

Marin/Sonoma Mosquito and Vector Control District 2018 Vector Surveillance Report

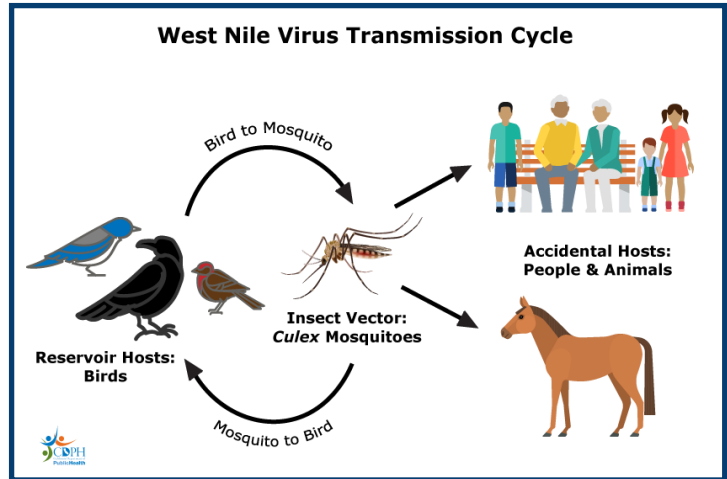


Laboratory Program Objectives

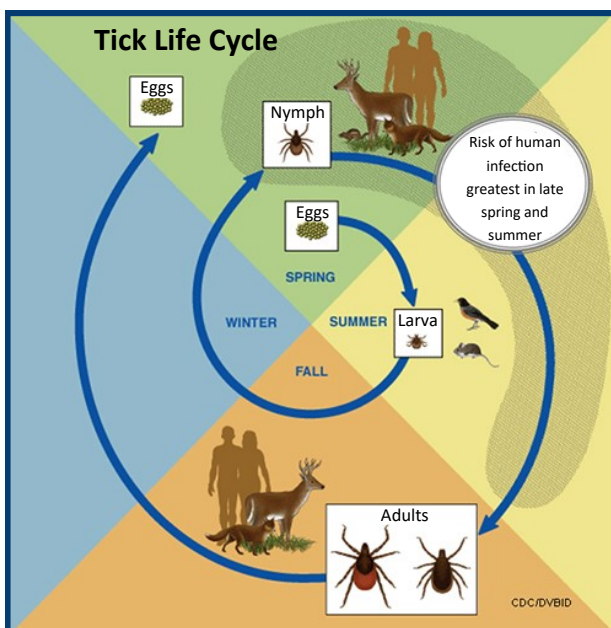
Arbovirus Surveillance Program

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 (mosquito trapping) and passive (dead bird and human reports) monitoring techniques to detect and quantify the intensity of virus transmission in the region in order to predict areas of elevated disease risk. This assessment is used by the District to direct critical vector control interventions to effectively protect human health.

Since 2014, the District has conducted enhanced invasive mosquito surveillance efforts. In addition to larval and adult surveillance for invasive *Aedes* mosquito species, the District also investigates travel-related cases of Zika virus. All potential vector species present in these areas are tested for chikungunya, dengue and Zika viruses, as well as WNV, SLEV and WEEV. As of 2018, no invasive *Aedes* mosquitoes have been identified in Marin or Sonoma counties.



Tick and Tick-borne Disease Surveillance Program



During the winter and spring seasons, District laboratory staff collect ticks from trails in state and regional parks and recreation areas throughout Marin and Sonoma counties. Ticks are collected by dragging a 1 meter square flannel flag on the ground and in vegetation along trails. Ticks are identified and separated by species, sex and life stage to be tested for pathogens when appropriate. Three main species are typically collected: *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 transmits the Lyme disease causing bacteria *Borrelia burgdorferi*. Adults and nymphs of this species are tested for this pathogen, as well as *Borrelia miyamotoi*, a bacteria that can cause a relapsing-fever type illness. To date, no cases of *B. miyamotoi* have been reported in California.

Executive Summary—Arbovirus Surveillance Program

In 2018, 143 mosquito pools from Marin County and 506 pools from Sonoma County were tested for WNV, SLEV and WEEV. WNV was detected in one (1) mosquito pool from Sonoma County. There were no detections of WNV in mosquito pools from Marin County. A total of 21 dead birds were reported to the District, of which 14 were viable for WNV testing. All birds tested negative. There were no human cases of WNV in Marin or Sonoma counties.

