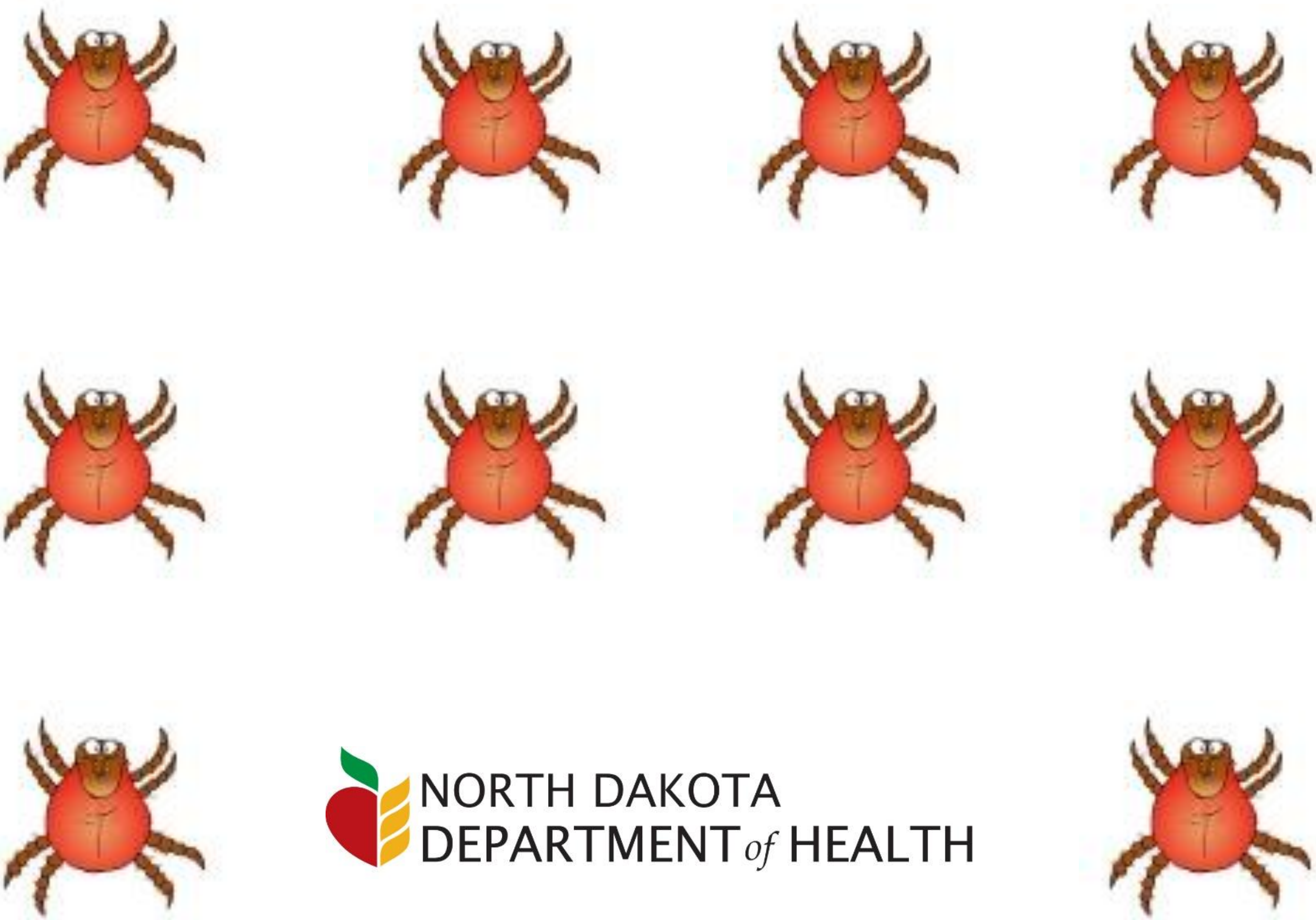
2017 NORTH DAKOTA TICK SURVEILLANCE PROGRAM



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2017 North Dakota Tick Surveillance Program's Mission

Through tick collection and speciation, the North Dakota Department of Health (NDDoH) monitors the risk of infection from tickborne pathogens known to exist in this region. The North Dakota Tick Surveillance Team focuses on *Dermacentor variabilis* and *Ixodes scapularis* for pathogen identification.

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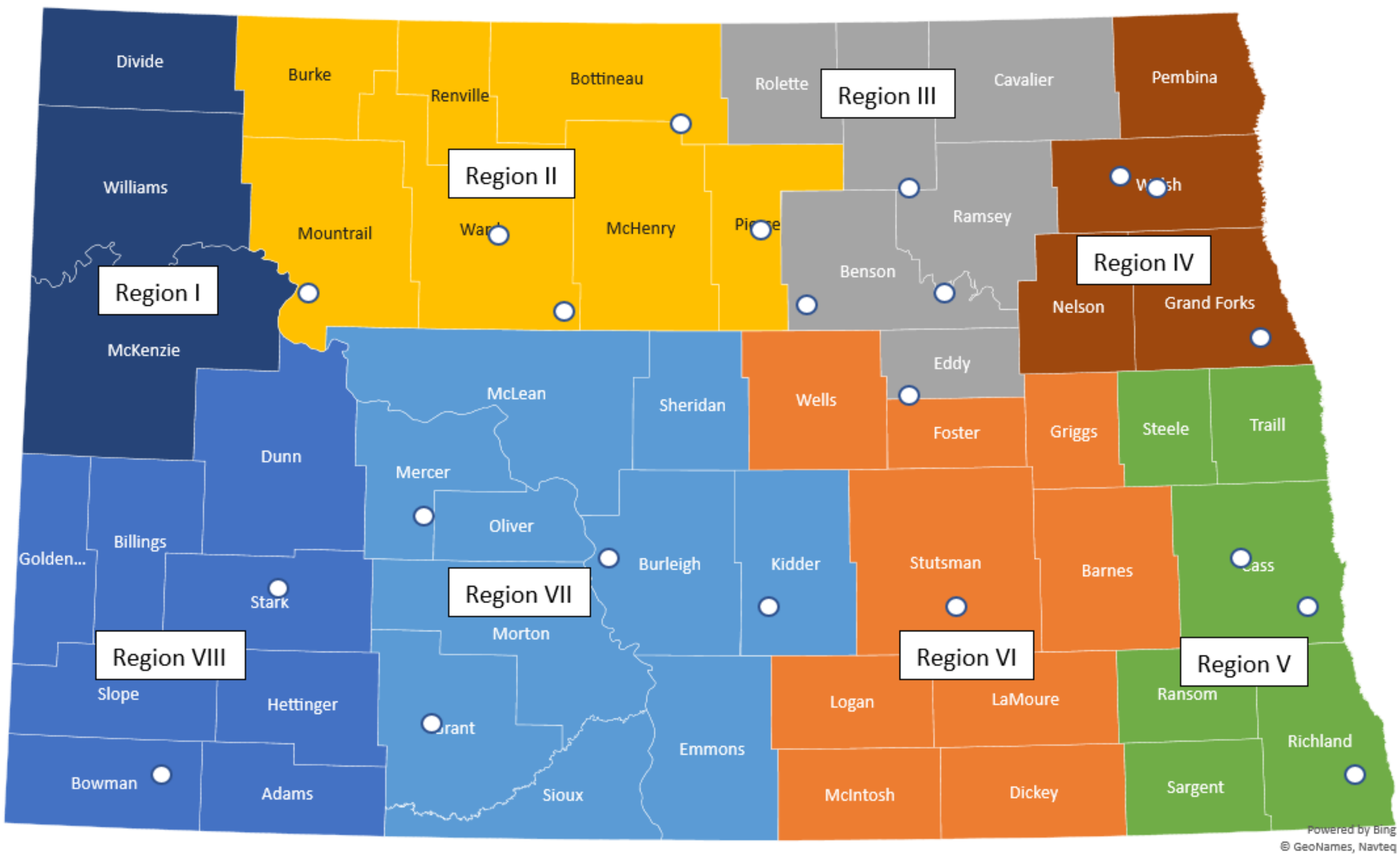
North Dakota Tick Surveillance Program Background

