



## FOUR COMMON TICKS OF PENNSYLVANIA

### Tick-borne Diseases and Prevention, Tick Distributions, Life Histories and Control

#### BACKGROUND INFORMATION

Ticks, of which there are more than 500 species world-wide, are parasitic arthropods closely related to mites. Most ticks feed on the blood of warm-blooded mammals but some species also feed on birds, reptiles and even amphibians. Fish are apparently the only vertebrates not plagued by these little blood-suckers.

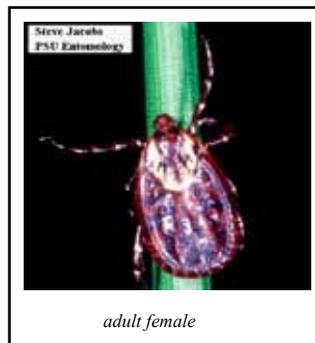
Many species of ticks can transmit diseases (zoonoses) from an infected host to other uninfected hosts. Some of the more frequently transmitted organisms include parasitic worms, viruses, bacteria, spirochetes and rickettsias. The most important of these to Pennsylvanians are spirochetes which cause Lyme disease, and rickettsias which cause Rocky Mountain spotted fever.

Currently, more than 25 species of ticks have been identified in Pennsylvania. Of these, four species account for nearly 90 percent of all submissions to Penn State for identification. The four ticks are: 1) the American dog tick, *Dermacentor variabilis*; 2) the blacklegged tick, *Ixodes scapularis*; 3) the lone star tick, *Amblyomma americanum*; and 4) a ground hog tick, *Ixodes cookei*.

#### TICKS

##### 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. It is the most commonly encountered tick in Pennsylvania and occurs in most counties.



adult female

**Hosts:** The immature stages are frequently found on small rodents such as meadow mice. The adults are frequently found on dogs

(hence the name) and can be recognized by the distinctive white markings on their back. The American dog tick may become greatly engorged, achieving the size of a grape. In addition to man, the other hosts are cat, cattle, donkey, hog, horse, mule, sheep, coyote, deer, fox, wolf, wildcat, badger, opossum, rabbit raccoon, rat, skunk, squirrel, weasel and ground hog.

**Diseases:** American dog ticks are the major carrier of Rocky Mountain spotted fever, which is less common than Lyme disease, but a potentially more serious illness. This tick has also been known to transmit tularemia, and to cause tick paralysis. It cannot transmit the spirochetes responsible for Lyme disease.

##### 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. It has been expanding its range in recent years and can now be found in most of the counties in Pennsylvania. Three areas of the state are heavily infested: (1) the southeastern portion of Pennsylvania (in those counties southeast of a line through Wayne to Adams Counties) (2) the north central counties of Elk, Clearfield and Cameron; and (3) Presque Isle in Erie County.



adult female

**Hosts:** The larvae feed on birds and small animals such as squirrels mice and grouse; the nymphs also feed on small mammals and birds, while the adults prefer deer. Any stage of the blacklegged tick can feed on humans.

**Diseases:** This tick is well known as the vector of Lyme disease and has also been known to carry human babesiosis - a generally mild febrile disease, but can be severe for persons with compromised immune systems. The blacklegged tick typically requires in excess of 24 hrs. of attachment before it can transmit the causative agent for Lyme disease.

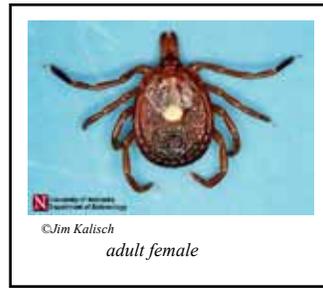
**Note:** This tick was previously known as the “deer tick, *Ixodes dammini*.” Recently, studies have proven that this tick is not a new species, and therefore the original designation is used. *I. dammini* is no longer a valid species designation.

\*Indicates average length of adult female

## Lone star tick

### *Amblyomma americanum*

**Distribution:** *Amblyomma americanum* is widely distributed in the United States. It is commonly found from Texas north to Missouri and eastward to the Atlantic coast. It is found most often in the southern counties of Pennsylvania near urbanized areas. The lone star tick may be active from early spring to late fall.



