



2015 TICK SURVEILLANCE REPORT

Marin/Sonoma Mosquito and Vector Control District

March 2016

Sampling Ticks in Marin and Sonoma Counties

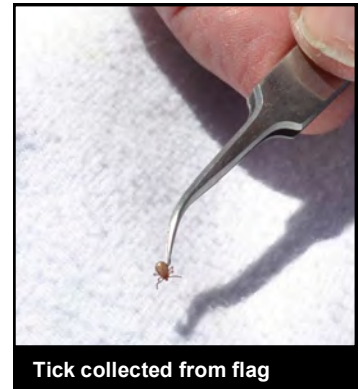
Staff from the Marin/Sonoma Mosquito and Vector Control District (“the District”) sample ticks from trails in parks and recreational areas throughout Marin and Sonoma counties during each winter and spring. In 2015, these areas included trails in State Parks, Regional Parks, and the Marin Municipal Water District (MMWD). Ticks are sampled by dragging a flannel flag along the ground or through trailside vegetation. Although tick collections in some years have targeted multiple species of ticks and multiple pathogens, surveillance in 2015 focused on adult and nymphal western black-legged ticks (*Ixodes pacificus*), the principal vector of Lyme disease on the west coast.



Ixodes pacificus tick



District biologist flagging for ticks



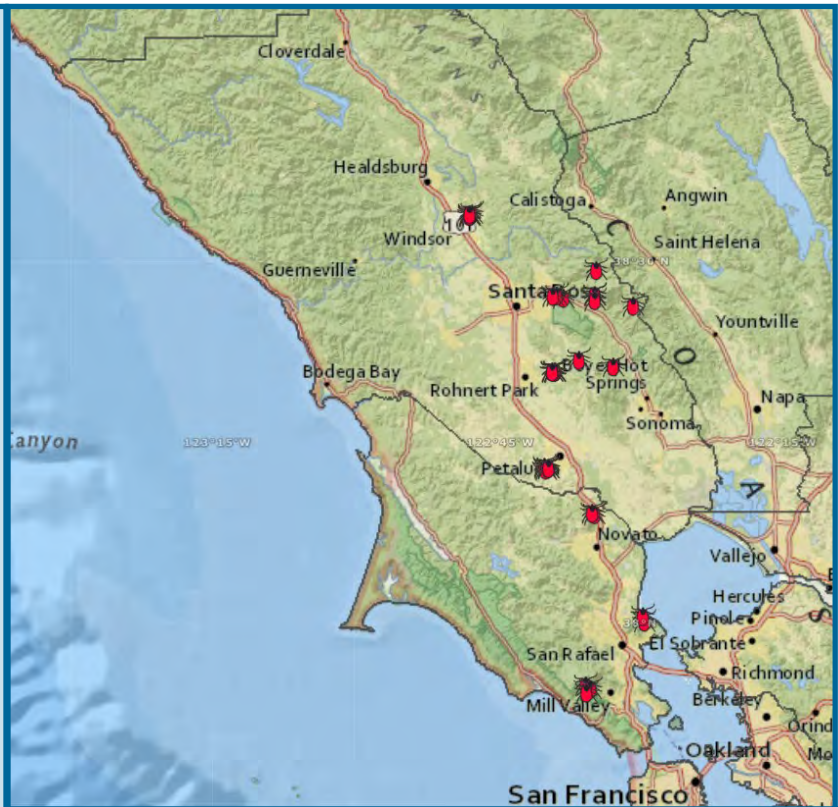
Tick collected from flag

2015 Tick Surveillance

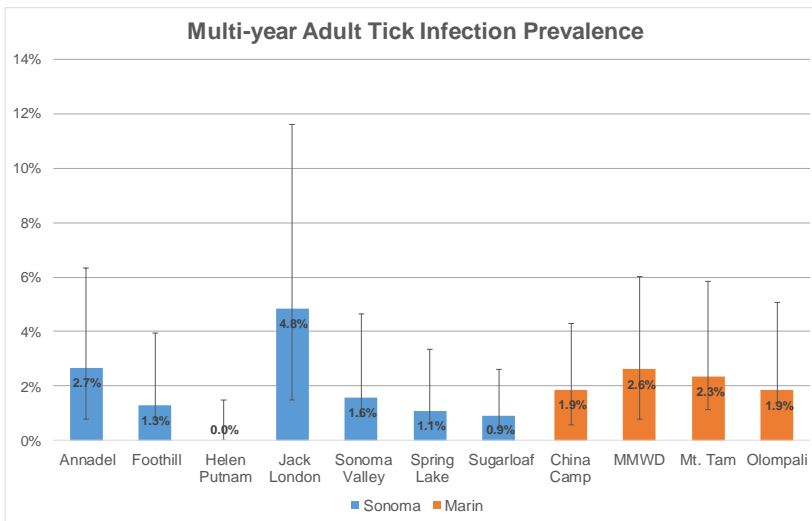


32 Trail Sampling Events (many grouped together into single markers due to scale of map)

- 9 sampling pools of adult ticks tested positive for *Borrelia burgdorferi* in 2015 (pg. 2)
- 8 nymphal ticks tested positive for *B. burgdorferi* in 2015 (pg. 3)
- Multi-year aggregated tick testing graphs for adult ticks (pg. 2) and nymphal ticks (pg. 3)
- Tick awareness education and safety information (pg. 4)



Tick Sampling Events, 2015



Tick Testing Results, 2008-2015

The district has tested 10,776 adult and 3,320 nymphal ticks from Marin and Sonoma counties over the past 8 years. The graphs at the top of pages 2 and 3 represent the overall infection prevalence calculated using a method called bias-corrected maximum likelihood estimation. These graphs also include error bars indicating 95% confidence intervals. Sites were excluded from these graphs if the testing sample size was less than 200 adult ticks or 50 nymphal ticks. Additional multi-year tick testing data is available on the District website:

