Lyme Disease and Occupational Exposure

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Abstract

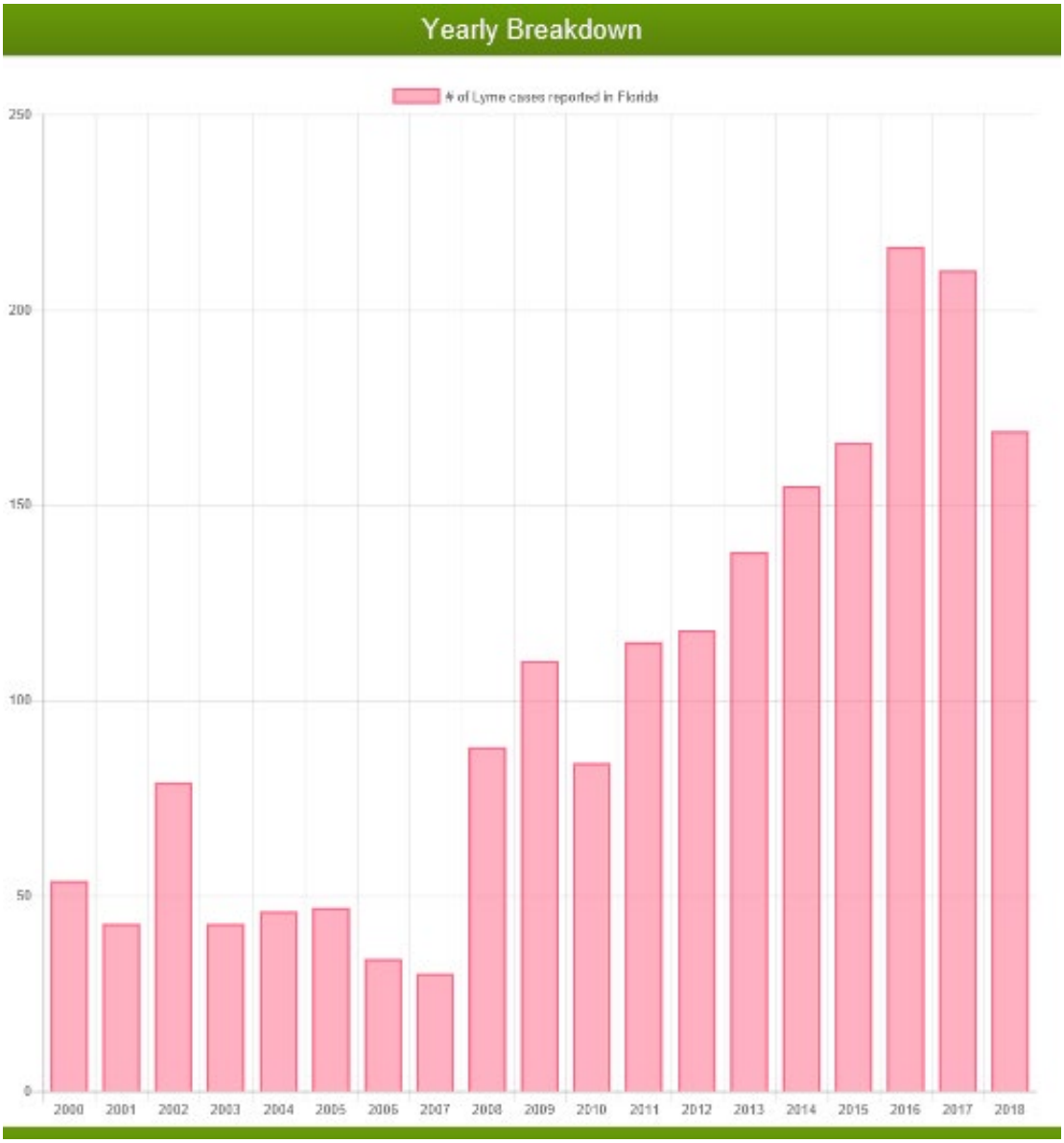
Lyme disease is on the rise in Florida. The disease can be debilitating to an employee creating unique challenges for conservation law enforcement. A survey was conducted with three major conservation agencies indicating a higher probability of exposure to ticks and Lyme disease while working outdoors as opposed to recreating, leading to the need for better education, testing, and post diagnosis management. Legislative presumption laws regarding Lyme disease were identified and discussed to aid conservation law enforcement agencies and its members when the member is disabled from the disease.

Introduction

Tick-borne illnesses are disturbingly on the rise, not only in occurrence, but also geographically. Such illnesses include the Rocky Mountain spotted fever, Anaplasmosis, and Ehrlichiosis. But the most prolific and debilitating of these illnesses is Lyme disease. According to the Centers for Disease Control (CDC), Lyme disease accounted for 82 percent of reported tick-borne illnesses from 2004 to 2016. The CDC further estimates nearly 300,000 people are infected with Lyme disease each year in the United States, most going unreported. (Hruetic, 2019; CDC, 2008)

So, what is Lyme disease? Lyme disease is a bacterium belonging to the species Borrelia infecting its victims via a tick bite. The bacteria cause the host's immune system to create neurotoxins that are not necessarily fatal but do cause injurious complications to the host. The vital function of the nervous system is vastly disrupted, and the host may experience neurodysfunction, fatigue, malaise and even cognitive impairment. Other symptoms include nausea, vomiting, abdominal pain, weight loss, fever, and body aches like the flu but it often lasts over a longer period. After several months, those infected may experience painful and swollen joints, Bell's palsy, poor muscular control, memory loss, difficulty to concentrate, irregular heartbeat, dizziness, shortness of breath, and hepatitis (liver disease). (Akoury, 2013)

In the late 1990s, there was an average of 30-50 cases of Lyme disease reported each year in Florida. That number has continually risen and according to Tick Check, they estimate based on CDC data, that the number is far greater and estimated to be approximately 19,110 cases of Lyme disease in Florida. (Tick Check, 2020)



Images taken from Tick Check at https://www.tickcheck.com/stats/state/florida/lyme

According to the CDC, the best way to prevent Lyme disease is to avoid ticks altogether. But this is an impossible endeavor when employed as an outdoor worker, especially as conservation law enforcement officers where they are often on the front lines for public safety in rural areas. These risks also include other government employees and law enforcement members that are required to operate in tick prone environments due to the nature of their job. (Barna, 2019)

As the numbers of government employees infected with Lyme disease rises each year, so does the impact of the work product, work force, and personal health and lifestyles of the employee(s). In the past, Lyme disease was not as common and somewhat of a rarity, but it is now becoming a widespread issue in Florida that agencies, supervisors, and employees will have to take a more proactive approach to maintain their effectiveness. Since Lyme disease may not be detected for days, weeks or even months

after the initial tick bite, this creates a dilemma with the management of an employee's time, health and medical treatments. Once an employee is infected with Lyme disease, work product, cognitive abilities, physical abilities, and time spent on the job often decrease while their medical needs and sick leave use increase. On the personal side of the issue, an infected employee often must manage increased personal fiscal responsibility for medical treatment and supplies, as well as fractured personal relationships due to changes in mood and cognitive impairment.

When an employee is infected with Lyme disease, in most cases, there is no definitive way to determine the time of the incident causing long-term complications for the agency and the employee. To better understand and mitigate Lyme disease and the professional and personal controversies it causes, the issues will be discussed, and some solutions identified.