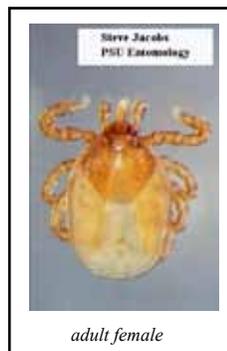
**Hosts:** The larvae feed on a variety of small animals, while the nymphs feed on many small and larger animals. Adults are usually found on larger animals, and all stages are found on deer and will feed on humans.

**Diseases:** The lone star tick is known to vector tularemia, Rocky Mountain spotted fever, and causes tick paralysis in man and in dogs. Although regarded as a poor vector for Lyme disease, there are anecdotal accounts of erythema migrans developing at the site of attachment. In Pennsylvania, this tick is known to transmit only Rocky Mountain spotted fever.

## Groundhog tick

### *Ixodes cookei*

**Distribution:** *Ixodes cookei* is found east of the Rockies from Texas to South Dakota and northeastwards through Maine. This tick is less common, or at least less commonly encountered, than the three previously mentioned ticks. It is, however, a relatively common tick in portions of western and northern Pennsylvania.



**Hosts:** This tick is very host-specific for groundhogs, but occasionally is found on birds, small animals or humans.

**Diseases:** It is not considered to be an important vector of Lyme disease because it tends to feed only on groundhogs. In laboratory studies, the larval *I. cookei* would not feed on *Peromyscus* sp. and as such is probably not a good candidate as a vector for Lyme borreliosis. Additionally, it is not a known vector for any other zoonoses.

## DISEASES

### Lyme Disease

Lyme Disease, or Lyme borreliosis, is an infection caused by the spirochete *Borrelia burgdorferi* which is transmitted to humans by ixodid ticks. It is a multisystem illness characterized initially by erythema migrans and a series of common nonspecific complaints and symptoms including headache, fever, sore throat,

nausea, etc. and late phase symptoms which left untreated may progress debilitating rheumatologic, cardiac, and neurologic conditions, but rarely directly to death.

A skin 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. This condition is called erythema migrans (EM) and for the purpose of CDC surveillance definition, the lesion must reach a size of 5 cm (approximately 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 or months after the initial erythema migrans there is 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.

### Rocky Mountain Spotted Fever (RMSF)

RMSF 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. In the west, the disease was limited mainly to men who worked and spent time in wooded areas, while in the east, cases occur when people come in contact with infected ticks from their pets or in their yards.

RMSF is caused by a rickettsia, *Rickettsia rickettsii*. The vector in the east is the American dog tick (*Dermacentor variabilis*), but the disease is also carried by the lone star tick and the Rocky Mountain wood tick (*Dermacentor andersoni*). Symptoms include a red-purple-black rash, usually on the wrists and ankles, which appears from two days to two weeks after infection. A fever, headaches, and malaise also are characteristic. Broad-spectrum antibiotics are used to treat RMSF. Diagnosis can be made with a blood test, but treatment should not wait for serological confirmation, as fatalities do occur.

### Tularemia

Also known as rabbit fever, tularemia is carried by the Rocky Mountain wood tick, the rabbit tick (*Haemaphysalis leporispalustris*), the lone star tick, and the American dog tick. Rabbits serve as a reservoir for the bacterium, *Francisella tularensis*. The number of cases in the United States has dropped considerably in the last 50 years. In 1989 only 144 cases were reported, compared to nearly 2,300 cases in 1939.

Symptoms include a sudden onset of fever, chills, loss of appetite, general body aches, and swollen lymph nodes. An ulcer forms

at the site of the bite. Serological tests are used in diagnosis, and treatment consists of antibiotics. If not treated, symptoms intensify. Tularemia causes a few deaths each year.