In 2017, the North Dakota Department of Health (NDDoH) started a tick surveillance program. Twenty-eight veterinarians and zoos were contacted from around the state and asked to collect ticks and submit them to NDDoH for identification and testing. Tick season ran from April 1 until July 1. Additional submissions were received through the month of October.

Submitting Veterinarians and Zoos

Vet Name	Town	County
Agassiz Animal Hospital	Park River	Walsh
All Pets Veterinary Clinic	Bismarck	Burleigh
Bowman Veterinary Clinic	Bowman	Bowman
Casselton Veterinary Service	Casselton	Cass
Chahinkapa Zoo	Wahpeton	Richland
Dakota Animal Care	Edinburg	Walsh
Dakota Prairie Veterinary Service	New Town	Mountrail
Dakota Zoo	Bismarck	Burleigh
Devils Lake Animal Clinic	Devils Lake	Ramsey
Dr. Dawn's Pet Stop	Jamestown	Stutsman
Elgin Veterinary Service	Elgin	Grant
Gibbens Veterinary Service	Cando	Towner
Golden Valley Veterinary Clinic	Park River	Walsh
Knife River Veterinary Clinic	Beulah	Mercer
Lewis and Clark Animal Hospital	Bismarck	Burleigh
Olson Veterinary Clinic	Esmond	Benson
Park River Veterinary Clinic	Park River	Walsh
Petcetera Animal Clinic	Grand Forks	Grand Forks
Prairie Veterinary Hospital	Jamestown	Stutsman
Red River Zoo	Fargo	Cass
Roosevelt Park Zoo	Minot	Ward
Rugby Veterinary Service	Rugby	Pierce
State Avenue Veterinary Clinic	Dickinson	Stark
Steele Veterinary Clinic	Steele	Kidder
The Pet Vet	Sawyer	Ward
Town & Country Veterinary Service	New Rockford	Eddy
Turtle Mountain Veterinary Service	Bottineau	Bottineau
West Oaks Animal Hospital	Minot	Ward