Literature Review

To further investigate the occupational infection risks of Lyme disease, we need to identify the illness and its proportion. The mean annual incidence is 5.1 cases for every 100,000 people in the United States, making it the most common vector borne illness in the United States. But scientists believe this number to be low and theorize for every case reported, there are nearly a dozen cases that go unreported. (Piacentino & Schwartz 2002)

During the early 1970s in Lyme, Connecticut, medical experts were puzzled by an illness similar in symptoms as arthritis but affecting young children. Scientist slowly learned that antibiotics could be an effective treatment, but it wasn't until the 1980s that scientists discovered that the vector of this illness was the deer tick. Most Lyme disease cases originated from the northeast coastal states and mid-Atlantic states. Minnesota, Wisconsin and California also have been identified to have a concentration of Lyme disease cases with other states increasing in reported cases, including Florida. (CDC 2008; Patlak, 1988)

In Florida, the black-legged tick (deer tick), Ixodes scapularis, is the most common vector of human transmission for the Lyme disease causing Borrelia burgdorferi bacteria. In seasonal states with cold winters like the northeast United States, the black-legged tick usually feeds on humans during the juvenile or nymphal stage. At this stage, they are small and can be easily overlooked by the host. But since Florida's temperate climate plays less of a role in the life cycle of ticks, adult ticks in addition to nymphs can also be found to transmit Lyme disease. (Lord &Connelly, 2001)

It all starts with the tick making a small hole in the skin to feed. The tick attaches itself to the host with recurved hook like teeth, held on with a glue-like substance. The hole is created for blood flow as the tick acts as a pool feeder on the blood. The Borrelia burgdorferi bacteria is then transmitted via the tick's saliva or digestive system to the host. (Butler & Denmark,1990)

The typical early symptom of Lyme disease is a rash at the tick bite site that starts with a small red dot and slowly grows larger over days to look like a bullseye. Usually within a month, other initial symptoms appear to include flu-like ailments such as fever, body aches, headache and fatigue. After several months, those infected may experience

painful and swollen joints, severe headaches, paralysis or poor muscular movement, memory loss, depression, difficulty in concentrating and multiple sclerosis. Some people may even develop irregular heartbeat, dizziness, shortness of breath, and hepatitis. Due to the vast list of symptoms, medical practitioners can often misdiagnose Lyme disease, especially since many people cannot determine or remember if they encountered a tick or its bite. (Akoury, 2013; Patlak, 1988)

There are tests that can be undertaken by medical practitioners to determine if a person has been infected with the Borrelia burgdorferi bacteria. Tests conducted during the early diagnosis phase are often unreliable due to the body's initial lack of antibodies to be detected. A spinal tap can also be utilized if a person is experiencing nervous system symptoms to detect inflammation of the spinal cord or brain. Antibiotics can effectively treat Lyme disease, especially if caught early. Doxycycline, Cefuroxime Axetil, and Amoxicillin are common antibiotics prescribed by doctors. Ceftriaxone can be administered for neurological symptoms and for patients experiencing heart problems. Following antibiotic treatment, an infected person may still exhibit muscle aches, neurological problems, memory and concentration trouble, and autoimmune problems. (NIH, 2008)

Even though studies show that a tick must be attached to the host for 48 hours to transmit Lyme disease, the best way to prevent Lyme disease is to avoid deer ticks altogether. This would require limiting contact with wild and domestic animals, refraining from entering wooded areas or walking over terrain with fallen foliage such as leaves and pine needles. This creates a dilemma for those employed in conservation organizations, work around animals, or anyone whose work in the outdoors requires to be in tick infested ecosystems. For those that cannot separate themselves from the environmental conditions, the CDC recommends that insect repellant containing at least 20-30 percent DEET to be applied to exposed skin and clothing. Permethrin can also be used since it kills ticks on contact and should be applied to outer garments. In addition to chemical methods, wearing long pants and longs sleeves tucked into pants and boots will act as a physical barrier to help keep ticks on the outside of clothing. Pets should be checked often since they can transport ticks into the house to attach to and bite a human. (CDC, 2008)

Anyone that spends any time in wooded areas or around animals also knows that no matter what kind of precautions a person takes to prohibit contact with ticks, that there is no absolute solution, and the problem is more mitigated than eradicated. This brings the question does a person's occupation in tick prone areas creates a higher risk of Lyme disease infection than that of indoor workers that participate in occasional recreational outdoor activities. A study by Brian Schwartz and Michael Goldstein was conducted in 1990 with the New Jersey Department of Environmental Protection (NJDEP) and found that most studies on Lyme disease focused more on leisure hours rather than work hours. It concluded that Lyme disease in outdoor workers was higher than expected compared to those of recreational users. The study identified 689 NJDEP employees of different divisions and locations around the state to include Parks & Forestry; Green Acres; Fish, Game & Wildlife; and Coastal Resources. It is important to note that the correlation with the presence of deer (implicated as a marker for Lyme disease in other reports) could not be established in their study and there was a lack of significant differences to those that tested seropositive between pet owners and non-pet owners. (Schwartz & Goldstein, 1990)

Schwartz and Goldstein also demonstrated the difficulty in identifying the time of infection, with 6 of 39 (15.4%) employees that tested seropositive for Lyme disease denied ever having any tick exposure and only 33 of 572 employees (5.8%) noted the presence of ticks on their body or clothing. These numbers denote how difficult it is to detect tick presence and a tick bite. Crude analysis of the study also notes that mitigation practices such as wearing long pants and long-sleeved shirts and tucking pants into socks did not significantly decrease the odds of testing seropositive for Lyme disease, but the use of insect repellant did show a slight decrease of testing seropositive. The most influential variables during the study appeared to be the age of the employee, insect repellant use and the work habitat. Younger members had a higher number of infections, but variables not documented such as specific work tasks that could cause a higher risk of infection could have altered the age group infection statistic. To conclude, Schwartz and Goldstein believe there is a substantial increased probability of occupational exposure compared to indoor employees. (Schwartz & Goldstein, 1990)

This may all seem like common sense, but the problem with scientifically identifying the occupational risk of Lyme disease comes with the historical lack of properly identifying and categorizing, in a systematic manner, the infected person's data to include occupation and suspected work habitat the tick was encountered. This lack of occupational data makes it difficult to absolutely determine if an increased risk of infection exists and by how much. There are so many variables and so little controls that true values may never be identified. Another factor to contort the statistical data is most outside workers often take personal precautions against insects by using chemical and physical deterrents as well as proactively looking themselves over on a regular basis to locate attached ticks. These educated approaches versus the uneducated recreational user can have the appearance of placing a finger on the scales of variability. (Piacentino & Schwartz, 2002)

The epidemiology of the Borrelia burgdorferi bacteria has been described and the proportions, vectors, symptoms and treatments identified. Higher occupational risks to be infected with Lyme disease and the difficulty to putting a time frame on infection and detection has also been discussed. But what exactly does Lyme disease do to the psychological facet of a person? How does it mentally, emotionally and socially affect an individual?

So, let's explore what Lyme disease does to a person and their wellbeing. For over 20 years, Meghan O'Rourke has been battling with the diagnosis, symptoms and treatment for Lyme disease. In 1997, Meghan began experiencing stabbing pains in her extremities every morning. These muscular twitches and spasms would come and go for months. As years passed, Meghan began experiencing vertigo, joint pain and memory problems to name a just few. Doctors continued to misdiagnose her as she regularly woke in the middle of the night, covered in sweat and hives. Dealing with her pain and exhaustion, she was diagnosed with an autoimmune disease in 2012. Meghan continued to be misdiagnosed by some of the best doctors available, many of whom didn't take insurance. Her debt continued to pile up as she was diagnosed with neuropathy of unclear origin, an unspecified connective tissue disease, and over exhaustion. In 2013, Meghan found her way to another doctor who specialized in infectious diseases where she received her first Lyme disease test. The more research Meghan did on Lyme disease, the less relief she found. (O'Rourke, 2019)

By the time Meghan was diagnosed with Lyme disease, she was to the point where she couldn't remember friends and she was having such dizzy spells, she would faint. The symptoms had Lyme disease written all over them, but her doctor showed Meghan different results from three different labs. One was negative while the other two were positive. This only created confusion in a time Meghan needed clarity. Meghan then sought the treatment of Dr. Richard Horowitz, a member of the Department of Health and Human Services, Tick-Borne Disease Working Group. Dr. Horowitz clinically diagnosed her with Lyme disease and prescribed Doxycycline to Meghan but warned her that as the antibiotics began to work and the bacteria in her body began to die, the bacteria would release toxins causing flu like symptoms. For nearly a month, Meghan took the Doxycycline, causing multiple symptoms like rashes and the feeling of rain hitting her body. The antibiotics ultimately made her allergic to sun light, causing dermal blistering. Meghan was also placed on an antimalarial drug to combat her ongoing night sweats and air hunger or continual thirst for oxygen. In 2014, she could barely walk down the street because she was so ill. She continued to experience the stabbing pain in her extremities and the burning pain up her neck. The pain was so severe one day while sitting in her apartment, Meghan looked at the window and thought she could just run and jump out the window to make the pain go away. (O'Rourke, 2019)

