



# 2016 TICK SURVEILLANCE REPORT

Marin/Sonoma Mosquito and Vector Control District

May 2017

## 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 2016, these areas included trails in State Parks, Regional Parks, the Marin Municipal Water District (MMWD), as well as special collections from a city park and the Golden Gate National Recreation Area. Surveillance in 2016 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 entomologist checking flag for ticks



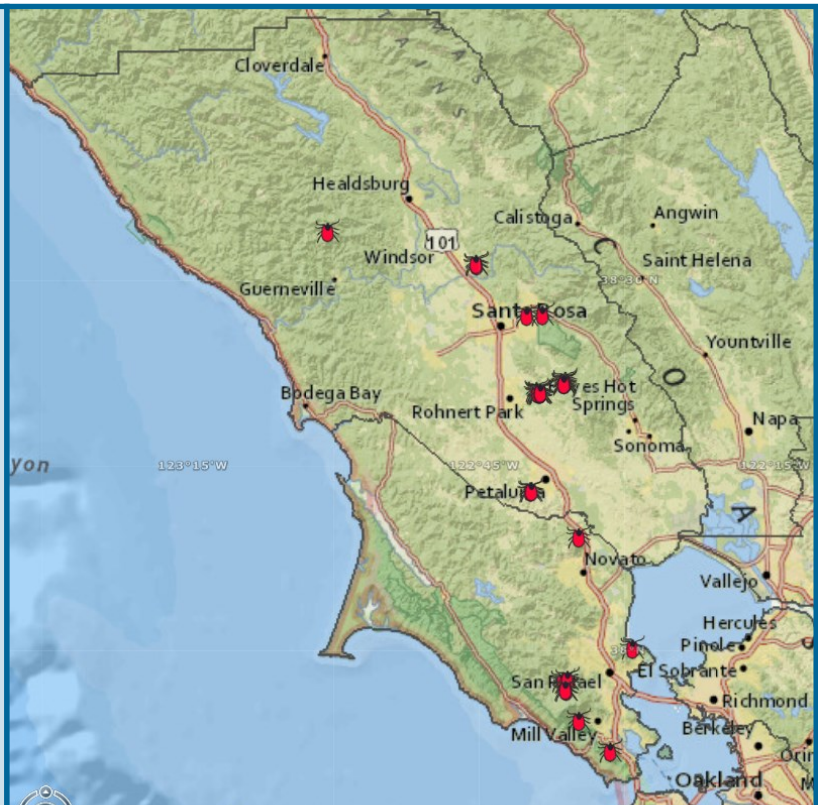
Ticks on flag

### 2016 Tick Surveillance

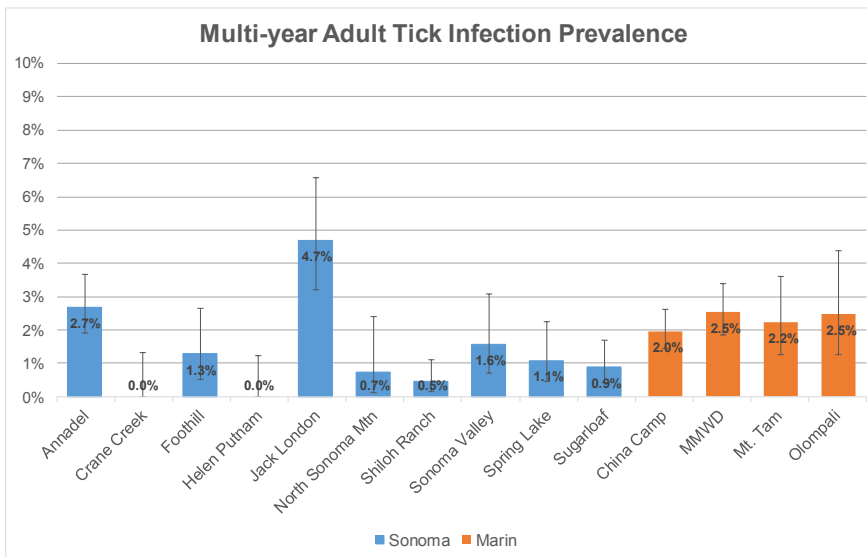


29 Trail Sampling Events  
(many grouped as single markers due to scale of map)

- 18 sampling pools of adult ticks tested positive for *Borrelia burgdorferi* in 2016 (pg. 2)
- 13 nymphal ticks tested positive for *B. burgdorferi* in 2016 (pg. 3)
- Multi-year aggregated tick testing graphs for adult ticks (pg. 2) and nymphal ticks (pg. 3)
- Tick testing for *Borrelia miyamotoi* (pg. 3 and 4)
- Other tick-borne disease surveys and collaborations (pg. 4)