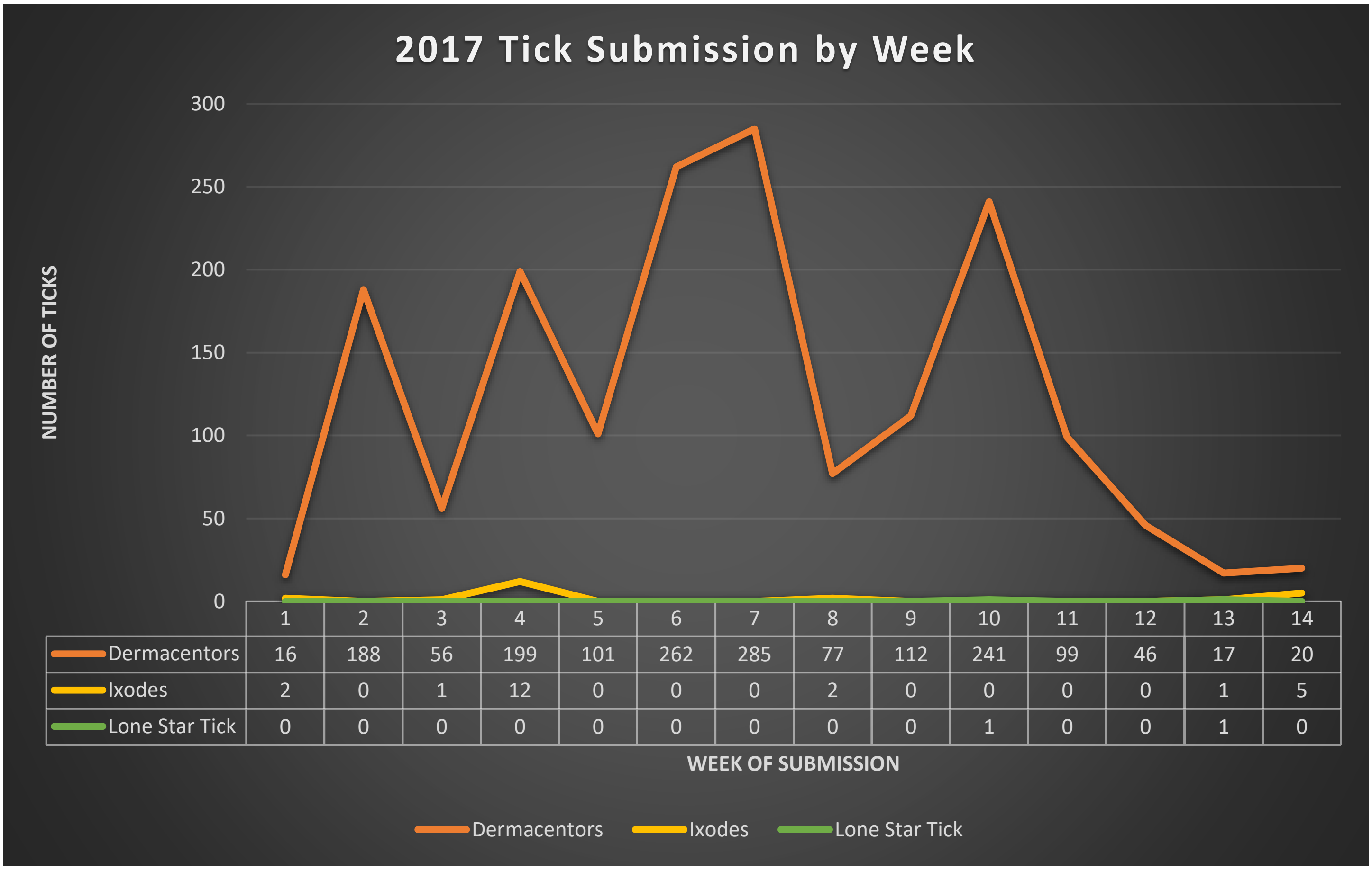
2017 Tick Surveillance Sites



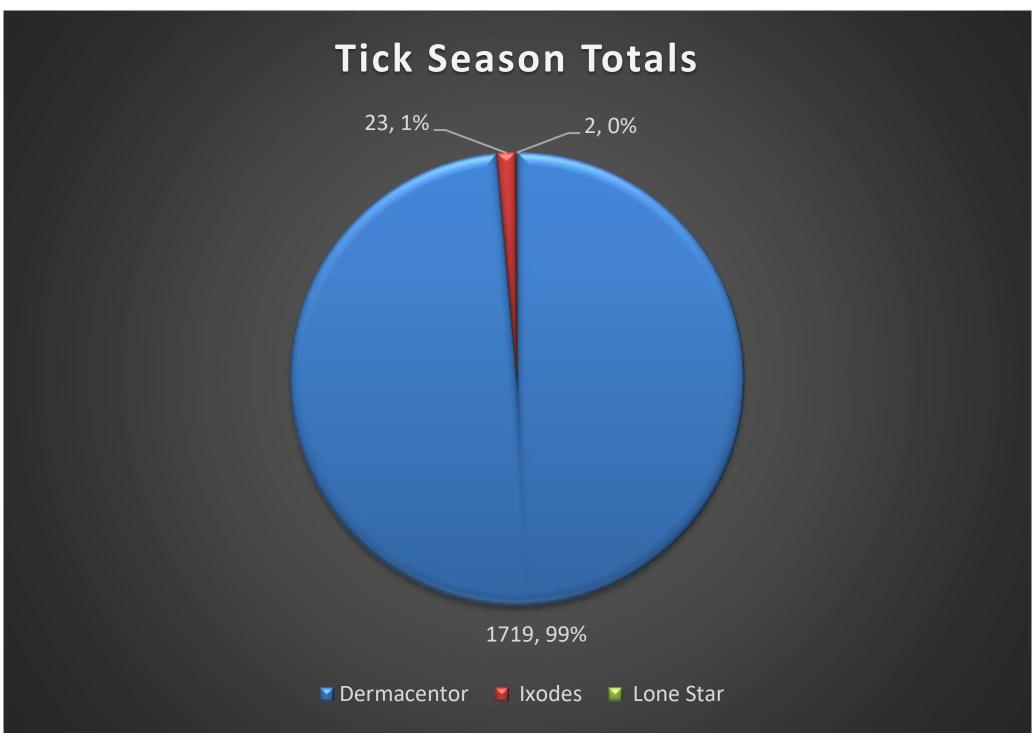
The Following Counties Are Included in Each Region:

Region	Counties
I	Divide, Williams, McKenzie
II	Burke, Renville, Bottineau, Mountrail, Ward, McHenry, Pierce
III	Rolette, Towner, Cavalier, Ramsey, Benson, Eddy
IV	Pembina, Walsh, Nelson, Grand Forks
V	Steele, Traill, Cass, Ransom, Sargent, Richland
VI	Wells, Foster, Griggs, Stutsman, Barnes, Logan, LaMoure, McIntosh, Dickey
VII	McLean, Sheridan, Mercer, Oliver, Burleigh, Kidder, Morton, Grant, Sioux, Emmons
VIII	Dunn, Golden Valley, Billings, Stark, Slope, Hettinger, Bowman, Adams