In the spring of 2015, Dr. Horowitz decided she could stop taking the Doxycycline. At this time, Meghan's severe symptoms had subsided, but she was still experiencing some of the mild Lyme disease symptoms, but this was the best she had ever felt since her initial symptoms in 1997. These mild chronic symptoms she was still experiencing are found in 20 percent of post-treatment patients and called post-treatment Lyme disease syndrome (PTLDS), now recognized by the Centers for Disease Control (CDC). It is believed that antibiotics only inhibit the replication of bacteria but do not kill dormant ones in the body, causing PTLDS. This means that a strong and healthy immune system is required to eradicate the dormant Borrelia burgdorferi bacteria. In the spring of 2017, Meghan began experiencing her excruciating symptoms again. Dr. Horowitz advised that her Lyme disease infection had recurred and that she would have to undergo another harsh treatment of antibiotics. (O'Rourke, 2019)

The unanswerable question is how much time has Lyme disease stolen from Meghan, mentally, emotionally and physically? Meghan's personal and professional life is holding on by a string, she often cannot remember friends or family member's or their names, she's fiscally upside down with no answers or cure, and her pain was so intense Meghan even considered jumping out of her apartment window. Lyme disease is a terrible illness that wrecks lives. (O'Rourke, 2019)

Meghan was lucky in one aspect of her Lyme disease infection. It is estimated that between 50 to 90 percent of those individuals infected with Lyme disease also experience mast cell activation syndrome (MCAS). Mast cells are white blood cells for the immune system, located in bone marrow, that release histamine to trigger inflammation in the body to speed up the body's healing. This release of histamine causes allergic reactions to fight off stress, infections, parasites, or any other agent the body finds offensive. These allergic reactions can mimic many of the symptoms of Lyme disease such as nausea, heart palpitations, shortness of breath, headaches and dizziness to name a few. MCAS is the misdirection of the immune system and can be triggered by several things to include mold,

hot or cold environments, mental or emotional stress, and foods containing histamine. (Patel, Farshchain & Forsgren, 2019)

MCAS often requires a complete dietary change to low-histamine foods. Food high in histamine include shellfish, all processed meats; several vegetables to include a variety of beans and peas, spinach, tomatoes, avocados, and potatoes; any type of fermented dairy such as cheese, yogurt and sour cream; any baked goods from bleached flour, several types of nuts to include walnuts, pecans and cashews; processed oils, chocolate and honey, all caffeinated drinks and beers to name few. This list is just the tip of the iceberg. (Patel, Farshchain & Forsgren, 2019)

It can be seen how disruptive and debilitating Lyme disease can be to a person. It can also be noted how expensive the disease can also get, even if the victim is only responsible for insurance copayments at a fraction of the costs. The disease will require numerous visits to medical practitioners and experts, and that is if the disease is properly identified and diagnosed. The physical and cognitive abilities of the employee will be challenged leading to the notion if the necessary and required job tasks are being successfully met by the employee. Another factor to be considered is the long-term disruption of the employee's family or personal life and how it relates to their professional life. It is easy to distance the employee, but in reality, the disease does not only affect the employee or their personal life. Reflecting on the studies, agencies must consider the higher likelihood of outside workers being infected with Lyme disease, dissect the issue(s) of when the infection took place, and determine how management will handle an infected employee.

Methods

The purpose of this research was to identify the occupational risks, exposure, and post infection management of Lyme disease victims in jobs that require outdoor tasks, more specifically those employed in conservation law enforcement.

Data was gathered through surveys given to employees of the Florida Fish and Wildlife Conservation Commission and of other state agencies of similar size and duties to include the Texas Parks and Wildlife Department and the California Department of Fish and Wildlife. Survey questions were designed to identify the amount of exposure to ticks while working in an official capacity, the frequency of this exposure, the frequency of actual tick bites, any precautions taken to limit exposure, employees diagnosed with Lyme disease, and any protocols that their division, agency or state law enact on the employee's behalf once diagnosed.

Information to establish employees' outdoor recreational habits were also sought to ascertain the time recreating outdoors versus time spent on required tasks at work to determine if heightened occupational exposure exists. Additionally, data regarding time on the job was also requested to identify any correlations between age groups or job longevity and Lyme disease exposure/diagnosis.

The survey was anonymous in order to encourage participation and candidness. At risk of losing participation, the survey was kept as brief as possible to get as much detailed information regarding occupational exposure and managing members diagnosed with Lyme disease.

Results

The survey was sent to sworn law enforcement members of the Florida Fish and Wildlife Conservation Commission (FWC), California Department of Fish and Wildlife (CDFW), and the Texas Parks and Wildlife Department (TPWD). CDFW and TPWD were included in the survey to compare other conservation agencies similar in geographic size, personnel, and work duties as FWC.

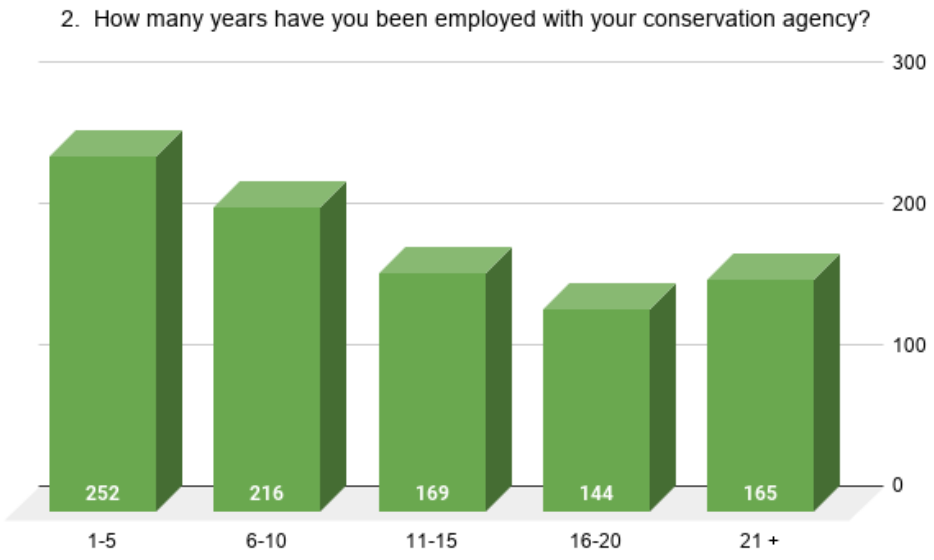
The first two questions on the survey were biographical in nature. The first question asked was what jurisdiction the respondents were from: Florida, Texas, California, or Other. At the time of the survey, FWC comprised of 848 Sworn members, TPWD comprised of 551 members, and CDFW comprised of 465 sworn members, for a total of 1864 surveys sent out. I received 948 responses for a total response rate of 50.86%. Out of 944 responses to question one (4 respondents did not reply),

FWC was represented by 671 (71.1%) of total respondents,
TPWD was represented by 161 (17.0%) of total respondents, and
CDFW was represented by 111 (11.8%) of total respondents.
One (0.1%) survey found its way to Alaska Department of Fish and Game (ADFG) and submitted under Other.

The second question asked respondents to indicate their tenure as a conservation officer. Of the 946 respondents that answered the question;

- 252 (27%) of respondents indicated they had 1-5 years of experience;
- 216 (23%) indicated 6-10 years;
- 169 (18%) indicated 11-15 years;
- 144 (15%) indicated 16-20 years;
- 165 (17%) indicated 21 years or more of experience;
- 2 survey participants chose to skip the question.

TABLE 1: Conservation Officer Tenure



The third and fourth questions were comparative with each other regarding working versus recreating in the outdoors where ticks can be found. The pair of questions were asked to identify trends or probabilities where most contact between respondents and ticks was observed.