In 2018, the California Department of Public Health (CDPH) reported two (2) travel-associated cases of Zika virus in Sonoma County and one (1) travel-associated case in Marin County. Six (6) mosquito pools collected during Zika virus probable case 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 detections 2004—2018

Year	Humans	Dead Birds	Mosquito Pools	Sentinel Chickens
2004	0	72	1	0
2005	1	92	0	0
2006	1	29	5	3
2007	1	23	1	0
2008	0	12	2	0
2009	0	Not Tested	0	0
2010	0	Not Tested	0	0
2011	0	Not Tested	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	Not Tested
2017	0	6	1	Not Tested
2018	0	0	1	Not Tested

Mosquito pools by species

Species	Number of Pools
<i>Culex erythrothorax</i>	276
<i>Culex pipiens</i>	58
<i>Culex stigmatosoma</i>	124
<i>Culex tarsalis</i>	189
<i>Culex thriambus</i>	2

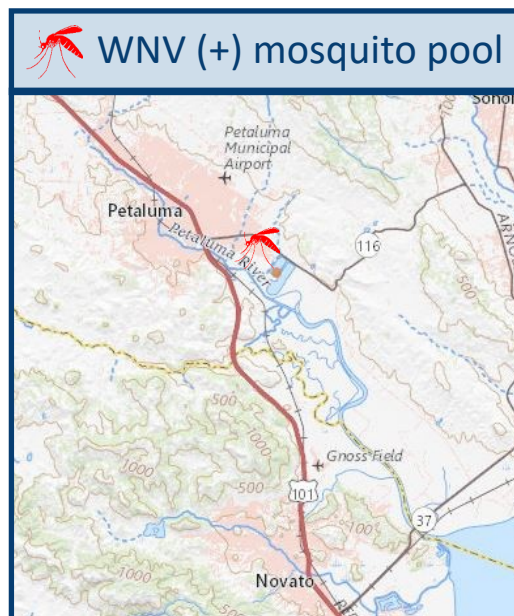
Birds by city 2018

Marin County

City	Processed	Tested	WNV+
Corte Madera	1	1	0
Novato	1	0	0
San Rafael	1	0	0

Sonoma County

City	Processed	Tested	WNV+
Glen Ellen	2	1	0
Petaluma	5	5	0
Santa Rosa	8	5	0
Sebastopol	3	2	0



Executive Summary—Tick Surveillance Program

In 2018, staff from the District sampled trails in state parks, regional parks and the Marin Municipal Water District (MMWD). A total of 28 trail sampling events occurred during the season, resulting in 89 *Ixodes pacificus* adults and 183 *Ixodes pacificus* nymphs being collected for testing. A multiplex PCR assay was used to test these samples for *Borrelia burgdorferi* (the causative agent of Lyme disease) and *Borrelia miyamotoi*.



Ixodes pacificus nymph, adult male and adult female



Removing a tick with forceps



District biologist flagging for ticks

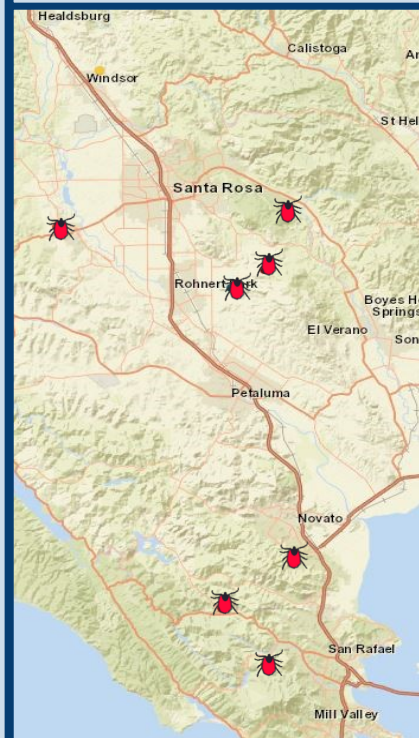


2018 Tick Surveillance Overview



- 28 sampling events at 7 regional and state parks and the MMWD
- 3 pools of adult ticks collected in Marin County and 2 collected in Sonoma County tested positive for *Borrelia burgdorferi* (pg 4)
- 4 nymphs collected in Marin County and 1 collected in Sonoma County tested positive for *B. burgdorferi* (pg 5)
- 2 nymphs collected in Marin County tested positive for *B. miyamotoi*, and 1 nymph from Sonoma County tested positive for both *B. burgdorferi* and *B. miyamotoi* (pg 5)