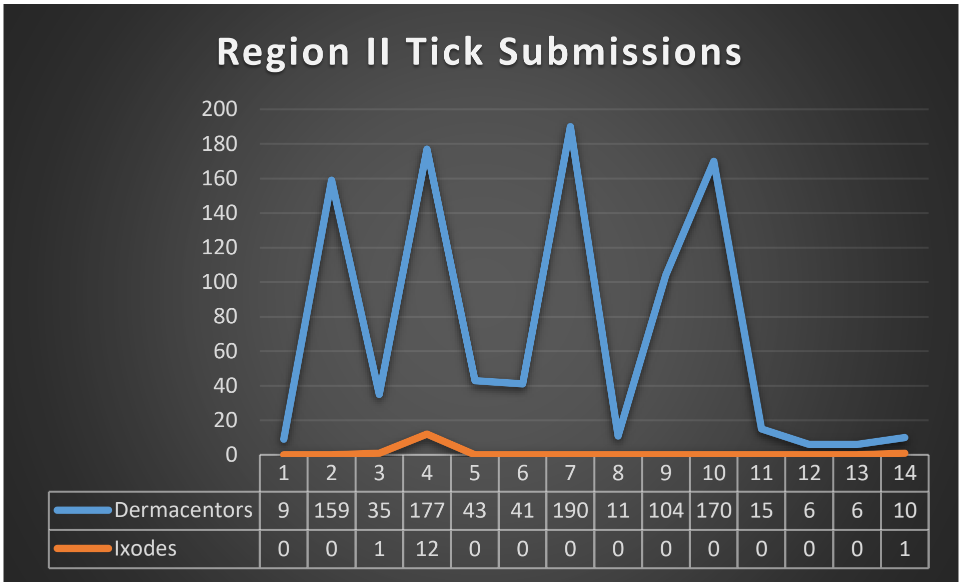
Tick Submissions by Week



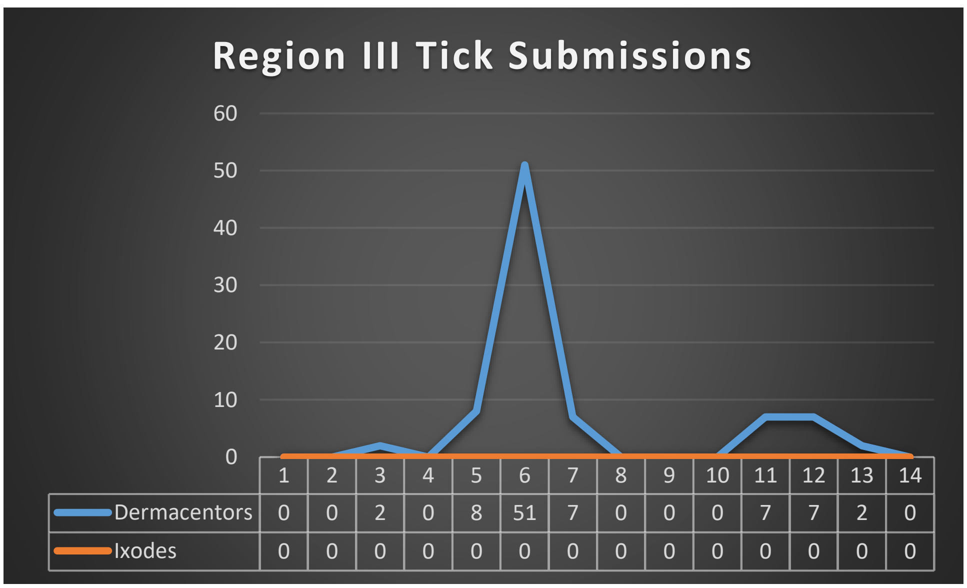
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dermacentors	16	188	56	199	101	262	285	77	112	241	99	46	17	20
Ixodes	2	0	1	12	0	0	0	2	0	0	0	0	1	5
Lone Star Tick	0	0	0	0	0	0	0	0	0	1	0	0	1	0



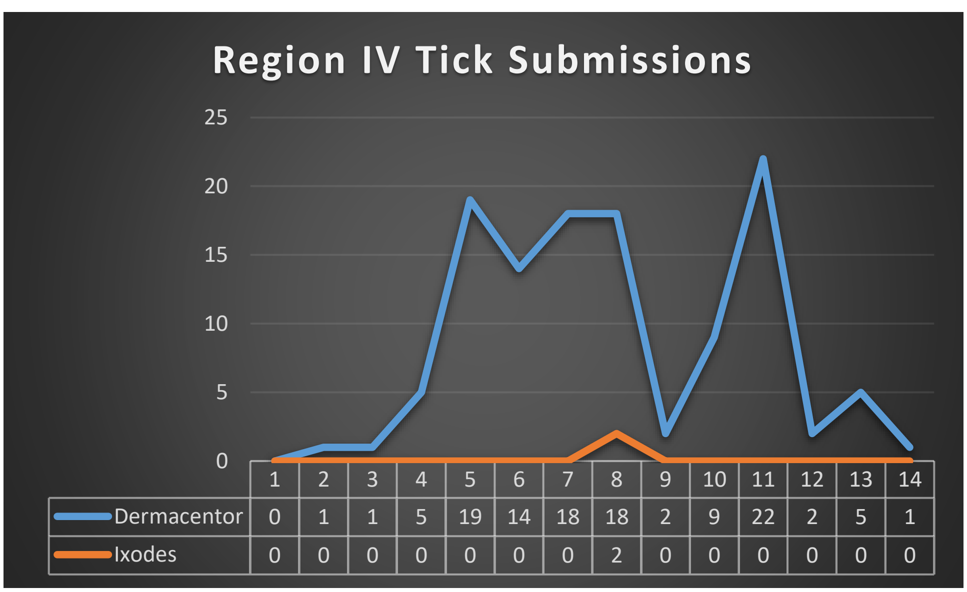
Tick Submissions by Region



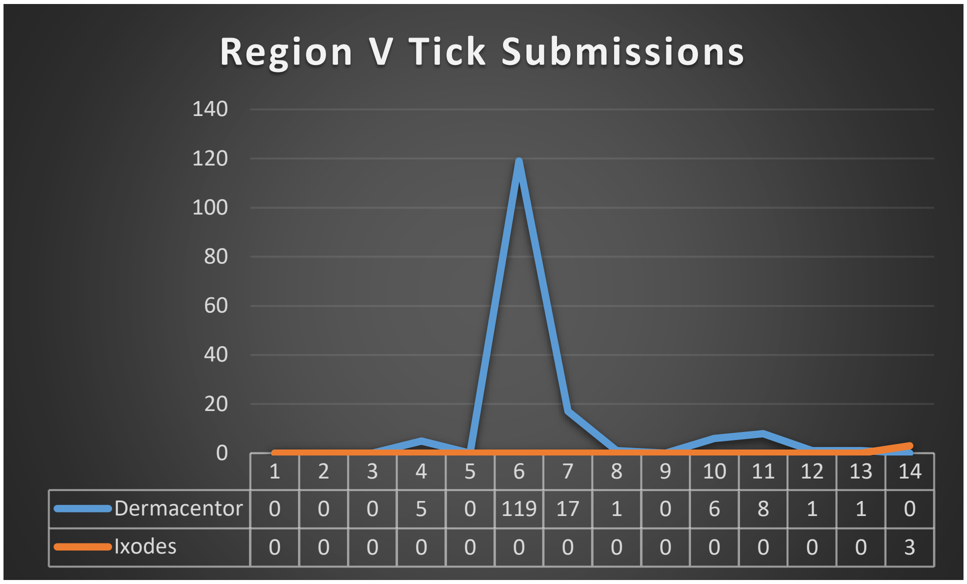
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dermacentors	9	159	35	177	43	41	190	11	104	170	15	6	6	10
Ixodes	0	0	1	12	0	0	0	0	0	0	0	0	0	1



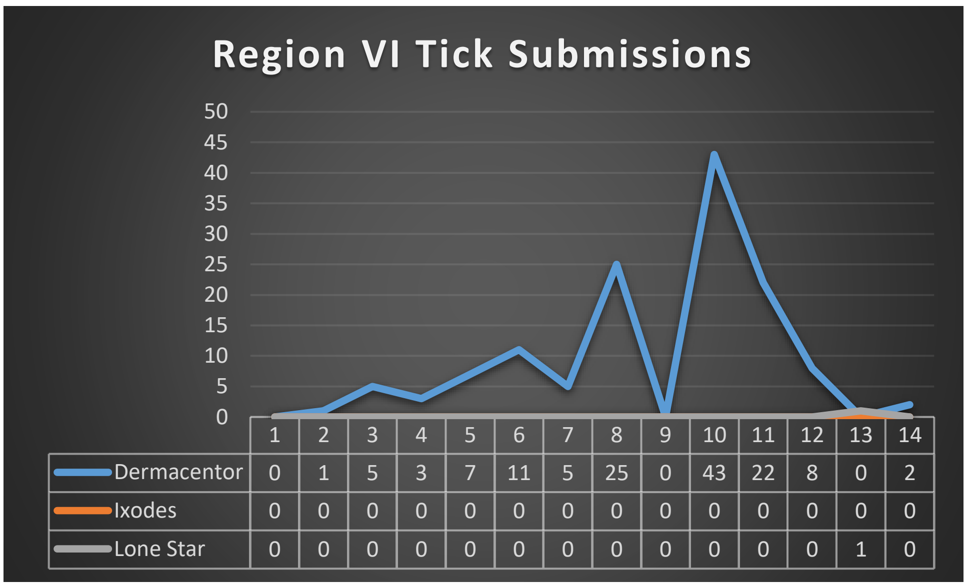
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dermacentors	0	0	2	0	8	51	7	0	0	0	7	7	2	0
Ixodes	0	0	0	0	0	0	0	0	0	0	0	0	0	0