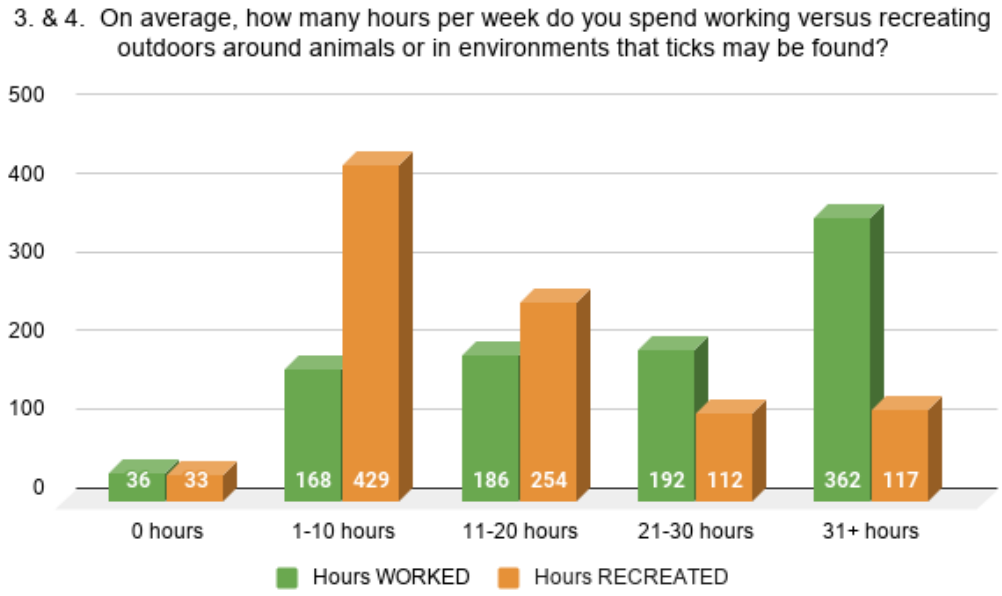
Question three focused on how many hours per week the respondent spent working outdoors around animals or in environments that ticks may be found. Of the 944 that responded to this question (4 chose not to respond);

- 36 (4%) answered they worked outside for 0 hours per week;
- 168 (18%) answered 1-10 hours;
- 186 (20%) answered 11-20 hours;
- 192 (20%) answered 21-30 hours,
- 362 (38%) answered 31 or more hours per week.

Question four focused on how many hours per week the respondent spent recreating outdoors around animals or in environments that ticks may be found. Of the 945 that responded to this question (3 chose not to respond);

- 33 (4%) answered they recreated outside for 0 hours per week;
- 429 (45%) answered 1-10 hours;
- 254 (27%) answered 11-20 hours;
- 112 (12%) answered 21-30 hours;
- 117 (12%) answered 31 or more hours per week.

TABLE 2: Hours Worked versus Recreated per Week Outdoors



The fifth and sixth questions were comparative with each other regarding tick mitigation techniques. The pair of questions were asked to compare behavioral patterns to repel or prevent tick contact while working versus recreating outdoors.

Question five asked respondents if they utilized any tick mitigating techniques while working. Sixty-eight (7.2%) respondents decided not to respond to the question with 880 of respondents answered in some way. Question 6 asked respondents if they utilized any tick mitigating techniques while recreating. Ninety-seven (10.2%) respondents decided not to respond to the question with 851 of respondents answering in some way. Both questions advised the respondents to choose all options that apply that included: DEET (Insect repellant), Permethrin (applied on clothing), physical barriers (long pants & long sleeves), tucking pants into boots, and a fill in option for any additional information. The following is data collected from questions 5 and 6:

Mitigation Techniques	Working (880)	Recreating (851)
DEET (insect repellant)	623 (71%)	613 (72%)
Permethrin (applied on clothing)	142 (16%)	147 (17%)
Long pants / Long Sleeves	663 (75%)	582 (68%)
Tuck pants into boots	139 (16%)	156 (18%)
Gloves and Buff	1 (0.1%)	1 (0.1%)
Trim leg hair	1 (0.1%)	1 (0.1%)
Lemon Eucalyptus	2 (0.2%)	2 (0.2%)
Bug suit	1 (0.1%)	0 (0%)
Snake boots	1 (0.1%)	1 (0.1%)
Tick bands / collars	2 (0.2%)	1 (0.1%)
Natural insect repellant	1 (0.1%)	1 (0.1%)
Tick meds for dog	0 (0%)	1 (0.1%)
Tick removal device	0 (0%)	1 (0.1%)
Therma-cell	0 (0%)	1 (0.1%)
Close search of body after	1 (0.1%)	1 (0.1%)
No, None, N/A, not usually	17 (2%)	19 (2%)
Left Blank	5 (0.6%)	5 (0.6%)

Questions seven and eight were comparative with each other regarding how many ticks on average respondents found on their body or clothing per week while working versus recreating. The pair of questions were asked to identify trends or probabilities where most contact between respondents and ticks was observed.

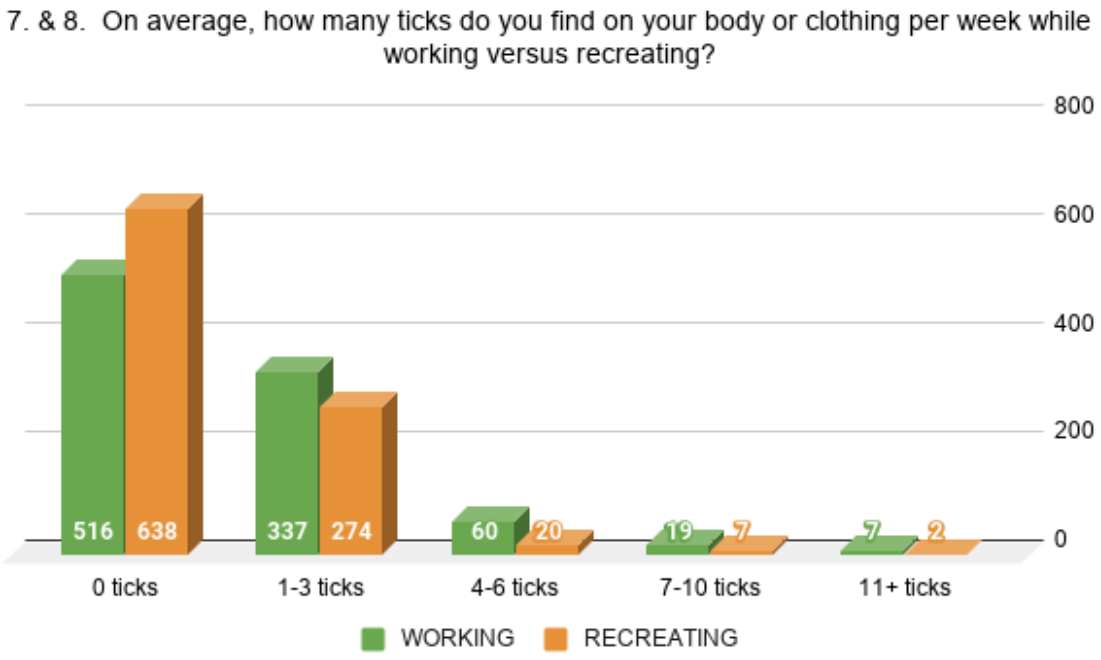
Question seven focused on how many ticks per week the respondent found on their body or clothing while working outdoors. Of the 939 that responded to this question (9 chose not to respond);

- 516 (55%) answered they found 0 ticks on average per week;
- 337 (36%) answered 1-3 ticks per week;
- 60 (6%) answered 4-6 ticks per week;
- 19 (2%) answered 7-10 ticks per week;
- 7 (1%) answered 11 or more ticks were found per week.

