63%. The 10-year MIP for adult ticks in Marin County is 2.12%. Six adult tick pools tested positive for *Borrelia miyamotoi* in 2021, for a MIP 1.96%.

Sonoma County parks and recreation areas had three *B. burgdorferi* positive pools out of 523 total adult ticks tested, for a MIP of 0.57%. The 10-year MIP for adult ticks in Sonoma County is 1.65%. Two adult tick pools tested positive for *B. miyamotoi* in 2021, for a MIP of 0.38%.

Marin County

Sonoma County

Park/Trail	Adults Tested (Pools)	<i>B. burgdorferi</i>		<i>B. miyamotoi</i>		Park/Trail	Adults Tested (Pools)	<i>B. burgdorferi</i>		<i>B. miyamotoi</i>	
		Pos. Pools	MIP	Pos. Pools	MIP			Pos. Pools	MIP	Pos. Pools	MIP
Camino Alto OSP	105 (31)	2	1.90%	1	0.95%	Annadell SP	90 (19)	3	3.33%	1	1.11%
Bay Vista Trail	67 (16)	0	0.00%	0	0.00%	Channel Trail	0 (0)	n/a	n/a	n/a	n/a
Camino Alto Fire Rd.	12 (3)	0	0.00%	0	0.00%	Lawndale Trail	90 (19)	3	3.33%	1	1.11%
Lower Summit Fire Rd.	9 (4)	0	0.00%	0	0.00%	Live Oak Trail	0 (0)	n/a	n/a	n/a	n/a
Octopus Trail	17 (8)	2	11.76%	1	5.88%	Foothill RP	45 (13)	0	0.00%	0	0.00%
Indian Tree OSP	87 (20)	1	1.15%	2	2.30%	Alta Vista Trail	1 (1)	0	0.00%	0	0.00%
Big Trees Trail	87 (20)	1	1.15%	2	2.30%	Oakwood Trail	6 (3)	0	0.00%	0	0.00%
Indian Valley OSP	57 (15)	1	1.75%	1	1.75%	Ravine Trail	37 (8)	0	0.00%	0	0.00%
Susan Alexander Trail	2 (2)	0	0.00%	0	0.00%	Three Lakes Trail	1 (1)	0	0.00%	0	0.00%
Waterfall Trail	55 (13)	1	1.82%	1	1.82%	Westside Trail	0 (0)	n/a	n/a	n/a	n/a
Marin Municipal Water District	57 (13)	1	1.75%	2	3.51%	Helen Putnam RP	141 (30)	0	0.00%	0	0.00%
Alex Forman Trail	57 (13)	1	1.75%	2	3.51%	Filaree Trail	0 (0)	n/a	n/a	n/a	n/a
Overall	306 (79)	5	1.63%	6	1.96%	South Loop Trail	141 (30)	0	0.00%	0	0.00%
						Jack London SP	71 (17)	0	0.00%	0	0.00%
						Wolf House Ruins Trail	71 (17)	0	0.00%	0	0.00%
						North Sonoma Mountain RP	0 (0)	n/a	n/a	n/a	n/a
						Umbrella Tree Trail	0 (0)	n/a	n/a	n/a	n/a
						Spring Lake RP	4 (2)	0	0.00%	0	0.00%
						Multipurpose Trail	4 (2)	0	0.00%	0	0.00%
						Taylor Mountain RP	172 (38)	0	0.00%	1	0.58%
						Red Tail Trail	172 (38)	0	0.00%	1	0.58%
						Overall	523 (119)	3	0.57%	2	0.38%

*MIP—Minimum Infection Prevalence =
(number of positive tick pools/total ticks tested) X 100;
used when ticks are tested in pools up to 5



2021 NYMPHAL TICK TESTING

Tick and Tick-Borne Disease Surveillance Program

Of the 310 nymphal *Ixodes pacificus* ticks tested in 2021, 10 tested positive for *Borrelia burgdorferi*, giving an overall infection prevalence (IP)* of 3.23% for Marin and Sonoma counties. The 10-year MIP for nymphal ticks in these counties is 4.21%. Four nymphal ticks tested positive for *B. miyamotoi* in 2021, for an overall IP of 1.29% for Marin and Sonoma counties.