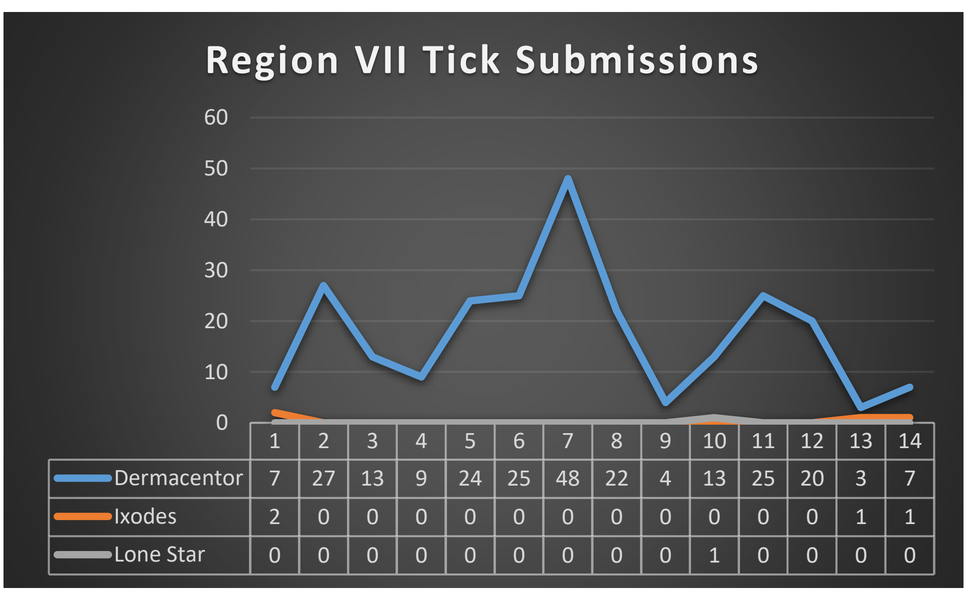
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dermacentor	0	1	1	5	19	14	18	18	2	9	22	2	5	1
Ixodes	0	0	0	0	0	0	0	2	0	0	0	0	0	0



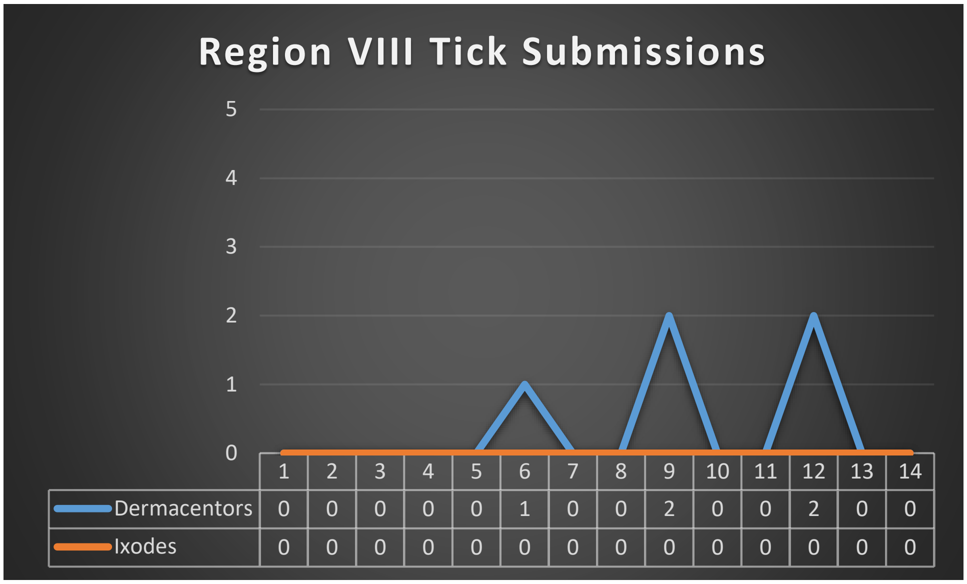
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dermacentor	0	0	0	5	0	119	17	1	0	6	8	1	1	0
Ixodes	0	0	0	0	0	0	0	0	0	0	0	0	0	3



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dermacentor	0	1	5	3	7	11	5	25	0	43	22	8	0	2
Ixodes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lone Star	0	0	0	0	0	0	0	0	0	0	0	0	1	0



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Dermacentor	7	27	13	9	24	25	48	22	4	13	25	20	3	7
Ixodes	2	0	0	0	0	0	0	0	0	0	0	0	1	1
Lone Star	0	0	0	0	0	0	0	0	0	1	0	0	0	0



Tickborne Pathogen and Disease Information

Anaplasmosis

Anaplasmosis is caused by the organism *Anaplasma phagocytophilum*. The tick that transmits *A. phagocytophilum* in the upper Midwestern United States is *Ixodes scapularis*, commonly known as the deer tick. In the past, *A. phagocytophilum* was known as *Ehrlichia equi* and *Ehrlichia phagocytophilum* and had been said to cause human granulocytic ehrlichiosis (HGE). In 2001, due to a taxonomic change, the organism was changed to *Anaplasma*, resulting in a name change for the disease to anaplasmosis. Symptoms of anaplasmosis begin to occur within 1-2 weeks from the time of the tick bite. These symptoms include fever, headache, malaise, muscle aches, chills, nausea, abdominal pain, cough, confusion, and rarely rash (rashes are more common in Rocky Mountain spotted fever and Lyme Disease). Severe cases may present with difficulty breathing, hemorrhage, renal failure or neurological involvement. Fatalities occur in less than 1 percent of cases. *A. phagocytophilum* infects the white blood cells of the patients, and has been known to survive up to a week in refrigerated blood, posing a risk when it comes to blood transfusions. Diagnosis of *A. phagocytophilum* can prove to be difficult, as testing for the organism may be negative for the first 7-10 days. Presence of morulae, which are microcolonies of *Anaplasma* seen in the cytoplasm of the white blood cells, can be seen in up to 20 percent of patients. Doctors must use their judgment to begin treatment when testing is negative, but clinical suspicion and history indicate anaplasmosis. Doxycycline is the antibiotic of choice for patients of all ages. Anaplasmosis was not reportable in North Dakota until 2011. From 2013 to 2017, 44 cases were reported to the NDDoH.