Question eight focused on how many ticks per week the respondent found on their body or clothing while recreating outdoors. Of the 941 that responded to this question (7 chose not to respond);

- 638 (68%) answered they found 0 ticks on average per week;
- 274 (29%) answered 1-3 ticks per week;
- 20 (2%) answered 4-6 ticks per week;
- 7 (0.8%) answered 7-10 ticks per week;
- 2 (0.2%) answered 11 or more ticks were found per week.

TABLE 3: Ticks Found While Working versus Recreating



Questions nine and ten were comparative with each other regarding how many ticks bite or attach to their body per week while working versus recreating. The pair of questions were asked to identify trends or probabilities where most tick bites occur.

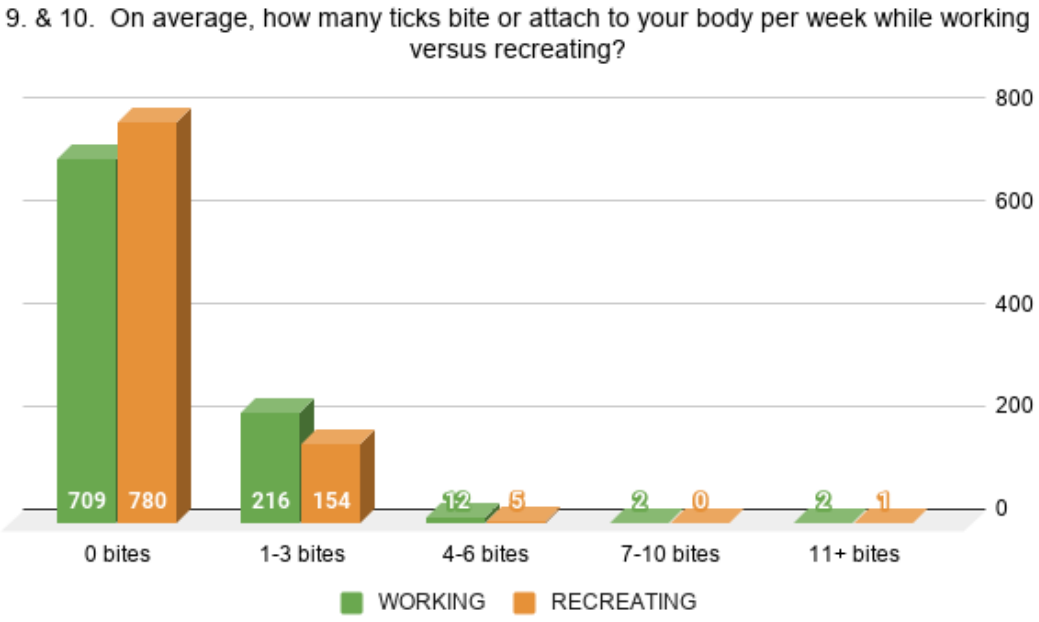
Question nine focused on how many ticks bite or attach to the respondents' body per week while working. Of the 941 that responded to this question (7 chose not to respond);

- 709 (75.3%) answered they found 0 ticks on average per week;
- 216 (23%) answered 1-3 ticks per week;
- 12 (1.3%) answered 4-6 ticks per week;
- 2 (0.2%) answered 7-10 ticks per week,
- 2 (0.2%) answered 11 or more ticks bit them per week while working.

Question ten focused on how many ticks bite or attach to the respondents' body per week while recreating. Of the 940 that responded to this question (8 chose not to respond);

- 780 (83%) answered they found 0 ticks on average per week;
- 154 (16.4%) answered 1-3 ticks per week;
- 5 (0.5%) answered 4-6 ticks per week;
- 0 (0%) answered 7-10 ticks per week,
- 1 (0.1%) answered 11 or more ticks bit them per week while recreating.

TABLE 4: Tick Bites While Working versus Recreating



Question eleven asked respondents if they had ever experienced a rash or bullseye mark around a tick bite. This question was asked to get an overall view of how many respondents that may have been exposed to Lyme disease. Of the 941 that responded to this question (7 chose not to respond);

- 163 (17.3%) answered Yes;
- 649 (69%) answered No;
- 123 (13.1%) answered Maybe;
- 6 (0.6%) answered Prefer not to say.

Question twelve asked respondents if they had ever been medically diagnosed with Lyme disease. This question was asked to get a de facto view of how many respondents that have been exposed to Lyme disease. Of the 946 that responded to this question (2 chose not to respond);

- 13 (1.4%) answered Yes;
- 926 (97.9%) answered No;
- 7 (0.6%) answered Prefer not to say.

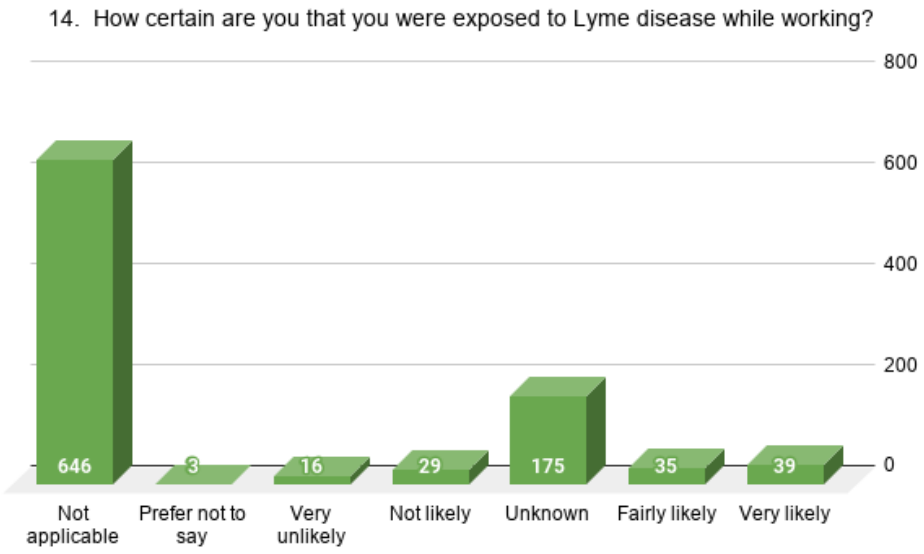
Question thirteen asked respondents when they were medically diagnosed with Lyme disease. This question was asked to better understand or identify trends on when respondents were exposed to Lyme disease. Of the 936 that responded to this question (12 chose not to respond);

- 914 (97.7%) answered Not applicable;
- 4 (0.4%) answered Prefer not to say;
- 4 (0.4%) answered Before becoming a conservation officer;
- 14 (1.5%) answered While employed with a conservation agency.

Question fourteen asked respondents how certain they were of being exposed to Lyme disease while working. This question was asked to better understand or identify trends on when respondents were exposed to Lyme disease. Of the 943 that responded to this question (5 chose not to respond);

- 646 (68.5%) answered Not applicable;
- 3 (0.3%) answered Prefer not to say;
- 16 (1.7%) answered Very Unlikely;
- 29 (3.1%) answered Not likely;
- 175 (18.6%) answered Unknown;
- 35 (3.7%) answered Fairly likely;
- 39 (4.1%) answered Very Likely.

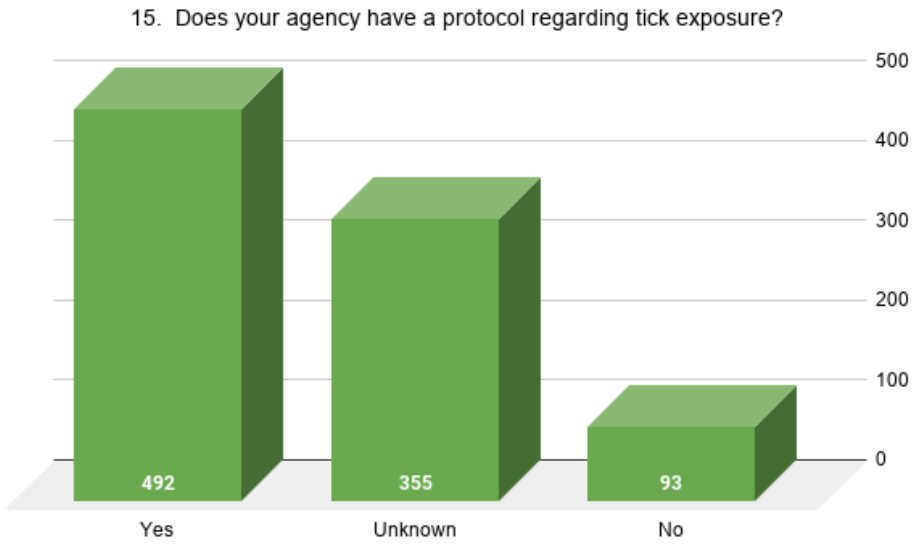
TABLE 5: Certainty of Exposure while Working



Question fifteen asked respondents if their agency had a protocol regarding tick exposure. This question was asked to explore other agencies' protocols while also verifying if respondents were educated and aware of any protocols. Of the 940 that responded to this question (8 chose not to respond);

- 492 (52%) answered Yes;
- 355 (38%) answered Unknown;
- 93 (10%) answered No.

