

# Common Ticks and Tick-borne Diseases in Pennsylvania

Tick identification, life history, and distribution; tick-borne diseases; and prevention



## Background Information

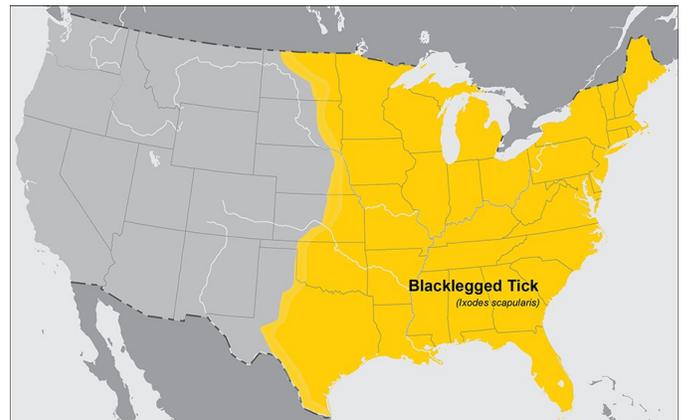
Ticks are parasitic arthropods that feed on the blood of vertebrates, particularly mammals (including humans) but also birds, reptiles and amphibians. Many species of ticks can transmit pathogens between animals and to humans, including various parasitic worms, viruses, and bacteria. The most important of these in Pennsylvania are the bacteria that cause Lyme disease and Rocky Mountain spotted fever.

There are more than 900 species of ticks worldwide, at least 25 of which occur in Pennsylvania. Of these, two species account for more than 90 percent of identification requests submitted to Penn State: blacklegged tick (*Ixodes scapularis*) and American dog tick (*Dermacentor variabilis*). Three other species that may be encountered are also covered herein: lone star tick (*Amblyomma americanum*), Asian longhorn tick (*Haemaphysalis longicornis*), and winter tick (*Dermacentor albipictus*).

## Blacklegged tick (*Ixodes scapularis*)



**Distribution:** *Ixodes scapularis* is found throughout the eastern United States and in parts of the northern mid-west in wooded, brushy locations as well as grassy edge habitat (Figure 2). While it was less widespread historically, the range of this species has been expanding in recent years and it can now be found throughout Pennsylvania.

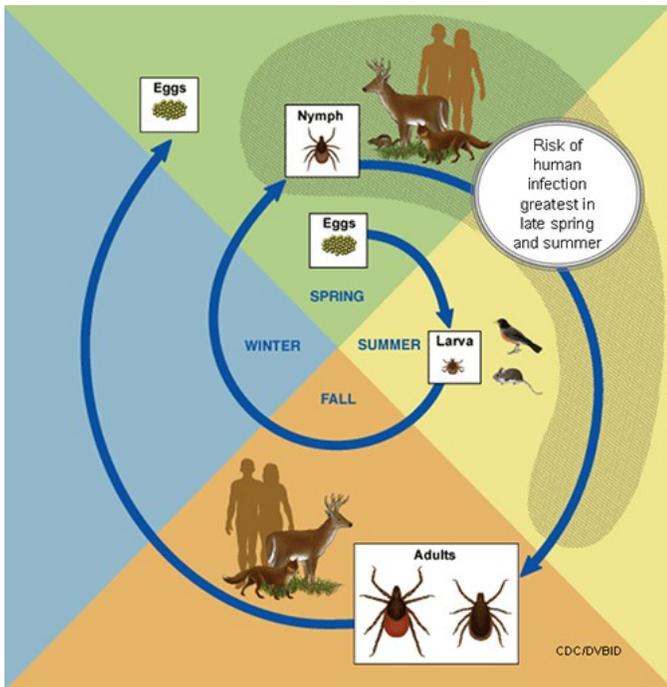


**Hosts:** Blacklegged tick larvae preferentially feed on small mammals such as mice and chipmunks and occasionally birds; nymphs also feed on small mammals and birds, as well as a range of medium- and large-mammals like raccoons, deer, and black bears. Adult blacklegged ticks feed on larger mammals with some preference for white-tailed deer. However, any stage is capable of feeding on humans, livestock, and companion animals.