## Babesiosis

Caused by a protozoan, *Babesia microti*, the disease is transmitted by the blacklegged tick (*Ixodes scapularis*). Fatigue and loss of appetite are followed by a fever with chills, muscle aches, and headaches. In more extreme cases, blood may appear in the urine. Babesiosis is more severe in older people and those with no spleen. Fatalities can occur in older patients. The condition has been treated with drugs that are used to treat malaria, but with limited success. Generally, the disease is self-limiting and symptoms disappear on their own.

## Erlchiosis

Most common in the southern United States, erlichiosis usually occurs in rural areas during May, June, and July. It is caused by a rickettsia belonging to the genus *Erlchia*. The clinical signs are similar to those of Rocky Mountain spotted fever: chills, headache, body aches, fever, and a rash, though the rash occurs with a lower frequency. Often the symptoms are very mild. Tetracyclines are the treatment, as with RMSF. Originally identified as an animal disease, erlichiosis was believed to be limited to dogs.

## Tick Paralysis

Tick paralysis is not a disease, but a condition caused by toxins that a tick injects into its host during feeding. Most mammals seem to be affected, but smaller and younger mammals (children) are more susceptible.

Symptoms begin a day or two after initial attachment. The victim loses coordination and sensation in the extremities. The paralysis progresses in severity, the legs and arms becoming useless; the face may lose sensation; and speech becomes slurred. If the breathing center of the brain is affected, the victim may die. If the tick or ticks are found and removed, recovery begins immediately, and the effects disappear within a day.

Generally, this condition is associated with ticks attached around the head area, particularly at the base of the skull. 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.

## PREVENTION AND CONTROL

The best advice for preventing Lyme disease and other tick-borne diseases is to:

1. Wear protective light-colored clothing while outdoors, including a broad-brimmed hat, a long-sleeved shirt, and long pants tucked into the socks;
2. Check the body daily for the presence of ticks;
3. Use tick repellents, DEET, or permethrins;
4. Use forceps or tweezers to carefully remove ticks attached to the skin. Apply gentle, constant retraction of the tick where it attaches to the skin (not the body of the tick);
5. Seek immediate medical attention if signs or symptoms of early Lyme disease appear.

The best way to avoid attachment of a blacklegged tick is to stay out of wooded or brushy areas in known Lyme disease counties. 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. Because of recent concern over adverse reactions in a few individuals, sprays with no more than 35 percent DEET are recommended.

An effective acaricide, Permanone™, contains the synthetic pyrethroid permethrin and is applied as a spray to clothing. It is not approved for use on skin. 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 a blacklegged tick by following deer trails and by resting on the forest floor. Studies in New York have shown that a high density of nymphal blacklegged ticks is present in leaf litter. Adult ticks more often are collected from narrow forest trails than from general sites throughout the forest, and they are more prevalent in high, brushy vegetation .

Hunters should be cautious when harvesting deer. The urine, blood, and liver could carry the spirochetes, which can enter through cuts in the hands, although this is highly unlikely. Cooking destroys the bacteria and eliminates any danger of getting Lyme disease from eating venison. There are no documented cases of transmission through handling or consuming deer flesh.

Self-examination is recommended after spending time in infested areas. 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.

## LYME DISEASE AND DOGS

Most dogs, even though they have been exposed to *Borrelia burgdorferi*, never exhibit any signs of Lyme disease. In certain highly endemic areas of New York and New Jersey dogs exhibit almost a 90% rate of exposure as evidenced by serosurvey. However, only about 4% of the dogs exhibit signs of Lyme disease including lameness, poor appetite and fever. Treatment of these animals with antibiotics typically results in rapid recovery.

A few dogs can develop lesions on the kidneys (Lyme nephropathy) and may not respond to antibiotic treatment. Interestingly, dogs susceptible to this condition may not be protected by the Lyme vaccines currently available. In fact, there are concerns that the vaccine may possibly sensitize a genetically predisposed individual to having a more intense immune-mediated reaction to Lyme antigens, or the vaccine may add to antigen-antibody complex deposition in tissues (Meryl P. Littman, VMD, DACVIM, University of Pennsylvania - personal comm. 2001).

