
Marin/Sonoma Mosquito and Vector Control District



2019 VECTOR SURVEILLANCE REPORT

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 monitoring techniques (defined below) to detect and quantify the density of mosquito populations and the intensity of virus transmission in the region. This information is 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 efforts 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 *Aedes* adult mosquitoes. All *Culex* adult mosquitoes collected in these areas are tested for all three viruses. There is no evidence that local *Culex* spp. can transmit these viruses. As of 2019, no invasive *Aedes* mosquitoes have been identified in Marin or Sonoma counties.

Active vs Passive Surveillance

The District utilizes both active and passive surveillance to identify potential areas of high mosquito abundance and disease transmission in Marin and Sonoma counties. Active surveillance involves collecting larval and adult mosquitoes, identifying changes in mosquito density and testing adult Culex species mosquitoes for WNV, SLEV and WEEV. The passive surveillance program relies on reports of virus activity in humans and horses, as well as citizens submitting dead birds, which are then tested for the presence of virus. The District can target active surveillance and control measures in an area if a bird, human or horse has become sick from the virus.

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 stage 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 the bacteria *Borrelia burgdorferi*, which causes Lyme disease. Adults and nymphs of this species are tested for this pathogen, as well as *Borrelia miyamotoi*, which is a bacterium 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 *Ixodes pacificus* ticks throughout the state, including in Marin and Sonoma counties.

Dermacentor species ticks can be tested for other pathogens in conjunction with the California Department of Public Health.



District staff flagging for ticks



Adult female *Ixodes pacificus*



District staff checking flags for ticks

EXECUTIVE SUMMARY

Arbovirus Surveillance Program

In 2019, 187 mosquito pools from Marin County and 583 pools from Sonoma County were tested for WNV, SLEv and WEEv. No virus was detected in any mosquito pools in either county. A total of 14 dead birds were reported to the District, of which 11 were viable for WNV testing. All birds tested negative. There were no human or equine cases of WNV in Marin or Sonoma counties.

In 2019, local health departments informed the District of 12 travel-associated probable cases of arthropod-borne diseases in Marin County and nine (9) travel-associated probable cases in Sonoma County. Twenty-five (25) mosquito pools collected during these follow-ups were tested for chikungunya, dengue and Zika viruses, as well as WNV, SLEv and WEEv. All pools tested negative for all viruses.

WNV detection 2004 - 2019

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

*N/A indicates that testing was not conducted

Mosquito pools by species 2019

Marin County

Species	Number of Pools
<i>Culex erythrothorax</i>	35
<i>Culex pipiens</i>	35
<i>Culex stigmatosoma</i>	14
<i>Culex tarsalis</i>	103
<i>Culex thriambus</i>	0
Total	187

Sonoma County

Species	Number of Pools
<i>Culex erythrothorax</i>	170
<i>Culex pipiens</i>	50
<i>Culex stigmatosoma</i>	103
<i>Culex tarsalis</i>	254
<i>Culex thriambus</i>	6
Total	583

Birds tested by city 2019

Marin County

City	Processed	Tested	WNV(+)
Corte Madera	1	1	0
San Anselmo	1	1	0
Novato	3	2	0
Mill Valley	1	1	0

Sonoma County

City	Processed	Tested	WNV(+)
Cotati	1	1	0
Glen Ellen	1	1	0
Santa Rosa	5	4	0
Sebastopol	1	0	0

Probable case follow-up

Disease	Marin	Sonoma
Chikungunya	1	0
Dengue	4	4
Malaria	1	0
Zika	6	5

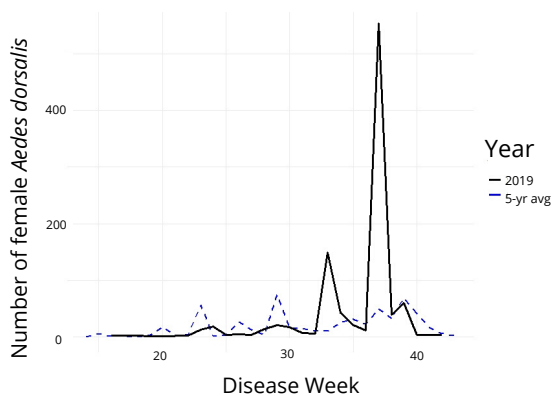
THE PALE MARSH MOSQUITO

Arbovirus Surveillance Program

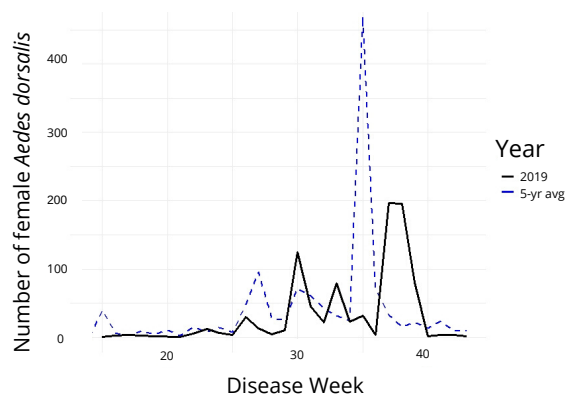
You might have noticed at the end of this summer that adult mosquitoes were fairly abundant. Beginning in April 2019, the District collected adult mosquitoes at regular weekly trap locations, and saw small shifts in the pattern of species abundance and timing to previous years.