Marin County parks and recreation areas had 10 *B. burgdorferi* positive nymphs out of 213 total nymphs tested, for an IP of 4.69%. The 10-year MIP for nymphal ticks in Marin County is 3.93%. Two nymphal ticks tested positive for *B. miyamotoi* in 2021, for an IP 0.94%.

Sonoma County parks and recreation areas had no *B. burgdorferi* positive nymphs out of 97 total nymphs tested. The 10-year MIP for nymphal ticks in Sonoma County is 4.50%. Two nymphal ticks tested positive for *B. miyamotoi* in 2021, for an IP of 2.06%.

Marin County

Sonoma County

Park/Trail	Nymphs Tested	<i>B. burgdorferi</i>		<i>B. miyamotoi</i>		Park/Trail	Nymphs Tested	<i>B. burgdorferi</i>		<i>B. miyamotoi</i>	
		Pos. Ticks	IP	Pos. Ticks	IP			Pos. Ticks	IP	Pos. Ticks	IP
Camino Alto OSP	53	0	0.00%	1	1.89%	Annadell SP	10	0	0.00%	0	0.00%
Bay Vista Trail	24	0	0.00%	0	0.00%	Channel Trail	0	n/a	n/a	n/a	n/a
Camino Alto Fire Rd.	0	n/a	n/a	n/a	n/a	Lawndale Trail	0	n/a	n/a	n/a	n/a
Lower Summit Fire Rd.	0	n/a	n/a	n/a	n/a	Live Oak Trail	10	0	0.00%	0	0.00%
Octopus Trail	29	0	0.00%	1	3.45%	Foothill RP	2	0	0.00%	1	50.00%
Indian Tree OSP	84	4	4.76%	0	0.00%	Alta Vista Trail	1	0	0.00%	1	100.00%
Big Trees Trail	84	4	4.76%	0	0.00%	Oakwood Trail	0	n/a	n/a	n/a	n/a
Indian Valley OSP	24	1	4.17%	1	4.17%	Ravine Trail	1	0	0.00%	0	0.00%
Susan Alexander Trail	0	n/a	n/a	n/a	n/a	Three Lakes Trail	0	n/a	n/a	n/a	n/a
Waterfall Trail	24	1	4.17%	1	4.17%	Westside Trail	0	n/a	n/a	n/a	n/a
Marin Municipal Water District	52	5	9.62%	0	0.00%	Helen Putnam RP	16	0	0.00%	0	0.00%
Alex Forman Trail	52	5	9.62%	0	0.00%	Filaree Trail	5	0	0.00%	0	0.00%
Overall	213	10	4.69%	2	0.94%	South Loop Trail	11	0	0.00%	0	0.00%
						Jack London SP	25	0	0.00%	0	0.00%
						Wolf House Ruins Trail	25	0	0.00%	0	0.00%
						North Sonoma Mountain RP	42	0	0.00%	1	2.38%
						Umbrella Tree Trail	42	0	0.00%	1	2.38%
						Spring Lake RP	2	0	0.00%	0	0.00%
						Multipurpose Trail	2	0	0.00%	0	0.00%
						Taylor Mountain RP	0	n/a	n/a	n/a	n/a
						Red Tail Trail	0	n/a	n/a	n/a	n/a
						Overall	97	0	0.00%	2	2.06%

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

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 treating clothes/personal outdoor equipment with an acaricide containing permethrin.
- 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 it in a sealed bag/container, wrapping it tightly in tape, or flushing it down the toilet.
- If redness or pain develops at the tick bite site, consult your physician.

For more information about our services and programs:
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