www.msosquito.com.

Infection Prevalence of *Borrelia burgdorferi* in Adult *Ixodes pacificus*, 2008-2015

| Park / Trail | Ticks Tested | Pools Tested | Pos. Pools | MIR |
|---------------------------|--------------|--------------|------------|--------------|
| Annadel | 17 | 6 | 1 | 5.9% |
| Channel Trail | 15 | 4 | 1 | |
| Cobblestone Trail | 2 | 2 | 0 | |
| Crane Creek | 25 | 8 | 0 | 0.0% |
| Buckeye Trail | 2 | 2 | 0 | |
| Creek Trail | 14 | 3 | 0 | |
| Fiddleneck Trail | 9 | 3 | 0 | |
| Foothill | 185 | 41 | 2 | 1.1% |
| Bobcat Trail | 4 | 1 | 0 | |
| Oakwood Trail | 78 | 17 | 1 | |
| Pond A Loop | 41 | 9 | 0 | |
| Pond B Loop | 52 | 11 | 1 | |
| Westside Trail | 10 | 3 | 0 | |
| Helen Putnam | 143 | 31 | 0 | 0.0% |
| Arroyo Trail | 14 | 3 | 0 | |
| Panorama Trail | 13 | 3 | 0 | |
| Ridge Trail | 11 | 3 | 0 | |
| South Loop Trail | 105 | 22 | 0 | |
| Hood Mountain | 86 | 20 | 1 | 1.2% |
| Alder Glen Trail | 10 | 3 | 0 | |
| Lower Johnson Trail | 76 | 17 | 1 | |
| Jack London | 13 | 4 | 0 | 0.0% |
| Wolf House Trail | 13 | 4 | 0 | |
| N. Sonoma Mountain | 7 | 3 | 1 | 14.3% |
| N. Son. Mtn. Ridge Tr. | 7 | 3 | 1 | |
| Spring Lake | 1 | 1 | 0 | 0.0% |
| Nature Trail | 1 | 1 | 0 | |
| Sugarloaf | 40 | 9 | 1 | 2.5% |
| Meadow Trail | 40 | 9 | 1 | |
| Sonoma Total | 517 | 123 | 6 | 1.2% |

2015 Adult Tick Testing

Ixodes pacificus adults

Of the 644 adult *Ixodes pacificus* ticks tested in 2015, 9 pools were positive for *Borrelia burgdorferi*, giving an overall minimum infection rate (MIR) of 1.4%. MIR = number of positive tick pools as a percentage of total number of ticks tested.