Tick Sampling Events, 2016



## Tick Testing Results, 2008-2016

The district has tested 11,457 adult and 3,601 nymphal ticks for *B. burgdorferi* (sensu stricto) from Marin and Sonoma counties over the past 9 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.msмосquito.com](http://www.msмосquito.com)

## Infection Prevalence of *Borrelia burgdorferi* in Adult *Ixodes pacificus*, 2008-2016

# 2016 Adult Tick Testing

### *Ixodes pacificus* adults

Of the 706 adult *Ixodes pacificus* ticks tested in 2016, 18 pools were positive for *Borrelia burgdorferi* (s.s.), giving an overall minimum infection rate (MIR) of 2.5%. MIR = number of positive tick pools as a percentage of total number of ticks tested.

Ticks from Austin Creek State Recreation Area in 2016 were collected and tested individually, in collaboration with the California Department of Public Health. More information on this special tick survey is on page 4 of this report.

Please note that the MIR derived from small collections of ticks may not represent the true infection prevalence in these tick populations. Accuracy of the MIR improves with increased sample size.

| Park / Trail                | Ticks Tested | Pools Tested | Pos. Pools | MIR         |
|-----------------------------|--------------|--------------|------------|-------------|
| <b>China Camp</b>           | <b>1</b>     | <b>1</b>     | <b>0</b>   | <b>0.0%</b> |
| Shoreline Trail             | 1            | 1            | 0          |             |
| <b>GGNRA</b>                | <b>3</b>     | <b>1</b>     | <b>0</b>   | <b>0.0%</b> |
| Marincello Trail            | 3            | 1            | 0          |             |
| <b>MMWD</b>                 | <b>72</b>    | <b>18</b>    | <b>1</b>   | <b>1.4%</b> |
| Berry Trail                 | 4            | 2            | 1          |             |
| Lagunitas Rock Springs Road | 55           | 12           | 0          |             |
| Pumpkin Ridge Tr.           | 13           | 4            | 0          |             |
| <b>Mt. Tamalpais</b>        | <b>11</b>    | <b>3</b>     | <b>0</b>   | <b>0.0%</b> |
| Lo. Fern Creek Tr.          | 11           | 3            | 0          |             |
| <b>Olompali SP</b>          | <b>50</b>    | <b>10</b>    | <b>3</b>   | <b>6.0%</b> |
| Miwok Trail                 | 50           | 10           | 3          |             |
| <b>Marin Total</b>          | <b>137</b>   | <b>33</b>    | <b>4</b>   | <b>2.9%</b> |

| Park / Trail             | Ticks Tested | Pools Tested | Pos. Pools | MIR         |
|--------------------------|--------------|--------------|------------|-------------|
| <b>Annadel SP</b>        | <b>68</b>    | <b>15</b>    | <b>2</b>   | <b>2.9%</b> |
| Cobblestone Trail        | 68           | 15           | 2          |             |
| <b>Austin Creek SRA</b>  | <b>30</b>    | <b>30</b>    | <b>1</b>   | <b>3.3%</b> |
| Bullfrog Pond Campground | 30           | 30           | 1          |             |
| <b>Crane Creek</b>       | <b>140</b>   | <b>36</b>    | <b>0</b>   | <b>0.0%</b> |
| Buckeye Trail            | 9            | 3            | 0          |             |
| Creek Trail              | 56           | 14           | 0          |             |
| Fiddleneck Trail         | 56           | 14           | 0          |             |
| North Loop Trail         | 10           | 3            | 0          |             |
| Poppy Trail              | 9            | 2            | 0          |             |
| <b>Helen Putnam</b>      | <b>50</b>    | <b>11</b>    | <b>0</b>   | <b>0.0%</b> |
| Arroyo Trail             | 6            | 2            | 0          |             |
| Savannah Trail           | 44           | 9            | 0          |             |
| <b>N. Sonoma Mtn</b>     | <b>266</b>   | <b>56</b>    | <b>12</b>  | <b>4.5%</b> |
| Entry/Picnic Area        | 2            | 1            | 0          |             |
| N. Sonoma Mtn. Tr.       | 198          | 40           | 8          |             |
| Umbrella Tree Trail      | 66           | 15           | 4          |             |
| <b>Shiloh Ranch</b>      | <b>15</b>    | <b>4</b>     | <b>0</b>   | <b>0.0%</b> |
| S. Ridge Trail           | 15           | 4            | 0          |             |
| <b>Sonoma Total</b>      | <b>569</b>   | <b>152</b>   | <b>14</b>  | <b>2.6%</b> |