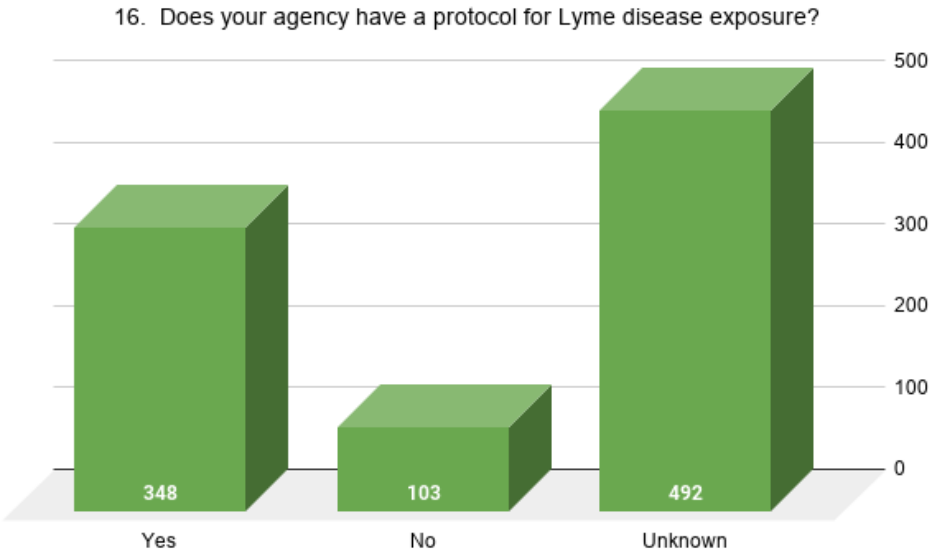
TABLE 6: Agency Protocol for Tick Exposure



Question sixteen asked respondents if their agency had a protocol for Lyme disease exposure. This question was asked to explore other agencies' protocols while also verifying if respondents were educated and aware of any protocols. Of the 943 that responded to this question (5 chose not to respond);

- 348 (37%) answered Yes;
- 103 (11%) answered No;
- 492 (52%) answered Unknown.

TABLE 7: Agency Protocol for Lyme Disease



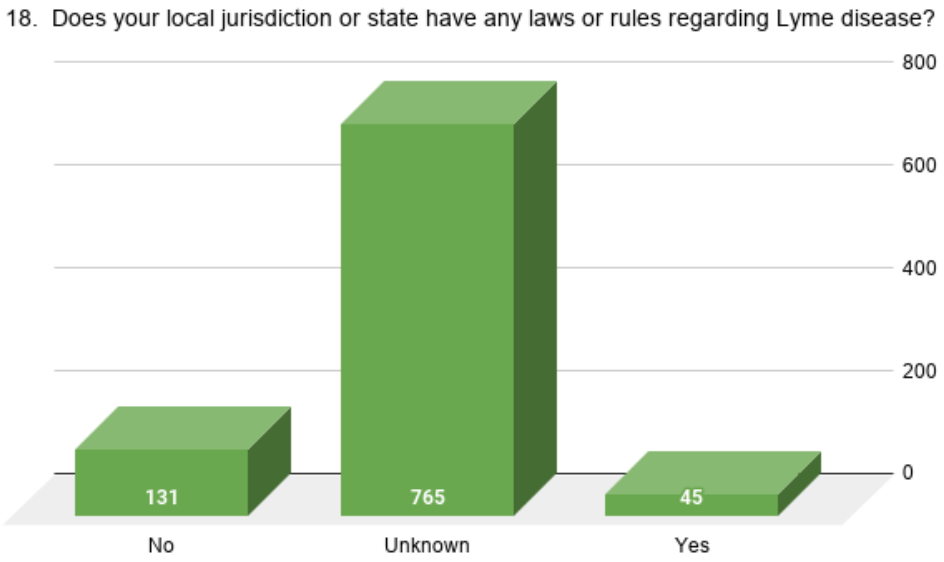
Question seventeen asked respondents if their local jurisdiction or state have any laws or rules regarding tick-borne illnesses. This question was asked to explore other jurisdictions' or states' pre-existing rules on any tick-borne illnesses that could possibly be referenced or utilized in other jurisdictions or states. Of the 942 that responded to this question (6 chose not to respond);

- 59 (6%) answered Yes;
- 130 (14%) answered No;
- 753 (80%) answered Unknown.

Question eighteen asked respondents if their local jurisdiction or state have any laws or rules regarding Lyme disease. This question was asked to explore other jurisdictions' or states' pre-existing rules on Lyme disease exposure that could possibly be referenced or utilized in other jurisdictions or states. Of the 941 that responded to this question (7 chose not to respond);

- 45 (5%) answered Yes;
- 131 (14%) answered No;
- 765 (81%) answered Unknown.

TABLE 8: Laws Regarding Lyme Disease



To conclude the survey, respondents were asked to provide any additional comments or recommendations regarding the matter. The most notable comment was regarding the frequency of tick encounters or bites. Some respondents commented that in some instances, 1-3 contacts per week was too often and 1-3 tick contacts per month could have been a better representation of their scenario. Other comments made by respondents included various mitigation techniques used and personal experiences with ticks and Lyme disease. See Appendix B for all the detailed replies from respondents.

Discussion

While an exact value cannot be placed on the increased risk of infection of Lyme disease due to a variety of factors to include the ambiguity of time of tick contact or false negatives with early tests, the survey is consistent with Brian Schwartz and Michael Goldstein's 1990 study and does identify trends of increased likelihood of tick and Lyme disease exposure while working.

According to survey results, it can be easily recognized that most of the respondents stated they worked more outdoors than they recreated in areas that ticks could be found. Respondents also answered that they found more ticks on their body or clothing per week and got bit by more ticks while working outdoors compared to recreating. So, the data supports the notion that there is higher risk of tick contact and bites while working.

The data also shows that according to the respondents' replies, that there is no significant difference in behavior or techniques to prevent tick exposure while working versus recreating. Percentages are near identical in value and indicates near equal precautions were taken while working and recreating. It can then be deduced that the behavior or techniques used by the respondents to prohibit tick exposure is generally systematic whether working or recreating, making tick mitigating techniques a neutral variable in this study.

The survey further indicated that over 163 respondents experienced the initial symptoms of Lyme disease with a rash or bullseye mark around a tick bite while only 13 respondents acknowledging being medically diagnosed with Lyme disease. This information from the survey suggests that for every medically diagnosed case, there could be 12.5 cases that go unreported. This is consistent with CDC theory that very few Lyme disease cases are diagnosed and reported. It is then reasonable to say that there may be several conservation law enforcement officers nationwide that have been exposed to Lyme disease without knowing or have been misdiagnosed by doctors, therefore, not getting properly reported.