However, a large number of one specific mosquito, *Aedes dorsalis*, caused a large uptick in adult mosquitoes in the late summer, accounting for the noticeable increase in biting females in both counties in August and September.

Female *Aedes dorsalis* Collected in Marin County By Disease Week



Female *Aedes dorsalis* Collected in Sonoma County By Disease Week



Aedes dorsalis - the pale marsh mosquito

Aedes dorsalis is a very common salt marsh mosquito in California. It can be found throughout the summer, and can impact schools, businesses, agriculture and the community! It is an aggressive daytime biter, and when populations are as heavy as they were this past summer, it can make it difficult to enjoy outdoor activities. Like all mosquito species, the District tries to control this mosquito at the larval stage, but when adults are present, you should use CDC recommended repellents, including products with DEET, picaridin, IR3535, oil of lemon eucalyptus (OLE) or para-methane-diol (PMD). For more information, visit our website (<https://www.msmosquito.org/repellents>).



EXECUTIVE SUMMARY

Tick and Tick-borne Disease Surveillance Program

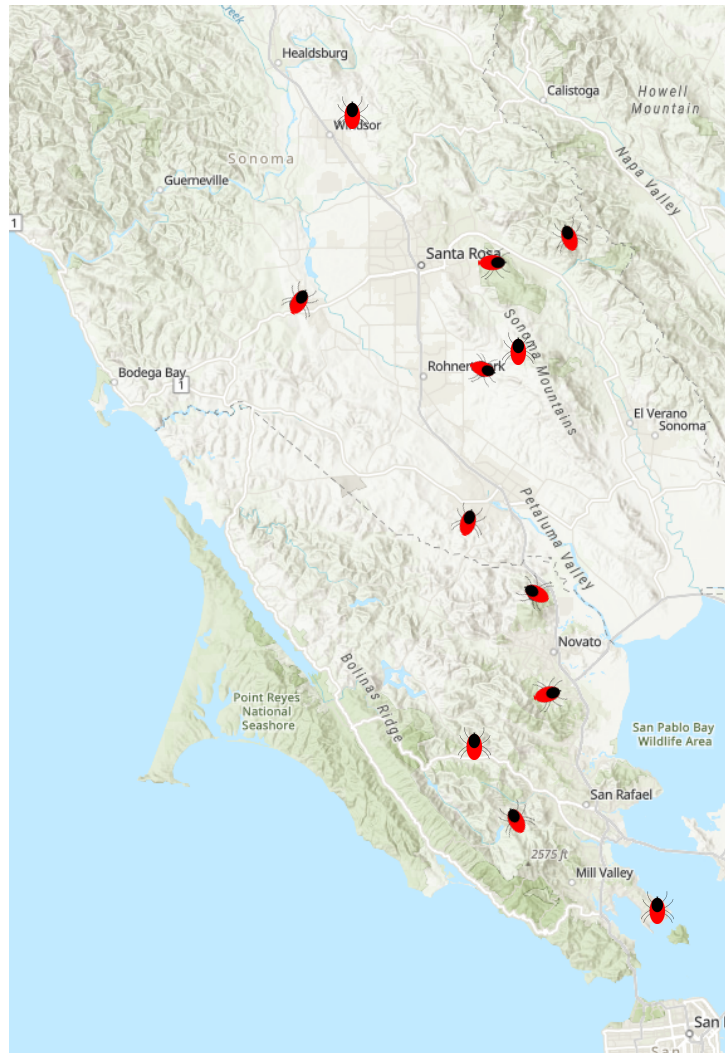
In 2019, staff from the District sampled trails in state parks, regional parks and Marin Municipal Water District (MMWD) lands. A total of 32 sampling events occurred during the season, resulting in 1163 adult *Ixodes pacificus* and 260 *Ixodes pacificus* nymphs being collected for testing. A multiplex PCR assay was used to test these samples 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).