## Multiplex Tick Testing:

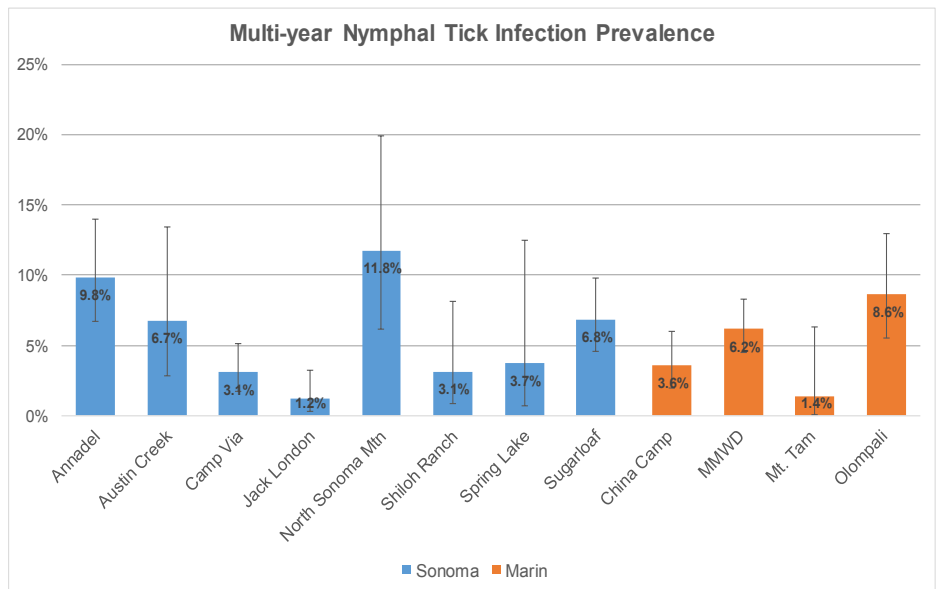
Adding a new pathogen to existing tick tests.

For years the District has tested ticks for *Borrelia burgdorferi* (s.s.), the causative agent of Lyme disease. Starting with selected collections in 2016, the District now tests for a related pathogen, *Borrelia miyamotoi*, which can cause a type of relapsing fever. Rather than running a separate test for each bacterium, we now run a single test to detect the DNA of both. This technique, using special primers and probes for multiple targets, is called multiplex testing.

*Borrelia miyamotoi* 2016 test results can be found on page 4 of this report.



Tick being placed into testing vial.



Infection Prevalence of *Borrelia burgdorferi* in Nymphal *Ixodes pacificus*, 2008-2016

## 2016 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 2016. Of the 297 nymphs tested in 2016, 13 were positive for *B. burgdorferi*, giving an overall infection rate (IR) in sampled parks of 4.4%.

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

It should be noted that these test results only approximate the true disease prevalence in any area. An IR of 0% does not preclude the presence of *B. burgdorferi* in ticks from any park or trail, and results will vary in collections made from year to year.

| Park / Trail         | Ticks Tested | Pos. Ticks | IR          |
|----------------------|--------------|------------|-------------|
| <b>China Camp</b>    | <b>9</b>     | <b>0</b>   | <b>0.0%</b> |
| Shoreline Trail      | 9            | 0          |             |
| <b>MMWD</b>          | <b>33</b>    | <b>2</b>   | <b>6.1%</b> |
| Pumpkin Ridge Tr.    | 22           | 2          |             |
| Sunnyside Trail      | 11           | 0          |             |
| <b>Mt. Tamalpais</b> | <b>11</b>    | <b>1</b>   | <b>9.1%</b> |
| Lo. Fern Creek Tr.   | 11           | 1          |             |
| <b>Olompali SP</b>   | <b>32</b>    | <b>0</b>   | <b>0.0%</b> |
| Miwok Trail          | 32           | 0          |             |
| <b>Marin Total</b>   | <b>85</b>    | <b>3</b>   | <b>3.5%</b> |