Babesiosis

Babesiosis is a tickborne illness caused by *Babesia* spp., which are microscopic parasites. *Babesia microti* causes most human cases of babesiosis in the United States. The vector for *B. microti* is the deer tick (*I. scapularis*). Many patients with babesiosis do not exhibit any signs or symptoms. Others may exhibit non-specific flu-like symptoms, such as fever, chills, sweats, headache, body aches, loss of appetite, nausea, or fatigue. *Babesia* specifically target red blood cells, which may lead to hemolytic anemia. People without a spleen, the elderly, and those who are immunocompromised or have underlying health conditions are at higher risk for a severe and potentially life-threatening complications. Severe complications include low and unstable blood pressure, thrombocytopenia, hemolytic anemia, disseminated intravascular coagulation (DIC), multiple organ failure, and death. Asymptomatic patients do not require treatment. Before beginning treatment, it is recommended that a proper diagnosis be made and then treatment options should be discussed with the physician. Babesiosis is usually diagnosed by examining blood smears under a microscope for *Babesia* parasites within red blood cells. Babesiosis became reportable in North Dakota in 2011. Five cases of babesiosis were reported to the NDDoH from 2013 to 2017.

Bartonella

The genus *Bartonella* has many species associated with human infections. *Bartonella* ssp. DNA has been detected in ticks, specifically the deer tick (*I. scapularis*); however, there is no evidence that the ticks are able to transmit *Bartonella* to humans. Most likely, human infection with *Bartonella* has come from another source, such as fleas or sandflies. The most common *Bartonella* infection in the United States, cat scratch disease or cat scratch fever, is caused by *B. henselae*. The common cat flea is the vector for *B. henselae*. *B. quintana*, the causative agent of Trench fever, is spread by body lice. *Bartonella* infections are not reportable in North Dakota.

Ehrlichiosis

The three bacterial species known to cause ehrlichiosis are *Ehrlichia chaffeensis*, *Ehrlichia ewingii* and *Ehrlichia muris*-like (EML). The vector associated with *E. chaffeensis* and *E. ewingii* is the lone star tick (*A. americanum*). The deer tick (*I. scapularis*) is a possible vector for EML. EML infections have only been seen in patients who live in or have traveled to Minnesota and Wisconsin. Symptoms of ehrlichiosis typically develop within 1 to 2 weeks after the bite of an infected tick. A wide range of non-specific symptoms present with varying combinations among patients, and may include fever, headache, chills, malaise, muscle and joint pain, nausea, vomiting, diarrhea, confusion, and conjunctival injection (red eyes). Skin rash may be seen in up to 60 percent of children and less than 30 percent of adults. Left untreated, ehrlichiosis may progress to severe illness or death. *Ehrlichia* bacteria infect white blood cells, and can survive in refrigerated blood for more than a week, which theoretically poses a risk for being transmitted through blood transfusions. Diagnosis of ehrlichiosis may be difficult, as antibodies may not be detectable for the first 7 to 10 days of illness in 85 percent of patients. Presence of morulae, which are microcolonies of *Ehrlichia* seen in the cytoplasm of the white blood cells, can be seen in up to 20 percent of patients. The patient may exhibit thrombocytopenia, leukopenia, or elevated liver enzymes. The diagnosis of ehrlichiosis must be made based on clinical signs and symptoms, and can later be confirmed using specialized confirmatory laboratory tests. Treatment should never be delayed pending the receipt of test results, or be withheld based on an initial negative result. Doxycycline is the antibiotic of choice for patients of all ages. Ehrlichiosis became a reportable disease in North Dakota in 2011. Fifteen cases were reported to the NDDoH from 2013 to 2017.

Lyme Disease

Lyme disease is caused by the bacterium *Borrelia burgdorferi*, and is spread by the deer tick (*I. scapularis*). In most cases, the tick must be attached for 36-48 hours or longer before *B. burgdorferi* can be transmitted. For this reason, most humans are infected through the bites of nymphs. Nymphs, which are immature ticks, are less than 2 mm in size and are difficult to see. Adult ticks can also transmit *B. burgdorferi*; however, due to their larger size, they are often discovered and removed before they can transmit the bacteria. Symptoms of Lyme disease can be broken down into early signs and symptoms, which occur from 3-30 days after a tick bite, and late signs and symptoms, which occur days to months after a tick bite. Early signs and symptoms may include fever, chills, headache, fatigue, muscle and joint aches, and swollen lymph nodes. One of the most commonly associated indicators of Lyme disease is erythema migrans (EM), also known as the "bull's-eye" rash. EM occurs in about 70-80 percent of infected people. The rash begins at the site of the tick bite anywhere from 3 to 30 days after the bite has occurred. EM gradually expands over a few days and can reach up to 12 inches across. It may feel warm to the touch, but is rarely itchy. Later signs and symptoms of Lyme disease may take months to years to develop and include severe headaches and neck stiffness, joint pain and swelling, especially in the large joints, facial paralysis, intermittent pain in tendons, muscles, joints and bones, heart palpitations or irregular heart beat (Lyme carditis), dizziness, shortness of breath, nerve pain, numbness and tingling in hands or feet, problems with short term memory, and inflammation of the brain and spinal cord. Most patients will recover with a few weeks of oral antibiotics. Treatment with intravenous antibiotics may be required for patients with neurological or cardiac involvement. A small percentage have symptoms that last longer than six months, which is then called Post-treatment Lyme Disease Syndrome. Lyme disease has been reportable in North Dakota since 1988. From 2013 until 2017, 165 cases of Lyme disease were reported to the NDDoH.

Powassan Virus Disease

Powassan is an RNA virus, which is related to West Nile, St. Louis encephalitis, and tickborne encephalitis virus. In North America, the three common vectors for Powassan virus are *Ixodes cookei*, *Ixodes marxi*, and *Ixodes scapularis*. There are two types of Powassan virus in the United States, 1 POW and 2 POW. 1 POW virus is associated with *I. cookei* or *I. marxi*. 2 POW virus, sometimes called the deer tick virus, is associated with the deer tick (*I. scapularis*). Both 1 POW virus and 2 POW virus have been associated with human disease. It is of interest that *I. cookei* and *I. marxi* ticks rarely bite humans, whereas *I. scapularis* is known to often bite humans. Studies in mice have shown that the *I. scapularis* only needs to be attached for 15 minutes to transmit the virus. The incubation period for Powassan virus is one week to one month. Many people who become infected with Powassan virus are asymptomatic. For those who do develop symptoms, the illness can be quite severe. Powassan virus can cause encephalitis and meningitis. Other symptoms include fever, headache, vomiting, weakness, confusion, loss of coordination, difficulty speaking, and seizures. About half of survivors have permanent neurologic conditions including headaches, muscle wasting, and memory problems. Approximately 10 percent of cases result in death. There is no specific treatment for Powassan virus disease. Patients with severe illness are often hospitalized and may receive respiratory support, intravenous fluids, and medications to reduce swelling of the brain. One case of Powassan virus disease has been reported in North Dakota.