2019 Overview



Parks Sampled in 2019

- Four (4) pools of adult ticks collected in Marin County and nine (9) pools of adult ticks in Sonoma County tested positive for *B. burgdorferi* (pg. 07)
- Five (5) nymphs collected in Marin County and eight (8) nymphs in Sonoma County tested positive for *B. burgdorferi* (pg. 08)
- Five (5) pools of adult ticks collected in Marin County, four (4) pools of adult ticks and (4) nymphs collected in Sonoma County tested positive for *B. miyamotoi* (pgs. 07-08)



2019 ADULT TICK TESTING

Tick and Tick-borne Disease Surveillance Program

Of the 1163 adult *Ixodes pacificus* ticks tested in 2019, 13 pools tested positive for *Borrelia burgdorferi*, giving an overall minimum infection prevalence (MIP)* of 1.12% for Marin and Sonoma counties. The 2010 - 2019 10-year MIP for adult ticks in these counties is 2.0%.

Marin County parks and recreation areas had four (4) *Borrelia burgdorferi* positive pools out of 515 total adult ticks tested, for an MIP of 0.78%. The 10-year MIP for adult ticks in Marin County is 0.79%. Five (5) adult tick pools tested positive for *Borrelia miyamotoi*, for a MIP of 0.97%.

Sonoma County parks and recreation areas had nine (9) *Borrelia burgdorferi* positive pools out of 648 total adult ticks tested, for a MIP of 1.39%. The 10-year MIP for adult ticks in Sonoma County is 1.83%. Four (4) adult tick pools tested positive for *Borrelia miyamotoi*, for a MIP of 0.62%.

Marin County

Park/Trail	Adults Collected [^]	Adults Tested	Pools Tested	<i>Borrelia burgdorferi</i> sl		<i>Borellia miyamotoi</i>	
				Pos. Pools	MIP	Pos. Pools	MIP
Indian Valley OSP	7	7	3	0	0.00%	0	0.00%
Pacheco Pond Trail	4	4	2	0	0.00%	0	0.00%
Waterfall Trail	3	3	1	0	0.00%	0	0.00%
MMWD	213	207	42	4	1.93%	3	1.45%
Alex Forman Trail	213	207	42	4	1.93%	3	1.45%
Old St. Hilary's OSP	0	0	0	N/A	N/A	N/A	N/A
Olompali SP	81	80	18	0	0.00%	0	0.00%
Loop Trail	22	22	6	0	0.00%	0	0.00%
Miwok Trail to Loop Trail	59	58	12	0	0.00%	0	0.00%
Roy's Redwoods OSP	238	221	46	0	0.00%	2	0.90%
Loop Trail	238	221	46	0	0.00%	2	0.90%
Overall	539	515	109	4	0.78%	5	0.97%

Sonoma County

Park/Trail	Adults Collected [^]	Adults Tested	Pools Tested	<i>Borrelia burgdorferi</i> sl		<i>Borellia miyamotoi</i>	
				Pos. Pools	MIP	Pos. Pools	MIP
Annadel SP	228	201	43	3	1.49%	1	0.50%
Cobblestone Trail	174	147	32	3	2.04%	1	0.68%
Lawndale Trail	54	54	11	0	0.00%	0	0.00%
Crane Creek RP	0	0	0	N/A	N/A	N/A	N/A
Creek Trail	0	0	0	N/A	N/A	N/A	N/A
Foothill RP	431	347	72	3	0.86%	3	0.86%
Pond B Loop Trail	429	345	70	3	0.87%	3	0.87%
Ravine Trail	2	2	2	0	0.00%	0	0.00%
Helen Putnam RP	12	12	3	0	0.00%	0	0.00%
Hood Mountain RP	75	75	16	2	2.67%	0	0.00%
Hood Mountain Trail	75	75	16	2	2.67%	0	0.00%
North Sonoma Mountain RP	13	13	4	1	7.69%	0	0.00%
Umbrella Tree Trail	13	13	4	1	7.69%	0	0.00%
Ragle Ranch RP	0	0	0	N/A	N/A	N/A	N/A
Blackberry and Thistle Trails	0	0	0	N/A	N/A	N/A	N/A
Overall	759	648	138	9	1.39%	4	0.62%

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

[^]When more than 30 pools of adult ticks are collected from a park, additional adult ticks will be tested at the discretion of the District staff. Ticks that are collected but not tested are used for educational purposes.

2019 NYMPHAL TICK TESTING

Tick and Tick-borne Disease Surveillance Program

Of the 260 nymphal *Ixodes pacificus* ticks tested in 2019, 13 tested positive for *Borrelia burgdorferi*, giving an overall infection prevalence (IP)* of 5.00% for Marin and Sonoma counties. The 2010 - 2019 10-year MIP for nymphal ticks in these counties is 4.14%.