Marin County parks and recreational areas had 3 positive pools out of a total of 127 adults tested, for a MIR of 2.36%. Parks located in Sonoma County had 6 positive pools out of 517 adults tested, for a rate of 1.16%.

Please note that the MIR from some parks from which very few ticks were collected may not represent the true infection prevalence in these tick populations. Generally speaking, accuracy of the MIR improves as sample size increases.

| Park / Trail | Ticks Tested | Pools Tested | Pos. Pools | MIR |
|----------------------|--------------|--------------|------------|-------------|
| China Camp | 40 | 9 | 0 | 0.0% |
| Shoreline Trail | 1 | 1 | 0 | |
| Turtle Hill Trail | 39 | 8 | 0 | |
| MMWD | 21 | 5 | 0 | 0.0% |
| Matt Davis Trail | 21 | 5 | 0 | |
| Mt. Tamalpais | 52 | 12 | 3 | 5.8% |
| Alice Eastwood Trail | 51 | 11 | 3 | |
| Bootjack Trail | 1 | 1 | 0 | |
| Olompali | 14 | 5 | 0 | 0.0% |
| Loop Trail | 3 | 2 | 0 | |
| Miwok Trail | 11 | 3 | 0 | |
| Marin Total | 127 | 31 | 3 | 2.4% |

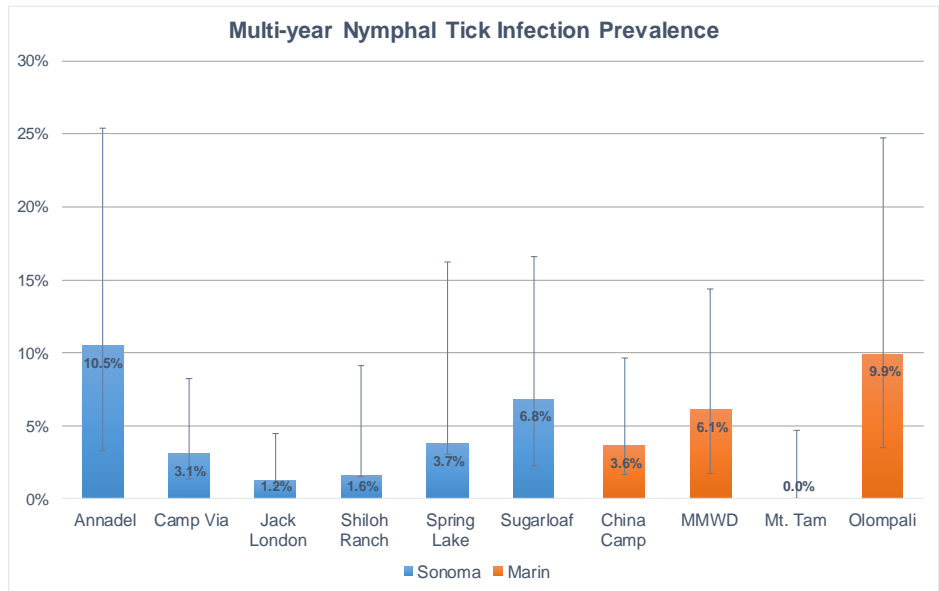
Tick Testing:

Molecular Techniques for Pathogen Detection

The District tests *Ixodes pacificus* ticks for the presence of *Borrelia burgdorferi* (sensu stricto), the bacterium that causes Lyme disease, using Real-Time Polymerase Chain Reaction (RT-PCR) technology. DNA is extracted from individual nymphal ticks and “pools” of up to 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 Parks, Regional Parks, and the Marin Municipal Water District (MMWD).



Preparing ticks for RT-PCR testing



Infection Prevalence of *Borrelia burgdorferi* in Nymphal *Ixodes pacificus*, 2008-2015

2015 Nymphal Tick Testing

Ixodes pacificus nymphs

To increase the accuracy of local Lyme disease risk assessment, the district began a pilot program testing nymphal *Ixodes pacificus* ticks individually in 2015. Of the 104 nymphs tested, 8 were positive for *B. burgdorferi*, giving an overall infection rate (IR) in sampled parks of 7.7%.