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**Activity period** (Figure 3): Adult ticks are present in the fall, throughout the winter, and in early spring. During the winter, adult ticks can be active and seek hosts any day when temperatures are above freezing. Larval ticks are typically present during the late summer and nymphs during the late spring and through the summer.



**Diseases:** Blacklegged ticks are best known as the vector of the pathogens that cause Lyme disease but have also been known to vector other pathogens including *Anaplasma* spp. and *Babesia* spp. which can cause anaplasmosis and babesiosis, respectively. While there is still some debate, blacklegged ticks typically need to feed for 24 hours before *Borrelia burgdorferi*, the causative agent of Lyme disease, is transmitted. However, another pathogen, Powassan virus, can be transmitted in as little as 15 minutes. Because ticks need to feed from a host infected with pathogens to be able to transmit those pathogens to humans or other animals, only nymphs and adult ticks spread the pathogen. In Pennsylvania, 20–40% of blacklegged ticks test positive for *B. burgdorferi* depending on location.

**Note s:** This tick is often called the “deer tick”. However, because deer have been historically considered the preferred host only during the adult stage, blacklegged tick is the preferred common name.

## American dog tick (*Dermacentor variabilis*)



**Distribution:** *Dermacentor variabilis* is found in the eastern two-thirds of the United States from Nova Scotia to the Gulf Coast, including all of Pennsylvania (Figure 5). They prefer open locations with little or no tree cover, such as grassy fields and scrublands.



**Activity period:** Larvae are most common during the spring and fall while nymphs and adults are found throughout the summer. However, unfed individuals of all life stages can survive for more than a year between hosts (larvae: 15 months; nymphs: 20 months; adults: 30 months), so all life stages may be encountered year-round.

**Hosts:** Larvae and nymphs prefer to feed on small rodents. Adults are frequently found on dogs (hence the common name) but also feed on other medium and large mammals such as squirrels, raccoons, rabbits, ground hogs, fox, deer, domestic livestock, and humans. They can be extremely aggressive biters.

**Diseases:** American dog ticks are main vector of the pathogens that cause Rocky Mountain spotted fever in Pennsylvania, which is less common than Lyme disease but a potentially more serious illness. They have also been known to transmit

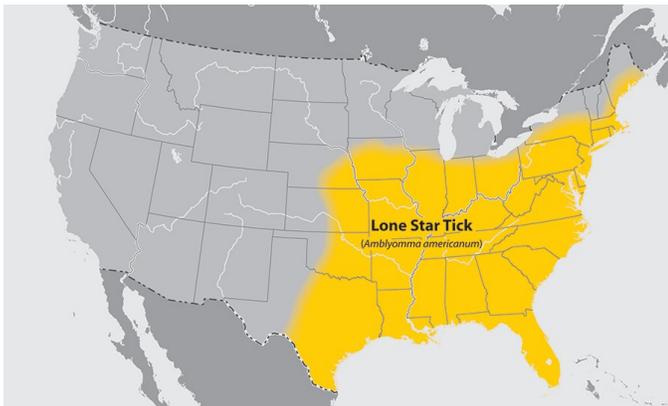
tularemia and to cause canine tick paralysis. *Dermacentor variabilis* do not vector the causative agent of Lyme disease.

**Notes:** American dog ticks are much larger than blacklegged ticks and engorged female ticks may be the size of a grape.

### Lone star tick (*Amblyomma americanum*)



**Distribution:** *Amblyomma americanum* is widely distributed in the United States from Texas north to Missouri and eastward to the Atlantic coast (Figure 7). It is found most often in the southern counties of Pennsylvania near urbanized areas.