Data further indicated that at least one of the states surveyed have laws or rules regarding Lyme disease. This information instigated further research to identify codified rules regarding the disease. This research revealed that California has implemented Lyme disease presumption into the California Labor Code. The California Workers' Compensation Law provides specifically identified law enforcement, to include conservation law enforcement, the presumption that Lyme disease was obtained while in the course of their employment and they shall include full hospital, surgical, medical treatment, disability indemnity, and death benefits. (Singer, 2020)

Additional comments and recommendations made by respondents suggested that the addition of a monthly and yearly option in the survey would have been a more demonstrative representation instead of just weekly. Suggestions for prevention were made for regularly schedule medical screenings for tick borne illnesses, the utilization of tick bands/dog collars around boots, and 'Lemon Eucalyptus' spray as a natural alternative to other chemical barriers. One respondent even places ticks in a container for preservation in case future symptoms arise, the ticks can be tested and readily identified which tick delivered the illness.

While the survey shows that there is an increased likelihood of exposure to Lyme disease while working as a conservation officer, the exact rate of exposure is difficult to determine without systematic testing of all officers over a given time. Different organizations studying the disease have varying numbers from a few cases to thousands per year. Even if we focus on the lower number of exposures, we must ask ourselves if this is acceptable due to the disease's debilitating nature.

Law enforcement spends myriad amounts of money, research, and time preparing officers for gun battle. Everything from body armor, firearms and regular tactical training

is provided to every officer to prepare for this unfortunate situation. According to the Federal Bureau of Investigations (FBI), 2,119 law enforcement officers in the United States were assaulted by a firearm in 2018. There were over 686,000 law enforcement officers in the Unites States in 2018, making these assaults 0.3% of the national law enforcement population. (FBI, 2018; Statista, 2020)

According to the survey, conservation law enforcement has more than 5 times the probability of being exposed to Lyme disease than any law enforcement officer has being assaulted with a firearm. This is in no way an attempt to minimize felonious encounters, but a good comparison of resources provided with one facet of the job to the lack of resources to a more probable facet. Agencies generally provide various benefits for these assaults if the officer is wounded or killed, yet, many agencies are not providing the same services for a vector borne disease that can have equal disabling effects. Is it acceptable for up to 1.5% of conservation law enforcement to be medically diagnosed with Lyme disease, exposed while working, and not have any assistance from the government?

Conversely, is it in the government's best interest to not provide assistance to these employees or not have a retirement plan parallel to other incapacitating injuries while on duty? Let's take a look from the government's perspective on concerns and best interests. An employee may exhibit memory loss, mood swings, physical illness and inevitably take sick days. The disease may even cause debilitating ailments such as poor muscular control, difficulty in concentrating, irregular heartbeat, dizziness, and liver disease. All are symptoms that are not conducive for a law enforcement officer to fulfill their duties, keep the public safe, and keep themselves safe. Things to consider by the agency is the member's continual or extended leave, drop in productivity and efficiency, social dynamics amongst peers and supervisors, and the personal and professional liability involved. Retaining a severely ill employee from Lyme disease is no different than one involved in a disabling car crash or felonious act against them.

In summary, there is an increased exposure to Lyme disease for conservation law enforcement while working. Since Florida does not have extreme cold seasons, there is an increased probability of Lyme disease since ticks are capable of being active year-round. This correlates to the continual rise in cases over the last 20 years in Florida. Probably the most progressive data to derive from the study is the Lyme disease presumption law in California. Many states have laws regarding other debilitating and disabling issues to be presumed to have been accrued or suffered while working. Florida has the firefighters and law enforcement special provisions relative to disability (FS 112.18) that presumes medical conditions, including but not limited to, tuberculosis, heart disease and hypertension were suffered while in the line of duty. States taking legislative action with such Lyme disease presumption would be an astounding step not just for conservation workers, but other members of government that are assigned to duties where ticks are found. This would give both the employee and employer avenues to help alleviate unfortunate hurdles caused by Lyme disease.

Recommendations

According to the survey, respondents were not clear on whether their agency, jurisdiction, or state had any Lyme disease protocols or rules. It would be beneficial not only to the employees, but also to agencies, to better educate their members on Lyme disease. This formal education should not be limited to the basic knowledge of the disease, but also habitats that are conducive for ticks, most effective mitigation techniques, and signs and or symptoms of Lyme disease. This education could be an addition to periodically required blood-borne pathogen training.

Routine testing for Lyme disease would also be beneficial to the study, diagnosis, and treatment of the disease. Tick bites should be documented, and the tick should also be preserved for further testing if needed. This will help agencies with determining when and where the tick exposure and bite occurred.

Conservation agencies should also codify in their policies any precautions that will be taken to mitigate any vector- borne illnesses, especially Lyme disease. Actions to occur if a member is bit by a tick should also be outlined to protect the agency and member. This will help minimize false claims by an officer to cover medical bills while also giving members proper coverage of medical if legitimately exposed to Lyme disease while working.

As the cases rise, agencies must look at strategies to deal with those members that are disabled by Lyme disease and unable to fulfill their duties as an officer. Legislation could be implemented that presumes exposure of Lyme disease while working. Legislative actions with such Lyme disease presumption would be an extraordinary measure for a disease that is only going to increase in exposure. This would give both the agency and member avenues to pursue if the member is determined to be unfit for duty.

Major Randy Bowlin has been in law enforcement for over 24 years. He started his law enforcement career in the Florida Keys with the Florida Marine Patrol in 1997. In July of 1999, the Florida Marine Patrol and the Florida Game and Freshwater Fish Commission merged to form the Florida Fish & Wildlife Conservation Commission where he served across northeast and central Florida as a uniform supervisor and investigations supervisor. Randy became the Northeast Region's investigations captain responsible for critical incidents to include fatal boating accidents, Human-Wildlife Conflict, and Hunting Accidents. He also served on the Northeast Region Special Operations Group and was the commander of the team until he recently promoted to Section Leader for Statewide Investigations and Intelligence. As section leader, Randy is responsible for statewide covert investigations, intelligence, JTTF liaisons, wildlife and marine law administration, and port investigations. Randy is a graduate of the Florida Leadership Academy, Class 34.

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Appendix A

Lyme Disease and Occupational Exposure Survey
Capt. Randy Bowlin
Florida Fish & Wildlife Conservation Commission

The purpose of this survey is to identify the occupational risks, exposure, and post infection management of Lyme disease in jobs that require outdoor tasks, more specifically those employed in conservation agencies. This survey is anonymous, and your answers will be used to identify exposure levels to ticks while working in an official capacity, the frequency of this exposure, and any protocols that your division, agency or state law can enact on an employee's behalf once diagnosed. The data may be shared with other agencies or divisions to locate heightened risks locations and identify best practices for Lyme disease exposure to employees.

1. What jurisdiction are you from?
    a. Florida
    b. Texas
    c. California
    d. Other

2. How many years have you been employed with your conservation agency?
    a. 1-5
    b. 6-10
    c. 11-15
    d. 16-20
    e. 21+

3. On average, how many hours per week do you spend **working** outdoors around animals or in environments that ticks may be found?
    a. 0
    b. 1-10
    c. 11-20
    d. 21-30
    e. 31+

4. On average, how many hours per week do you spend **recreating** outdoors around animals or in environments that ticks may be found?
    a. 0
    b. 1-10
    c. 11-20
    d. 21-30
    e. 31+

5. Do you utilize any tick mitigating techniques while **working**? (choose all that apply)
    a. DEET (Insect repellant)
    b. Permethrin (applied on clothing)
    c. Physical barriers (long pants & long sleeves)
    d. Tucking pants into boots

6. Do you utilize any tick mitigating techniques while **recreating**? (choose all that apply)
    a. DEET (Insect repellant)
    b. Permethrin (applied on clothing)
    c. Physical barriers (long pants & long sleeves)
    d. Tucking pants into boots

7. On average, how many ticks do you find on your body or clothing per week while **working**?
    a. 0
    b. 1-3
    c. 4-6
    d. 7-10
    e. 11+

8. On average, how many ticks do you find on your body or clothing per week while **recreating**?
    a. 0
    b. 1-3
    c. 4-6
    d. 7-10
    e. 11+

9. On average, how many ticks bite or attach to your body per week while **working**?
    a. 0
    b. 1-3
    c. 4-6
    d. 7-10
    e. 11+

10. On average, how many ticks bite or attach to your body per week while **recreating**?
    a. 0
    b. 1-3
    c. 4-6
    d. 7-10
    e. 11+