Kennels, runs, or yards can be treated with a variety of residual insecticides labeled for tick control at these locations. Tick pesticides that are labeled for exterior tick control include bifenthrin, cyfluthrin, deltamethrin, esfenvalerate, permethrin and tralome-thrin. Follow all label instructions. Do not apply materials labeled for kennels, yards and other exterior sites on your pets.

## **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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## GLOSSARY OF MEDICAL/ENTOMOLOGICAL TERMINOLOGY

**Arthralgias:** a pain in a joint; it may be in a single joint such as the knee or in several joints, and commonly involves the larger joints.

**Atrioventricular Conduction:** conveyance from the atrium to the ventricle of nerve impulses which stimulate the heart muscle.

**Bell's Palsy:** a paralysis of the facial nerve (Cranial nerve VII), causing a muscular weakness on one side of the face. Associated may be the inability to close an eye, loss of taste sensation and hearing impairment causing sounds to be excessively loud.

**Cranial Neuritis:** an inflammation or degeneration of the nerves that arise directly from the brain; a manifestation of Lyme disease.

**Encephalomyelitis:** an acute inflammation of the brain and spinal cord. Several arthroporne viruses are vectored by mosquitoes, ticks and mites.

**Erythema Migrans (EM):** a characteristic skin lesion of Lyme disease which occurs in 60% to 83% of patients with the disease. The lesion appears about three to thirty days after the tick bite. It initially commences with a red macule (spot) or papule (raised area) at the site of the tick bite which expands over a period of days or weeks into a flat annular lesion (measuring at least 5 cm), usually with a partially clear central area. The border of the lesion is inflamed and migrates outward, causing a bulls-eye-like pattern around the site of the original bite. The average size of the lesion is 15 cm, but lesions 4 times as large have been reported. Untreated, the lesion will fade after weeks or months; on the average after a month. Thereafter in the affected area, dead tissue will scale and slough off and eventually the area regains normal coloration. This does not mean an end to the disease.

**Febrile:** with a fever.

**Fibromyalgia Syndrome:** a variant of the chronic fatigue syndrome that causes widespread musculoskeletal pain and may occur one to five months or later after early Lyme disease is observed.

**Ixodid:** belonging to the genus *Ixodes*.

**Larva (pl., larvae):** the first developmental stage in tick development. The larvae have three pairs of legs. In a tick embryo the rudiments of all four pairs of legs are present. However, the fourth pair of legs reside as masses of latent cells beneath the cuticle of a larva. During the quiescent molting period that precedes the nymphal stage, the development of the fourth pair of legs takes place. Entomologists generally restrict the usage of larva to developmental stage of insects with complex of complex metamorphosis; the term nymph is used for the developmental stage of insects with gradual metamorphosis. The acarological usage is at variance with the entomological usage.

**Meningitis:** an inflammation of the meninges due to an infection by viruses or bacteria.

**Malaise:** a vague feeling of bodily discomfort.

**Myalgia:** pain in the muscles.

**Myocarditis:** an inflammation of the muscular walls of the heart or myocardium and usually the pericardium (membrane surrounding the heart) as well.

**Nymph:** As used by acarologists, the term nymph has a significantly different meaning from common entomological usage. A nymphal ixodid tick is the second stage in morphological development, occurs following a larval stage and precedes the adult. Upon molting from larva to nymph, ticks gain a fourth pair of legs. As used in entomology, the nymph is the immature stage of those insects that have gradual or incomplete metamorphosis.

**Palpitations:** rapid, skipped, fluttering or abnormal rhythm of heart.

**Radiculoneuropathy:** a disease of central nervous system, usually causing weakness and numbness. The distribution of the symptoms are in an area corresponding to one or more nerve roots.

**Rickettsiae:** a pathogenic organism thought to be intermediate between bacteria and viruses, because they have features in common with both.