**Activity period:** Larval lone star ticks are active during the late summer and fall while nymphs and adults are active during the spring and summer. Lone star tick larvae are often encountered in large numbers.

**Hosts:** This tick has a broad host range. The larvae feed on a variety of small to medium-sized animals, while the nymphs feed on many medium and large animals. Adults prefer to feed on larger animals. All stages are aggressive biters that will readily feed on humans, livestock, and companion animals.

**Diseases:** Lone star ticks can vector the causative agents of Rocky Mountain spotted fever, ehrlichiosis, tularemia and STARI (southern tick-associated rash illness), as well as Heartland virus and Bourbon virus. *Amblyomma americanum* bites are also associated with alpha-gal (red meat) allergy.

**Notes:** Adult females are easily identified by the presence of a single white dot in the center of a reddish-brown body.

### Groundhog (Woodchuck) tick (*Ixodes cookei*)



**Distribution:** *Ixodes cookei* is found east of the Rockies from Texas to South Dakota and northeastwards through Maine. Groundhog ticks were the most commonly encountered tick species in Pennsylvania prior to 1990 but have since declined in prevalence compared to blacklegged ticks and American dog ticks.

**Hosts:** Groundhog ticks are host-specific on groundhogs, but are occasionally found on birds, small animals or humans.

**Diseases:** Groundhog ticks can vector Powassan virus, which causes Powassan virus encephalitis. They are not an important vector of the pathogen that causes Lyme disease because of their tendency to feed only on groundhogs, which do not harbor the pathogen.

### Asian longhorned tick (*Haemaphysalis longicornis*)



**Distribution:** *Haemaphysalis longicornis* is an invasive tick native to East and Central Asia. It has spread throughout the Oceania and was first reported publicly from New Jersey in 2013, but it appears this tick may have been present in the United States as early as 2010. A large population was discovered on a New Jersey sheep farm in 2017 and it has since been detected in eight states. As of May 2019, only three samples of Asian longhorned tick have been found in Pennsylvania, although this number is expected to rise as the tick becomes established.

**Hosts:** Because Asian longhorned tick is new to North America, it is unknown what its preferred hosts will be. In other areas of the world, larvae and nymphs prefer small mammals and birds while adults prefer large animals, such as cattle, horses, deer, and sheep. A single report of *H. longicornis* biting a person has been reported in the US thus far.

**Diseases:** Asian longhorned tick is not known to vector any pathogens in North America. However, in its native range it is known to vector *Anaplasma* spp., *Ehrlichia* spp., and Powassan virus so the potential exists that it will vector those pathogens in the US as well.

**Notes:** For more information, see this [Penn State fact sheet about Asian longhorned ticks](#).

## Diseases

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### Lyme Disease

Lyme Disease or Lyme borreliosis is an infection caused by the bacterial spirochete *Borrelia burgdorferi*, which is transmitted by ixodid ticks. Humans, dogs, and horses seem to be the most susceptible to the infection. It is a multisystem illness characterized initially by erythema migrans (bullseye rash) and a series of common nonspecific complaints and symptoms including headache, fever, sore throat, and nausea. Left untreated, it may progress to late phase symptoms including debilitating rheumatologic, cardiac, and neurologic conditions, but rarely directly to death.

Approximately 70-80% of people who contract Lyme disease develop a skin lesion after the bite of an infected tick. The lesion appears as a red macule or papule and expands to form a large round lesion over a period of days or weeks. The center of this lesion often tends to progressively clear, resulting in a "bull's-eye". This condition is called erythema migrans (EM) and for the purpose of CDC surveillance definition, the lesion must reach a size of 5 cm (~2 inches). Associated or secondary lesions may be present. This symptom is generally accompanied with intermittent fatigue, fever, headache, a stiff neck, arthralgias or myalgias.