Rocky Mountain Spotted Fever

Rocky Mountain Spotted Fever (RMSF) is a tickborne illness caused by the bacteria *Rickettsia rickettsii*. *R. rickettsii* is transmitted by the American dog tick (*D. variabilis*), as well as other *Dermacentor* species. RMSF is the most serious and commonly reported spotted fever group (SFG) rickettsioses in the United States. Other pathogens in the SFG include *Rickettsia akari, Rickettsia parkeri,* and *Rickettsia philipii*. Spotted fevers can range in severity from mild to life-threatening. RMSF can present with non-specific symptoms such as fever and headache, but can rapidly progress to a serious illness. A rash usually develops two to four days after fever begins. Other symptoms include stomach pain, nausea, vomiting, loss of appetite, and muscle pain. Delayed treatment may lead to severe illness or death. Some patients who recover from severe RMSF may be left with irreversible damage including hearing loss, paralysis, mental disability, or damage to blood vessels in extremities that may require amputation of arms, legs, fingers or toes. Early treatment with antibiotics can prevent severe illness and death. Twenty-six cases of RMSF were reported to the NDDoH from 2013 to 2017.

Tularemia

Tularemia is caused by *Francisella tularensis* bacteria. *F. tularensis* can be transmitted by tick and deer fly bites, skin contact with infected animals, ingestion of contaminated water, inhalation of contaminated aerosols or agricultural dusts, or laboratory exposure. Several species of ticks are known to transmit *F. tularensis* to humans, including the American dog tick (*D. variabilis*), the wood tick (*D. andersoni*), and the lone star tick (*A. americanum*). Symptoms of tularemia vary depending on the route of transmission. All forms of tularemia present with fever, which can be as high as 104˚C. Other symptoms of tularemia can include chills, headaches, diarrhea, muscle aches, joint pain, dry cough, and progressive weakness. There are two forms of tularemia commonly associated with tick bites. The first is ulceroglandular disease, the most common form of tularemia. A skin ulcer appears at the site of the tick bite. The ulcer is accompanied by swollen glands (lymph nodes), usually in the armpit or groin. Glandular disease is similar to ulceroglandular, but does not include an ulcer. Symptoms can appear between one and 21 days after exposure, but usually appear within three to five days. Antibiotics are used to treat tularemia. Ten cases of tularemia were reported to the NDDoH from 2013 to 2017, however, few of those cases were likely caused by ticks.

For more information on tickborne diseases, visit www.ndhealth.gov/disease/Tickborne or www.cdc.gov/ticks/diseases/index.html.

Tick Life Cycle and Ticks in North Dakota

There are two different categories of ticks: hard ticks and soft ticks. The following description of the life cycle is written pertaining to the hard tick, as those are the ticks found in North Dakota.

All ticks have the following four stages in their life cycle: egg, 6-legged larvae (seed tick), 8-legged nymph, and adult. Most ticks, throughout the course of their development, will feed on three hosts over the span of two to three years. After hatching from their eggs, the ticks must eat blood at every stage of development to survive. Most ticks die because they don't find a host for their next feeding. Ticks can feed on mammals, birds, reptiles, and amphibians. Some ticks feed on the same host during all stages of their life, but most prefer a different host animal at each stage.

Ticks can find their host by detecting any of the following: carbon dioxide emitted by warm-blooded animals, body odors, sensing body heat, moisture, and vibrations. Ticks wait for a host along well-used paths, resting in tall grasses and shrubs.

Ticks cannot fly or jump, so they wait in a position known as "questing." While questing, ticks hold onto leaves and grass with their third and fourth pairs of legs. They hold their first pair of legs outstretched, waiting for a host to come by. Once the host brushes up against the tick, the tick quickly climbs onto the host where it will either attach immediately, or it will climb to a place where the skin is thinner, such as the ear. In many species, the ticks in the larva stage quest at ground level, seeking out smaller hosts. Nymphs climb to higher vegetation to find larger hosts, while adult ticks climb highest of all to find the largest hosts. Some species will find a one host and spend their whole lives on it.

It is during the feeding process that ticks transmit or acquire pathogens. Preparation for feeding can take anywhere from 10 minutes to two hours, depending on the stage of life. Once the tick finds a spot to feed, it grabs the host's skin and cuts into the surface. When attaching to the host, the tick will secrete saliva that has an anesthetic in it. It's because of this anesthetic effect that the host often does not feel the tick attach itself. The tick will insert a feeding tube into the incision it has made. The feeding tube often has barbs that keeps the tick in place. Some species secrete a cement-like substance that will keep the tick firmly attached while eating. Depending on where the tick has attached itself, it may go unnoticed, and the tick can feed for several days. If the host has a bloodborne infection, the tick will ingest the pathogen. While feeding, small amounts of saliva from the tick can enter the host animal. If the tick has acquired a pathogen during any of its previous feedings, it can now be transmitted to the host through the tick's saliva. Some pathogens can be transferred to the host in as little as 15 minutes, whereas other pathogens require the tick to be attached to the host for up to 48 hours. When removing a tick from the host, it is imperative to grab the tick as close to the skin's surface as possible and to lift straight up from the skin. Twisting or jerking the tick can cause the mouth-parts to break off and remain in the skin, allowing for potential pathogens to continue to be transmitted to the host. After feeding, most ticks will drop off and prepare for the next stage of life.

Ticks begin their life as an egg. The adult female lays eggs in the spring. As ambient temperatures and moisture levels rise, eggs hatch. The ticks emerge from the eggs as a six-legged larva which begin looking for a host to feed upon. Some species of tick larvae can live up to 540 days without feeding, however a blood host is necessary to continue through the life cycle. A larva will feed for approximately five days, then it drops off the host, digests its blood meal and begins to grow. During late summer, approximately one to three weeks after feeding, the larvae molt into eight-legged nymphs. The nymphs are typically inactive during the winter and will start to feed again in the spring, when they will lie in wait for a second host to attach to and engorge on blood. It takes two to three days for nymphs to become engorged. After engorgement, nymphs drop to the ground where they will molt again into the adult ticks. The feeding and molting process of the nymphs occurs throughout the summer months, while the fall is spent feeding and breeding. The adult tick's sole purpose is to hunt for a third host so it can feed and then breed. It takes about four to seven days for adults to become fully engorged. Adult ticks will mate after engorgement on a blood meal. The adult female tick will deposit 3,000-6,000 eggs on the ground. Common places for the egg deposits to be made are inside wood piles, under rocks, and in crevices of walls and structures. Male ticks will usually die after mating with one or more females, whereas the females die soon after laying their eggs.