11. Have you ever experienced a rash or bullseye mark around a tick bite?
    a. Yes
    b. No

12. Have you ever been medically diagnosed with Lyme disease?
    a. Yes
    b. No

13. When was the medical diagnosis of Lyme disease made?
    a. Not Applicable
    b. Before becoming a conservation employee
    c. While employed with a conservation agency

14. How certain are you that you were exposed to Lyme disease while working?
    a. Not Applicable
    b. Very Likely
    c. Fairly Likely
    d. Unknown
    e. Not Likely
    f. Very Unlikely

15. Does your agency have a protocol regarding tick exposure?
    a. Yes
    b. No
    c. Unknown

16. Does your agency have a protocol for Lyme disease exposure?
    a. Yes
    b. No
    c. Unknown

17. Does your local jurisdiction or state have any laws or rules regarding tick borne illnesses?
    a. Yes
    b. No
    c. Unknown

18. Does your local jurisdiction or state have any laws or rules regarding Lyme disease?
    a. Yes
    b. No
    c. Unknown

Thank you for taking the time to participate in this survey regarding Lyme disease and occupational exposure. The information you provided will help better understand the exposure risks of Lyme disease to conservation employees. Please use the space below to provide any additional comments or recommendations.

Appendix B

Closing survey comments by respondents:

- Have had the one time, Lyme disease prevention shot in 1997.
- I did experience a weird rash and tingling in my fingers and toes last year. Doctor tested for tick disease, but results came back negative, however they did not know what else it might be. Was given antibiotics and rash went away.
- I have completed first report of injury due to tick bites / highly irritated areas due to tick bites in the past.
- The once a week frequency is too frequent. Should have an option for how many times per month or quarter. I avoid areas with high tick concentrations.
- Tick bites vary. Just recently I was covered with hundreds of minuscule size ticks and received numerous bites. But I try to continuously monitor ticks on me and get them before they bite. I have had numerous tick bites throughout my career and have never been checked for Lyme disease.
- Game warden. Tick bitten approximately once a month.
- Tick exposure (bites) is limited to months apart, not weekly!
- The 1-3 bites per week is high this could be maybe better per month 1-3.
- I feel that our agency should allow members to get tested bi-annually for tick borne illnesses. This would mitigate interactions where a worker may have unknowing come into contact with Lyme disease.
- In my life, I've been bitten by a tick one time while working, 3 times while recreating.
- I have found ticks on my body or clothes while both recreating and working but very rarely. Less than one per week. Also, I primarily work on a boat in the ocean, hence low tick exposure.
- It’s very rare that I find ticks on my clothes
- I average one tick bite a year, a few times a year find ticks on my clothing, depending on location working. While working I usually wear long pants, boots and long sleeve shirt, and most of the time while walking, I wear a bug tamer jacket.
- I answered 1-3/week on finding ticks. It is more like 1-3 a month but that wasn’t an option.
- Please research 'Lemon Eucalyptus' spray. It’s a very effective and non-toxic way of keeping ticks off; and kills them within 15 minutes. Also use tape rollers to remove any ticks from clothing.

- I have had an estimated 10 tick bites since Jan of this year, this surveys questions need to be based on monthly or seasonal exposure instead of weekly.
- I participated in this survey because in the past I was exposed to ticks while working in a patrol capacity. I haven't actively worked patrol over the past six years.
- state should pay for a test each year.
- The Q [question] for weekly was tough but annually on average one tick bite a year.
- Once a week is too often, per month would be a better numerical result for my area of patrol.
- I remove on average 3-5 ticks a year. I generally save them in a plastic bag for several weeks until I'm certain no bullseyes has formed. Warden [name removed]
- Don't forget the other tick-borne diseases like alpha-gal. I know several people with it.
- On question 8, I answered "1-3 a week" for tick bites, however I have only found one tick fully attached to the skin (but that answer was not an option) … also some of my answers are not consistent. I do think I got Lyme disease from a tick bite at work, but I received a negative Lyme disease test result. (Negative test results with symptoms of Lyme disease was not an answer). False negatives are common, especially in early detection. With so little known about Lyme disease, coupled with the head aches and body aches following the tick bite, I opted to take the antibiotic treatment.
- It is recommended by my agency to complete an exposure report for tick bites, but I know a lot of officers do not do it, so the true amount of tick bites is likely much higher than those reported.
- I feel that these questions will be answered very differently based on geography (Rural vs Urban) around Florida and FWC assignment; inland position vs marine position.
- I usually find less than a handful of ticks on me per year.
- I get ticks, but not weekly. Average of 1 tick per month or two.
- The area I work used to have many ticks. Fire ants have pretty well reduced their numbers in this area. Still find one occasionally. I know several people in this area that have contracted Lyme disease, but most got it years ago.
- coastal unit, only in heavy woods occasionally.
- A natural preventative for tick control would be beneficial.
- Really, what can we do? We are in area and brush with ticks. It's an acceptable hazard of the occupation. We can be cautious, yes. I'm more concerned about being shot.
- I have only had two ticks bite/attach to me while working over the past 3 years.
- I may fine 1-3 tick bites a year. But not per week.
- If bitten by a tick while on duty, make a first report of injury so it is documented.
- Ticks are part of the outdoors, and a natural part of having a job outdoors. It seems unreasonable for an employee to submit a first report of injury for every single time they are exposed to a tick/bite.

- I know or have known 4 wildlife officers with confirmed diagnosed Lyme disease.
- Earlier in my career, I was exposed to ticks on a much more regular basis.
- I have been tick bit twice in the last 3 years. both times while at work.
- My dog who works with me on patrol picked up a tick last year. He's on NexGard year-round but still developed a bullseye on his inner thigh. I started him on Doxycycline immediately and he has since tested negative for Lyme.
- We do not have an issue with ticks in the area I currently live/work. When I have lived/worked in areas with high tick populations I have taken the proper precautions and never had an issue.
- My wife got bit by a tick that I most likely brought home on my clothes in 2013. Most Dr.'s believe Lyme disease does not exist in California regardless of documentation I provided that it does. Because of that, my wife was not treated after the tick was removed and now, she is dealing with the long term effects of Lyme Disease. We had to get her tested out of our own pocket, since the doctor would not get her tested or provide us a referral.
- As far as I know, the CDFW does not have official policy or recommendations on tick bites or Lyme disease. Our Agency simply references Department of Public Heath guidelines for bites/exposure.
- I know approx. 25 people that have contracted Lyme disease, of which approx. 20 are in conservation law enforcement and 1 person in VA in conservation LE that contracted rocky mountain spotted fever.
- I primarily work near the desert along the TX/MX border.

Appendix C

California Labor Code 3212.12 and California Penal Code Peace Officers 830.2(e)

California Labor Code 3212.12, Subdivision (a), This section applies to peace officers, as defined in subdivision (b) of Section 830.1 of the Penal Code, subdivisions (e), (f), and (g) of Section 830.2 of the Penal Code, and corps members, as defined by Section 14302 of the Public Resources Code, and other employees at the California Conservation Corps classified as any of the following…….

Subdivision (b), The term injury, as used in this division, includes Lyme disease that develops or manifests itself during a period in which any person described in subdivision (a) is in the service of the department.

Subdivision (c), The compensation that is awarded for Lyme disease shall include full hospital, surgical, medical treatment, disability indemnity, and death benefits, as provided by this division.

Subdivision (d), Lyme disease so developed or manifesting itself in these cases shall be presumed to arise out of and in the course of the employment. This presumption is disputable and may be controverted by evidence that the Lyme disease is not reasonably linked to the work performance. Unless so controverted, the appeals board shall find in accordance with the presumption. This presumption shall be extended to a person described in subdivision (a) following termination of service for a period of three calendar months for each full year of the requisite service, but not to exceed 60 months in any circumstance, commencing with the last date actually worked in the specified capacity.

California Penal Code 830.2(e) Employees of the Department of Fish and Game designated by the director, provided that the primary duty of those peace officers shall be the enforcement of the law as set forth in Section 856 of the Fish and Game Code.