Later, musculoskeletal, nervous, and cardiovascular systems exhibit more profound manifestations. Weeks to months after the initial erythema migrans there may be recurrent swelling of the joints which may become a chronic condition in one or more sites. Lymphocytic meningitis, cranial neuritis, bilateral facial palsy (Bell's palsy), radiculoneuropathy and

occasionally encephalomyelitis occur alone or in combinations. Atrioventricular conduction problems may arise which may lead to myocarditis. Additional symptoms of arthralgia, myalgia, fibromyalgia, headache, fatigue, stiff neck, palpitations, and bundle branch block may be associated, but are not confirmative of Lyme disease.

For more information, please see the [CDC webpage about Lyme disease](#).

### Rocky Mountain Spotted Fever (RMSF)

RMSF is caused by the bacteria *Rickettsia rickettsii*. The disease was first recognized in the United States during the 1890s, but until the 1930s it was reported only in the Rocky Mountains. By 1963, over 90 percent of all cases were reported east of the Rockies. *Rickettsia rickettsia* is vectored by American dog ticks and lone star ticks in the eastern US, while it is vectored in the western US by Rocky Mountain wood ticks (*Dermacentor andersoni*).

Symptoms of RMSF include a fever and often a red, purple, or black rash, which develops on the wrists and ankles 2-4 days after the fever begins. Other early symptoms include headaches, and malaise, nausea, and vomiting, while later symptoms can include abdominal and joint pain, conjunctivitis, and forgetfulness.

Due to the inability of common serologic tests to distinguish RMSF from closely related diseases (e.g., *Rickettsia parkeri* rickettsiosis, Pacific Coast tick fever, and rickettsialpox), RMSF is reported with other spotted fever-group rickettsias (SFR). The number of SFR cases in the US has risen sharply from less than 1 to more than 15 cases per million people between 1920 and 2018. However, the fatality rate has dropped from 10-15% to less than 0.5% due to the discovery of tetracycline antibiotics in the 1940's, which are used to treat RMSF and other SFR.

For more information, please see the [CDC webpage about RMSF](#).

### Tularemia

Tularemia, which is also called rabbit fever, is caused by the bacterium *Francisella tularensis*. The bacterium can be vectored by lone star ticks, American dog ticks, Rocky Mountain wood ticks, rabbit ticks (*Haemaphysalis leporispalustris*), and deer flies, as well as exposure to rabbit blood (e.g., butchering a rabbit without gloves and other protection or via [aerosolized blood after a rabbit is struck by a lawnmower](#)).

The number of cases in the United States has dropped considerably in the last 50 years, from nearly 2,300 cases in 1939 to 100-200 every year since 1995 (excluding 2015, which saw slightly more than 300 cases reported).

Symptoms of tularemia include a sudden onset of fever, chills, loss of appetite, general body aches, and swollen lymph nodes. When the disease is contracted via a tick or fly bite, an ulcer forms at the site of the bite. Treatment of tularemia consists of antibiotics, which decrease the fatality rate from higher than

60% to less than 4%.

For more information, please see the [CDC webpage about tularemia](#).

## Babesiosis

*Babesia microti*, the causative agent of babesiosis, is a protozoan parasite transmitted by the blacklegged tick (*Ixodes scapularis*), although it is also rarely transmitted via blood transfusions (as there are no known screenings for the pathogen) and congenitally from a mother to her baby during pregnancy or birth. Babesiosis is most commonly reported from the northeastern US but cases have been reported across the country. Between 2011–2014, 900–180 cases were reported country-wide per year.

Signs and symptoms of babesiosis include fatigue and loss of appetite, followed by a fever with chills, muscle aches, headaches and, in more extreme cases, blood may appear in the urine. The disease is generally self-limiting and symptoms disappear on their own in otherwise healthy patients. However, babesiosis is more severe in certain groups, including older individuals, those without a spleen, and immunocompromised people. In these high-risk groups, additional complications can occur, including low and unstable blood pressure, severe anemia, low platelet count, organ malfunction, and death.