Surveillance Sites



2018 Adult Tick Testing

Of the 89 adult *Ixodes pacificus* ticks tested in 2018, 5 pools tested positive for *Borrelia burgdorferi*, giving an overall minimum infection prevalence (MIP) of 5.6%. The 10 year average MIP for adult ticks in Marin and Sonoma counties is 2.0%.

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

Marin County parks and recreation areas had 3 positive pools out of a total of 43 adults tested, for an MIR of 7.0%. Parks in Sonoma County had 2 positive pools out of 46 adults tested for a rate of 4.3%.

No adult tick pools tested positive for *Borrelia miyamotoi* in 2018.

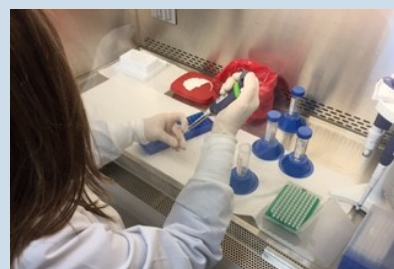
Please note that the MIR may not reflect the true infection prevalence when a small number of ticks are collected. Generally speaking, the accuracy of the MIR improves as sample size increases. Overall sample size in 2018 is lower than previous years, which could account for variability in the MIP's for both Marin and Sonoma counties.

Park/Trail	Ticks Tested	Pools Tested	Pos. Pools	MIP	Park/Trail	Ticks Tested	Pools Tested	Pos. Pools	MIP
Indian Valley OSP	2	2	1	50.0%	Annadel SP	6	3	0	0%
Waterfall Trail	2	2	0		Cobblestone Trail	5	2	0	
Schwindt Trail	0	0	0		Lawndale Trail	1	1	0	
MMWD	9	3	0	0%	Crane Creek RP	5	2	0	0%
Alex Forman Trail	9	3	0		Creek/Fiddleneck Trails	5	2	0	
Pumpkin Ridge Trail	0	0	0		N. Sonoma Mountain RP	35	9	2	5.7%
Roy's Redwoods	32	7	2	6.3%	Umbrella Tree Trail	35	9	2	
Rim Trail	32	7	2		Ragle Ranch RP	0	0	0	0%
Marin Total	43	12	3	7.0%	Thistle/Hilltop Trails	0	0	0	
					Sonoma Total	46	14	2	4.3%

Tick Testing Protocol

Molecular Techniques for Pathogen Detection — The District tests *Ixodes pacificus* ticks for the presence of *Borrelia burgdorferi* (the bacterium that causes Lyme disease) and *Borrelia miyamotoi* using real-time polymerase chain reaction (RT-PCR) technology.

DNA is extracted from individual nymphs and pools of up to five (5) adult ticks using the MagMax™ automated Sample Prep System. RT-PCR is performed on the Applied Biosystems® 7500 Real-Time PCR System, using TaqMan® probe-based detection. Results are posted on the District website and reported to state and regional parks and the Marin Municipal Water District.



Preparing ticks for RT-PCR testing

2018 Nymphal Tick Testing

To increase the accuracy of local Lyme disease risk assessment, the District began testing nymphal *Ixodes pacificus* ticks individually in 2015. Of the 183 nymphs tested, 5 tested positive for *B. burgdorferi*, giving an overall infection rate (IR) of 2.73% for all parks sampled. The 10-year MIP for nymphs in Marin and Sonoma counties is 4.3%.

$$IR = (\text{number of infected ticks} / \text{number of ticks tested}) * 100$$

Marin County parks and recreation areas had 4 positive nymphs out of a total of 70 nymphs tested, for an IR of 5.7%. The 10-year MIP is 4.3%. Parks in Sonoma County had 1 positive individual out of 113, for an IR of 0.9%. The 10-year MIP is 4.3%.

It should be noted that variability in the overall IR from year to year is often observed. In 2015, for example, nymphs collected at N. Sonoma Mountain Regional Park had a *B. burgdorferi* IR of 11.1%, while in 2018 none of the 113 nymphs tested harbored the pathogen. Overall sample size in 2018 is lower than previous years, which could account for variability in the IR's for both Marin and Sonoma counties.