Dermacentor variabilis, the American dog tick, in its nymph stage can live up to 580 days without feeding. Adults can live up to two years without feeding. They are most active from mid-April to early September. Whereas the larvae are most active from March through July, nymphs are active from June to early September. *D. variabilis* will usually take three months to three years to complete a life cycle, whereas the deer tick (*I. scapularis*), generally takes two years to complete a life cycle.

Cold temperatures do not affect *I. scapularis*, as they will find shelter under leaf litter during the winter months and begin looking for a host again once temperatures are above freezing. Engorged larvae molt over the winter and emerge in May as poppy seed-sized nymphs. Because the nymphs are so small, the feeding often goes unnoticed, and most people do not remember being bitten by a tick. Adult *I. scapularis* become active in October and will remain active whenever the ground is not frozen. In fact, adult deer ticks begin their feeding activity around the time of the first frost. Engorged females will survive the winter and lay their eggs in the spring. The eggs will hatch in the summer, and the life cycle begins again when the larvae become active again in late summer to early fall.

The lone star tick, *Amblyomma americanum*, is found mostly in wooded areas with thick undergrowth and around animal resting areas. The four stages of the lone star tick's life cycle are the same as the other hard ticks, with the nymphs being active in May through August, and adults being active in April through August. Adult females have a distinct white dot or "lone star" on their backs. Adult males have varied white streaks or spots around the margins of their shield. The lone star tick is known to be an aggressive biter of humans in all stages of the life cycle. Larvae do not carry disease, but the nymphs and adults are known to transmit numerous diseases. There is also believed to be an association between a bite from the lone star tick and an allergy to alpha-gal, a carbohydrate found in the meat of mammals.

During the 2017 tick surveillance season, the majority of ticks collected were identified as American dog ticks (*D. variabilis*). Deer ticks (*I. scapularis*) were submitted from Cass, Mercer, Morton, Oliver, Pierce, Rolette, and Walsh counties. Two ticks identified as lone star ticks (*A. americanum*) were submitted from Dunn and Dickey counties. Additional information about the 2017 tick surveillance project can be found at www.ndhealth.gov/disease/Tickborne/.

PCR Results

Each submission throughout the season was separated by species, and each species was pooled together by region, with each pool containing a maximum of 20 ticks. No engorged ticks were tested. Throughout the 14-week season, 47 pools were tested for the following seven markers: *Rickettsia* spp., *Rickettsia rickettsii, Francisella tularensis, Anaplasma phagocytophilum, Babesia microti, Borrelia burgdorferi*, and Powassan virus. Of the 43 *D. variabilis* pools tested, 25 tested positive for *Rickettsia* spp. and five tested positive for *F. tularensis*. Of the four *I. scapularis* pools tested, three tested positive *Rickettsia* spp., one tested positive for *F. tularensis*, and one tested positive for *B. burgdorferi*.

POOL LOCATION	Tick Species	Quantity	PCR Results
Region 2 Pool 1	*Dermacentor*	20	Positive Rickettsia spp
Region 2 Pool 2	*Dermacentor*	20	Positive Rickettsia spp
Region 2 Pool 3	*Dermacentor*	20	Positive Rickettsia spp
Region 2 Pool 4	*Dermacentor*	20	Positive Rickettsia spp
Region 2 Pool 5	*Dermacentor*	10	Negative
Region 2 Pool 6	*Ixodes*	1	Negative
Region 2 Pool 7	*Dermacentor*	20	Positive Tularemia
Region 2 Pool 8	*Dermacentor*	20	Postive Rickettsia spp, Positve Tularemia
Region 2 Pool 9	*Dermacentor*	20	Positive Rickettsia spp
Region 2 Pool 10	*Dermacentor*	20	Negative
Region 2 Pool 11	*Dermacentor*	20	Negative
Region 2 Pool 12	*Dermacentor*	20	Positive Rickettsia spp, Positive Tularemia
Region 2 Pool 13	*Dermacentor*	20	Positive Tularemia
Region 2 Pool 14	*Dermacentor*	20	Positive Rickettsia spp
Region 2 Pool 15	*Dermacentor*	20	Positive Rickettsia spp
Region 2 Pool 16	*Dermacentor*	20	Positive Rickettsia spp
Region 2 Pool 17	*Dermacentor*	20	Negative
Region 2 Pool 18	*Dermacentor*	20	Positive Rickettsia spp
Region 2 Pool 19	*Dermacentor*	16	Positive Rickettsia spp, Positive Tularemia
Region 2 Pool 20	*Ixodes*	3	Positive Rickettsia spp, Positive Tularemia
Region 3 Pool 1	*Dermacentor*	20	Postive Rickettsia spp
Region 3 Pool 2	*Dermacentor*	50	Postive Rickettsia spp
Region 3 Pool 3	*Dermacentor*	18	Negative
Region 3 Pool 4	*Dermacentor*	4	Negative
Region 4 Pool 1	*Dermacentor*	20	Positive Rickettsia spp
Region 4 Pool 2	*Dermacentor*	20	Negative
Region 4 Pool 3	*Dermacentor*	20	Negative
Region 4 Pool 4	*Ixodes*	4	Positive Rickettsia spp, Positive Borrellia
Region 4 Pool 5	*Dermacentor*	20	Positive Rickettsia spp
Region 4 Pool 6	*Dermacentor*	3	Negative
Region 5 Pool 1	*Dermacentor*	20	Negative
Region 5 Pool 2	*Dermacentor*	7	Negative
Region 5 Pool 3	*Dermacentor*	2	Negative
Region 6 Pool 1	*Dermacentor*	20	Positive Rickettsia spp
Region 6 Pool 2	*Dermacentor*	20	Positive Rickettsia spp
Region 6 Pool 3	*Dermacentor*	16	Positive Rickettsia spp
Region 6 Pool 4	*Dermacentor*	13	Postive Rickettsia spp
Region 7 Pool 1	*Dermacentor*	20	Positive Rickettsia spp
Region 7 Pool 2	*Dermacentor*	20	Positive Rickettsia spp
Region 7 Pool 3	*Dermacentor*	20	Negative
Region 7 Pool 4	*Dermacentor*	14	Positive Rickettsia spp
Region 7 Pool 5	*Ixodes*	1	Positive Rickettsia spp
Region 7 Pool 6	*Dermacentor*	20	Positive Rickettsia spp
Region 7 Pool 7	*Dermacentor*	20	Negative
Region 7 Pool 8	*Dermacentor*	9	Positive Rickettsia spp
Region 8 Pool 1	*Dermacentor*	5	Postive Tularemia
Miscellaneous	*Dermacentor*	1	Negative

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