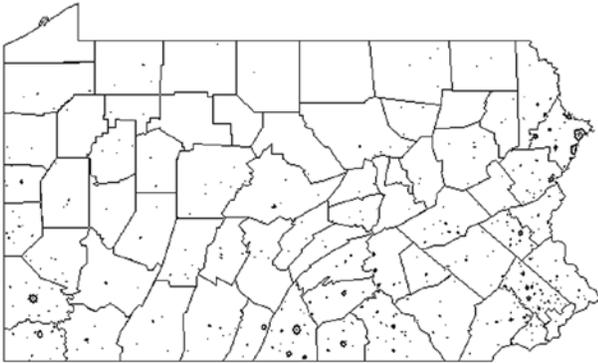
**Spirochetes:** an order of bacteria containing slender cells 6 to 500µm in length in the form of spirals of at least one complete turn. They are motile, whirl or spin about on their long axis, and are thereby propelled forward or backward. Some forms are parasites; others are free-living or saprophytic.

**Vector:** an organism (generally an arthropod or a mollusk) that carries and transmits a parasite or pathogen from one vertebrate host to another. A vector is usually an intermediate host of a disease causing organism, and as a carrier is capable of transmitting parasites or pathogens to a definitive or final host. If the parasites or pathogens multiply in the host organism, it is a biological vector; if multiplication or development does not occur, it is a mechanical vector.

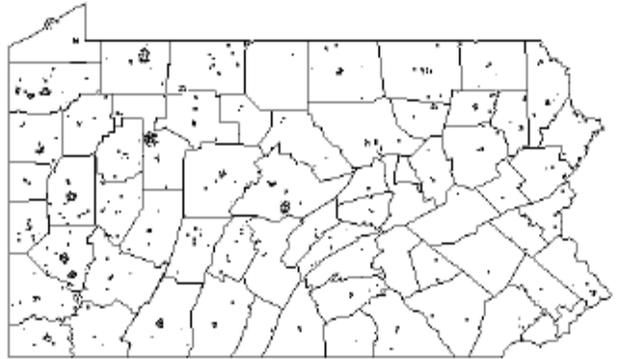
**Zoonoses:** diseases (infections), the agents of which periodically invade the human body and are also common to other animals. In the United States and western Europe, this generally means diseases shared with other vertebrates, especially other mammals. In eastern Europe, it means all animals including invertebrates. Entomologists are concerned with those infections in which arthropods appear in the chain of transmission. Zoonoses involves man becoming the accidental or terminal host when inoculated with a pathogen by an arthropod vector.

**PENNSYLVANIA TICK DISTRIBUTIONS\***  
**1900-2000**

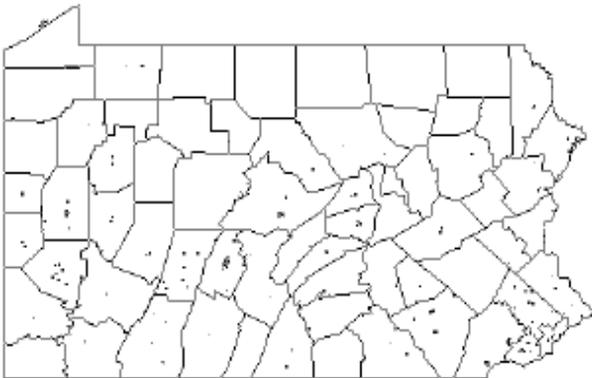
**AMERICAN DOG TICK**  
*Dermacentor variabilis*



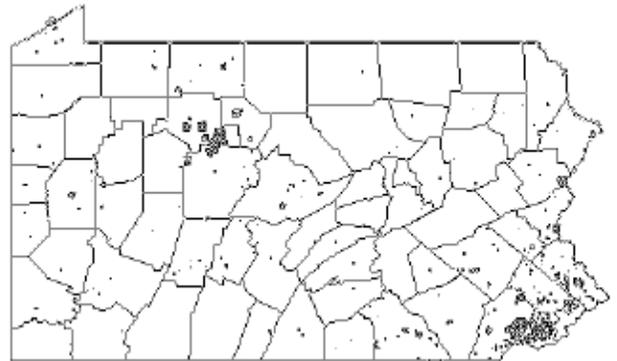
**GROUNDHOG TICK**  
*Ixodes cookei*



**LONE STAR TICK**  
*Amblyomma americanum*



**BLACKLEGGED TICK**  
*Ixodes scapularis*



\* SOURCE: Penn State Insect ID Lab