IR = number of positive ticks as a percentage of total number of ticks tested.

Marin County parks and recreational areas had 5 positive nymphs out of a total of 62 nymphs tested, for an IR of 8.06%. Parks located in Sonoma County had 3 positive individuals out of 42 tested, for a rate of 7.14%.

It should be noted that only a relatively small number of tick nymphs were able to be collected and tested in 2015. As a consequence, these test results only approximate the true disease prevalence in any park. An IR of 0% does not preclude the presence of *B. burgdorferi* in ticks from any park or trail.

| Park / Trail | Ticks Tested | Pos. Ticks | IR |
|------------------------------|--------------|------------|--------------|
| Hood Mountain | 8 | 0 | 0.0% |
| Alder Glen Trail | 6 | 0 | |
| Lower Johnson Trail | 2 | 0 | |
| Jack London | 15 | 1 | 6.7% |
| Wolf House Trail | 15 | 1 | |
| North Sonoma Mountain | 18 | 2 | 11.1% |
| N. Son. Mtn Ridge Trail | 18 | 2 | |
| Sugarloaf | 1 | 0 | 0.0% |
| Meadow Trail | 1 | 0 | |
| Sonoma Total | 42 | 3 | 7.1% |

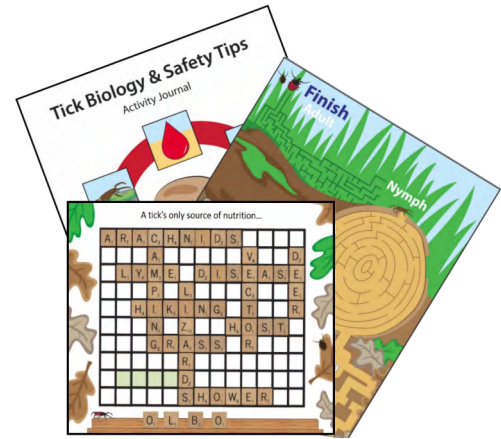
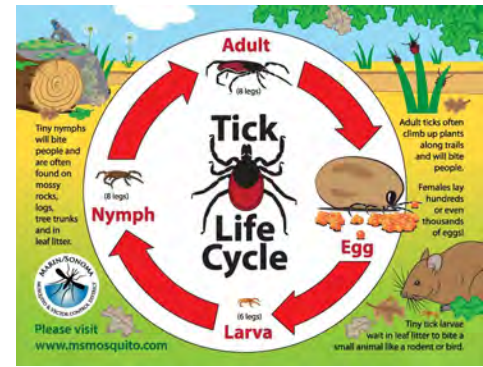
| Park / Trail | Ticks Tested | Pos. Ticks | IR |
|----------------------|--------------|------------|--------------|
| China Camp | 18 | 2 | 11.1% |
| Shoreline Trail | 9 | 2 | |
| Turtle Hill Trail | 9 | 0 | |
| MMWD | 12 | 1 | 8.3% |
| Matt Davis Trail | 12 | 1 | |
| Mt. Tamalpais | 1 | 0 | 0.0% |
| Bootjack Trail | 1 | 0 | |
| Olompali | 31 | 2 | 6.5% |
| Loop Trail | 2 | 0 | |
| Miwok Trail | 29 | 2 | |
| Marin Total | 62 | 5 | 8.1% |

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 they 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 education materials

Tick Safety Tips

- Wear light-colored clothing with long sleeves and long pants when hiking, walking or working in areas where ticks may be present.
- Clothing and equipment can be pre-treated with a permethrin product to kill ticks.
- Apply repellent containing DEET (at least 20% concentration) on exposed skin to repel ticks. Always follow label instructions when using repellents or permethrin and be especially careful when applying to children.
- Showering after being in tick habitat is one of the best ways to detect ticks. Continue to periodically check your body for several days.
- Remove ticks promptly using the correct technique (see below).
- Contact your physician if you have concerns or become ill after being bitten by a tick.

How to remove a tick

- Use fine-tipped tweezers to grasp the tick as close to the skin's surface as possible.
- Pull upward with steady, even pressure.
- After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol, an iodine scrub, or soap and water.



Contact Us

For more information about our services and programs:

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