Babesiosis is treated with drugs that are typically used to treat malaria, which is also a protozoan disease.

For more information, please see the [CDC webpage about babesiosis](#).

## Erlchiosis

Erlchiosis is caused by three species of rickettsia bacteria in the genus *Erlchia* (*E. chaffeensis*, *E. ewingii*, and *E. muris eauclairensis*). It is most common in the southern United States but has been reported from most states east of the Rocky Mountains. Most cases occur during the summer during high tick activity, but there have been cases reported from every month. Erlchiosis has only been reportable to the CDC since 2000; since then, the number of reported cases has steadily risen from ~250 a year to 1500–1700 per year country-wide.

The clinical signs are similar to those of Rocky Mountain spotted fever or flu and include chills, headache, body aches, and fever. A rash like that of RMSF appears in up to 30% of people infected approximately 5 days after fevers begin. Symptoms are often very mild but may become severe if antibiotic treatment is delayed. Late-stage, severe signs and symptoms can include brain or nervous system damage due to meningoencephalitis, respiratory failure, uncontrolled bleeding, organ failure, and death. The very young and old and those with compromised immune systems are at higher risk of developing a severe infection.

As with RMSF, tetracycline antibiotics are used to treat erlichiosis.

For more information, please see the [CDC webpage about erlichiosis](#).

## Powassan virus

Powassan virus is an RNA virus related to West Nile and St. Louis encephalitis and causes Powassan virus encephalitis. It is transmitted by blacklegged ticks, groundhog ticks, and squirrel ticks (*Ixodes marxi*). It is rarely reported, with 115 total cases from 2008–2017, although it is likely underreported as many people who become infected with the virus do not develop any symptoms. Most cases occur in the Northeast and Upper Midwest.

Powassan virus encephalitis manifests 1–4 weeks after a tick bite and symptoms can include fever, headache, vomiting, weakness, confusion, loss of coordination, and seizures. Approximately 10% of all Powassan virus encephalitis cases are fatal and half of survivors develop permanent neurological symptoms.

There are no vaccines or medications to treat Powassan virus encephalitis, although supportive care including respiratory support, intravenous fluids, and medications to reduce swelling in the brain can aid in recovery.

For more information, see the [CDC webpage about Powassan virus](#).

## Tick Paralysis

Tick paralysis is a condition caused by toxins that a tick injects into its host during feeding. Most mammals, including pets and livestock, can be affected, but smaller and younger mammals are more susceptible. Human cases are rare and usually occur in children under 10 years of age.

Tick paralysis is associated with ticks that are attached around the head area, particularly at the base of the skull. Symptoms manifest one to seven days after a tick attaches and begin with weakness in the legs. This weakness progresses into paralysis that ascends to the trunk, arms, and head within a few hours. Tick paralysis can lead to respiratory failure and death when the ascending paralysis reaches the lungs. If the tick(s) is found and removed, recovery begins immediately, and the effects disappear within a day.

Ticks that have been implicated in tick paralysis in the United States are the Rocky Mountain wood tick, the lone star tick, and the American dog tick. However, not all members of a species cause tick paralysis. The toxin that causes this condition is part of the salivary fluid that the tick injects. Because the problem is associated with ticks attached on the head, and because recovery is quick upon removal of the tick, it is theorized that the toxin acts locally and is broken down in the body rapidly. Tick paralysis occurs only sporadically; the important thing is to be aware that it exists and, when symptoms occur, to attempt to find the tick and remove it.

## Alpha-gal allergy

Alpha-gal (galactose-alpha-1,3-galactose) is a molecule found in all mammals except Old World monkeys and apes (including humans). Alpha-gal allergy, which is also called meat allergy or mammalian meat allergy (MMA), is a food allergy that can develop when a lone star tick that has fed on a non-human mammal bites a human. During a bite, a tick may inject some of the alpha-gal from its gut into a person along with saliva. The person's body tries to fight the foreign alpha-gal by releasing a flood of IgE antibodies.