Borrelia miyamotoi positive samples

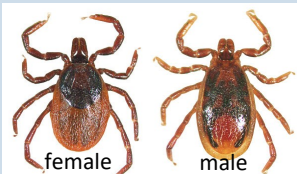
All individual and pooled ticks are tested for both *Borrelia burgdorferi* and *Borrelia miyamotoi*. In 2018, three (3) nymphs tested positive for *Borrelia miyamotoi*; two (2) nymphs collected from the Alex Forman trail at the MMWD and one (1) collected from the Cobblestone Trail at Annadel State Park. The nymph collected from Annadel SP tested positive for both *Borrelia burgdorferi* and *Borrelia miyamotoi*, indicating that a single tick can carry both pathogens in nature.

Park/Trail	Ticks Tested	Pos. Ticks	IR
Indian Valley OSP	9	0	0%
Waterfall Trail	5	0	
Schwindt Trail	4	0	
MMWD	32	1	3.1%
Alex Forman Trail	30	1	
Pumpkin Ridge Trail	2	0	
Roy's Redwoods	29	3	10.3%
Rim Trail	29	3	
Marin Total	70	4	5.7%

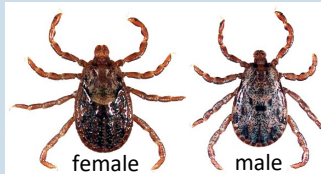
Park/Trail	Ticks Tested	Pos. Ticks	IR
Annadel SP	20	1	5.0%
Cobblestone Trail	20	1	
Lawndale Trail	0	0	
Crane Creek RP	0	0	0%
Creek/Fiddleneck Trails	0	0	
N. Sonoma Mountain RP	93	0	0%
Umbrella Tree Trail	93	0	
Ragle Ranch RP	0	0	0%
Thistle/Hilltop Trails	0	0	
Sonoma Total	113	1	0.9%

Common Ticks of California

Western Black-legged Tick
Ixodes pacificus



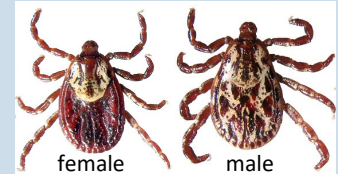
Pacific Coast Tick
Dermacentor occidentalis



Brown Dog Tick
Rhipicephalus sanguineus



American Dog Tick
Dermacentor variabilis



Pictures from TickEncounter: Resource Center

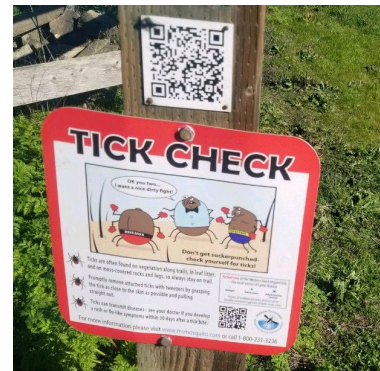
Outreach and Education

Although the District does not conduct tick control, it maintains an active program to raise awareness of ticks and tick-borne diseases, with a focus on tick safety. District staff conduct occupational tick safety training sessions and work with local parks to post signs warning hikers about ticks on trails.

The District also connects with the public through participation in a wide variety of local fairs and community events, and gives presentations on ticks and Lyme disease to schools and community groups. "Tick School" is taught by the District's Education Program Specialist, and is available for grades K-8. Students learn about the tick life cycle and habitats where ticks can be found, as well as why ticks are dangerous and how they can protect themselves from bites.

To find out more about the District's tick education and outreach programs, or to schedule a presentation, visit our website:

www.msosquito.com.



Examples of tick educational materials

Tick Safety Tips

Before entering tick habitat, take the following precautions:

- Consider applying an effective tick repellent to exposed skin. Repellents recommended by the California Department of Public Health include DEET, picaridin, IR3535 and oil of lemon eucalyptus.
- 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 nymph habitat, 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.
- Tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks after you come indoors.
- Shower after coming indoors and carefully check for ticks.
- Properly remove any attached ticks immediately.

Contact Us

For more information about our services and programs:

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Visit us on the web at
www.msosquito.com