| Park / Trail             | Ticks Tested | Pos. Ticks | IR           |
|--------------------------|--------------|------------|--------------|
| <b>Annadel SP</b>        | <b>3</b>     | <b>0</b>   | <b>0.0%</b>  |
| Cobblestone Trail        | 3            | 0          |              |
| <b>Austin Creek SRA</b>  | <b>89</b>    | <b>6</b>   | <b>6.7%</b>  |
| Bullfrog Pond Campground | 89           | 6          |              |
| <b>Helen Putnam</b>      | <b>2</b>     | <b>0</b>   | <b>0.0%</b>  |
| Savannah Trail           | 2            | 0          |              |
| <b>Howarth Park</b>      | <b>17</b>    | <b>0</b>   | <b>0.0%</b>  |
| Leaf litter areas        | 17           | 0          |              |
| <b>N. Sonoma Mtn</b>     | <b>67</b>    | <b>8</b>   | <b>11.9%</b> |
| Entry/Picnic Area        | 4            | 0          |              |
| N. Sonoma Mtn. Trail     | 2            | 0          |              |
| Umbrella Tree Trail      | 61           | 8          |              |
| <b>Shiloh Ranch</b>      | <b>34</b>    | <b>2</b>   | <b>5.9%</b>  |
| Big Leaf Trail           | 34           | 2          |              |
| <b>Sonoma Total</b>      | <b>212</b>   | <b>10</b>  | <b>7.5%</b>  |

# Other Tick and Tick-borne Disease Surveillance

As discussed on page 3, the District laboratory has started to test for another tick-borne disease pathogen which has been found in parts of California, *Borrelia miyamotoi*. Although not all ticks collected this past year were evaluated, all *I. pacificus* ticks collected in 2017 will be tested for this pathogen.

Adult tick testing results for *B. miyamotoi* in 2016:

| Park             | Total ticks | Pools Tested | <i>Bmiya+</i> pools | MIR  |
|------------------|-------------|--------------|---------------------|------|
| N. Sonoma Mtn RP | 17          | 5            | 1                   | 5.9% |
| Shiloh Ranch RP  | 15          | 4            | 0                   | 0.0% |
| Sonoma Co. Total | 32          | 9            | 1                   | 3.1% |

| Park             | Total ticks | Pools Tested | <i>Bmiya+</i> pools | MIR  |
|------------------|-------------|--------------|---------------------|------|
| MMWD             | 70          | 17           | 3                   | 4.3% |
| China Camp SP    | 1           | 1            | 0                   | 0.0% |
| GGNRA            | 3           | 1            | 0                   | 0.0% |
| Mt. Tamalpais SP | 11          | 3            | 0                   | 0.0% |
| Marin Co. Total  | 85          | 22           | 3                   | 3.5% |

All tick nymphs tested in 2016 were negative for *B. miyamotoi*. This includes ticks from the MMWD, Mt. Tamalpais and China Camp State Parks, North Sonoma Mountain and Shiloh Ranch Regional Parks, and Howarth Park in Santa Rosa.

## 2016 Tick Surveillance Collaborations

In addition to routine sampling and testing of ticks for *Borrelia burgdorferi*, the District at times participates in collaborative efforts to examine other tick-borne diseases in Marin and Sonoma counties.

District staff and CDPH biologists sampled *I. pacificus* ticks from a popular campground in the Austin Creek State Recreation Area in Sonoma County to test for the presence of *Anaplasma phagocytophilum*, the bacterium that causes a febrile disease called anaplasmosis. A few cases of anaplasmosis are diagnosed in California residents every year. Ticks collected in this survey were tested for *A. phagocytophilum* and *B. miyamotoi* by the CDPH lab, as well as for *B. burgdorferi* (s.s.) by the District in-house lab. All adult and nymphal ticks tested in this collection were tested individually. Larvae were tested in pools.

| Collection date | Location                            | Tick species        | Adult # | Nymph # | Larvae # | <i>Borrelia burgdorferi</i> (s.s.) results    | <i>Anaplasma</i> results |
|-----------------|-------------------------------------|---------------------|---------|---------|----------|---|--------------------------|
| 5/11/2016       | Austin Creek SRA - Bullfrog Pond CG | <i>I. pacificus</i> | 30      | 89      | 270      | 1+ <i>Bbss</i> Adult<br>6+ <i>Bbss</i> Nymphs | 1+ Adult<br>1+ Nymph     |

The District also assisted CDPH and CDC staff with tick collections from the Golden Gate National Recreation Area for an ongoing CDC study focusing on the Pacific Coast Tick, *Dermacentor occidentalis*. This study is ongoing and results are not yet available.



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### Contact Us

For more information about our services and programs:

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