Like other IgE-mediated allergies, symptoms can include whole-body itching, hives, gastrointestinal upset, and anaphylaxis. Respiratory distress may be particularly severe in people with asthma. Unlike other food allergies, which typically have an immediate or rapid onset of symptoms, an allergic reaction to alpha-gal typically takes 3–8 hours to manifest. Some patients with alpha-gal allergy report the ability to eat certain lean meats (e.g., venison) and the allergy may naturally recede over a period of time, with patients reporting time frames of 8 months to 5 years.

## Emerging diseases

There are several emerging tick-borne diseases about which little is known, including Heartland virus and Bourbon virus.

More than 40 cases of Heartland virus, a few of which have been fatal, have been reported from the southeastern and southcentral U.S. While no cases have been reported from Pennsylvania, serological tests of wild animals from neighboring states in the northeast have been positive. Lone star ticks are thought to vector the virus.

Five cases of Bourbon virus, one of which was fatal, have been reported from Kansas, Oklahoma, and Missouri, since the disease was discovered in 2014. However, there is no diagnostic test available for the virus, so it is possible that milder infections have gone undetected. Lone star ticks, which are present in Pennsylvania, have tested positive for Bourbon virus and may vector the pathogen.

Most patients with Heartland virus or Bourbon virus infections have reported fever, fatigue, headache, nausea, muscle or joint pain; because of the similar symptoms, these diseases may be confused with ehrlichiosis or anaplasmosis. Most patients require hospitalization. There are no vaccines or medications to treat Heartland virus or Bourbon virus, although supportive care to treat symptoms may help aid recovery.

For more information, see the [CDC webpage about Heartland virus and Bourbon virus](#).

## Prevention and Control of Ticks on People

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The best way to avoid tick bites is to stay out of wooded or brushy areas. However, this option is not always realistic. Repellents such as DEET (N,N-Diethyl-meta-toluamide) offer considerable protection if applied to clothing and exposed skin. Another protective option is the application of Permanone™, an effective acaricide that contains the synthetic pyrethroid permethrin and is applied as a spray to clothing. It is not approved for use on skin. For more information, see the [EPA Repellent Search Tool](#).

Long-sleeved shirts and long pants tucked into socks also aid in preventing tick bites. Light-colored clothing helps to detect the dark-colored tick provided the wearer inspects for ticks intermittently.

Hunters and hikers increase their risk of encountering ticks by following deer trails and by resting on the forest floor. However, deer do not carry the pathogen that causes Lyme disease. For other game, like turkey, cooking destroys the bacteria and eliminates any danger of getting Lyme disease; there are no documented cases of transmission through handling or consuming hunted game with previously attached ticks.

Self-examination is recommended after spending time outdoors, even if at a park or school. If an embedded tick is found, it should be removed with fine tweezers by grasping the head and pulling with steady firm pressure. The tick should not be grabbed in the middle of its body because the gut contents may be expelled into the skin. The use of heat (lit match, cigarette, etc.), or petroleum jelly is **not** recommended to force the tick out. These methods will irritate the tick and may cause it to regurgitate its stomach contents into the individual, thereby increasing the possibility of infection.

If signs or symptoms of Lyme disease or other diseases manifest, seek immediate medical attention and alert your physician to the history of a tick bite.

## Prevention and Control of Ticks on Animals

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Lyme disease and other tick-borne diseases also affect livestock and companion animals, in particular dogs and horses. For information on prevention and control in animals, please see the Penn State fact sheets on [Protecting Companion Animals Against Ticks in Pennsylvania](#) and [Protecting Livestock Against Ticks in Pennsylvania](#).

## Warning

Pesticides are poisonous. Read and follow directions and safety precautions on labels. Handle carefully and store in original labeled containers out of the reach of children, pets, and livestock. Dispose of empty containers right away, in a safe manner and place. Do not contaminate forage, streams, or ponds.

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