Marin County parks and recreation areas had five (5) *Borrelia burgdorferi* positive nymphs out of 109 total nymphal ticks tested, for an IP of 4.59%. The 10-year MIP for nymphal ticks in Marin County is 3.85%. No nymphs tested positive for *Borrelia miyamotoi*.

Sonoma County parks and recreation areas had eight (8) *Borrelia burgdorferi* positive nymphs out of 151 total nymphal ticks tested, for an IP of 5.30%. The 10-year MIP for nymphal ticks in Sonoma County is 4.38%. Four (4) nymphs tested positive for *Borrelia miyamotoi*, for an IP of 2.65%.

Marin County

Park/Trail	Nymphs Tested	<i>Borellia burgdorferi</i> sl		<i>Borellia miyamotoi</i>	
		Pos. Pools	IP	Pos. Pools	IP
Indian Valley OSP	29	1	3.45%	0	0.00%
Pacheco Pond Trail	24	1	4.17%	0	0.00%
Waterfall Trail	5	0	0.00%	0	0.00%
MMWD	34	0	0.00%	0	0.00%
Alex Forman Trail	34	0	0.00%	0	0.00%
Old St. Hilary's OSP	0	N/A	N/A	N/A	N/A
Olompali SP	19	1	5.26%	0	0.00%
Loop Trail	19	1	5.26%	0	0.00%
Miwok Trail to Loop Trail	0	0	0.00%	0	0.00%
Roy's Redwoods OSP	27	3	11.11%	0	0.00%
Loop Trail	27	3	11.11%	0	0.00%
Overall	109	5	4.59%	0	0.00%

Sonoma County

Park/Trail	Nymphs Tested	<i>Borellia burgdorferi</i> sl		<i>Borellia miyamotoi</i>	
		Pos. Pools	IP	Pos. Pools	IP
Annadel SP	59	3	5.08%	1	1.69%
Cobblestone Trail	59	3	5.08%	1	1.69%
Lawndale Trail	0	0	0.00%	0	0.00%
Crane Creek RP	0	N/A	N/A	N/A	N/A
Creek Trail	0	N/A	N/A	N/A	N/A
Foothill RP	50	1	2.00%	1	2.00%
Pond B Loop Trail	42	0	0.00%	0	0.00%
Ravine Trail	8	1	12.50%	1	12.50%
Helen Putnam RP	0	N/A	N/A	N/A	N/A
Hood Mountain RP	0	N/A	N/A	N/A	N/A
Hood Mountain Trail	0	N/A	N/A	N/A	N/A
North Sonoma Mountain RP	42	4	9.52%	2	4.76%
Umbrella Tree Trail	42	4	9.52%	2	4.76%
Ragle Ranch RP	0	N/A	N/A	N/A	N/A
Blackberry and Thistle Trails	0	N/A	N/A	N/A	N/A
Overall	151	8	5.30%	4	2.65%

*IP - Infection Prevalence = (number of positive ticks/total ticks tested)*100; used when ticks are tested individually
 #Two (2) nymphs collected at Olompali State Park were not tested. These ticks were used for educational purposes.

TICKS AND WILDFIRE

Tick and Tick-borne Disease Surveillance Program

Do wildfires kill ticks?

The short answer is no, fire does not necessarily directly kill ticks. Some research has looked at ticks placed in the soil of a controlled burn, and found that the ticks are able to survive the fire. The District has also seen evidence of this in 2019. After the Kincadee fire burned through Foothill Regional Park, lab staff conducted routine surveillance to see if any ticks were still alive and questing. One trail that was severely damaged by the fire produced 30 adult *Ixodes pacificus* ticks.

Another study looking at areas where wildfires have occurred has shown that in the year following the fire, the ticks remain abundant. However, the following years may see a sharp decline in the population. The same study saw a decrease in important vector hosts such as deer in wildfire areas.

The District plans to continue to sample trails at Foothill Regional Park in upcoming years, and hopes to help add to the growing body of information on how wildfires affect tick populations.



Three (3) adult *Ixodes pacificus* ticks collected at Foothill Regional Park in December 2019



Burned area on the trail at Foothill Regional Park in December 2019

Sources

Padgett, KA, Casher, LE, Stephens, SL and Lane, RS. 2009. *Effect of Prescribed Fire for Tick Control in California Chaparral*. Journal of Medical Entomology 46(5)
MacDonald, AJ, Hyon, DW, McDaniels, A, O'Connor, KE, Swei, A and Briggs, CJ. 2018. *Risk of vector tick exposure initially increases, then declines through time in response to wildfire in California*. Ecosphere 9(5)

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 the tick 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 remove a tick properly

- 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:
Marin/Sonoma Mosquito and Vector Control District
595 Helman Lane, Cotati, CA 94931
(707) 285-2200 www.msmosquito.org