



Ticks

Introduction

Ticks are arthropods that are sometimes mistakenly called insects. Insects have three body regions, six legs, and typically possess wings. Ticks lack wings, have two body regions, and depending upon their developmental stage, may have either six or eight legs. Ticks possess tremendous potential for transmitting organisms that may cause disease in humans and other animals. These disease-causing organisms include protozoa, viruses, and bacteria. Bites from certain ticks can cause a rare limp paralysis starting in the lower limbs and moving upwards with death resulting if the tick is not promptly removed. Additionally, tick bites can cause skin irritations or even allergic reactions in sensitive people who are repeatedly bitten.

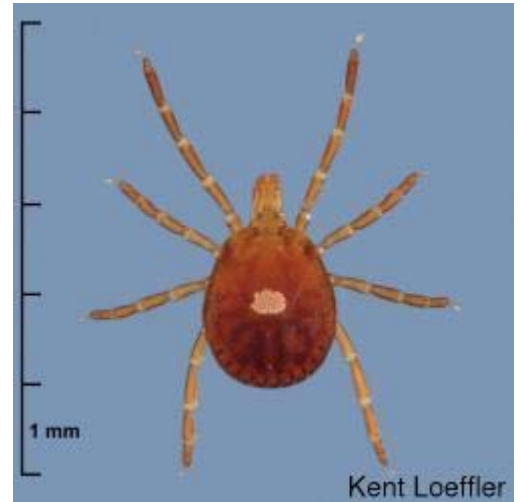
Taxonomy and Description

Animals in the phylum Arthropoda (known as arthropods) share several key characteristics including: a segmented body arranged in two or three groups; paired, segmented appendages; and an exoskeleton made of chitin. Examples of commonly encountered arthropods include crustaceans, spiders, insects, millipedes, and centipedes. The Arachnida is a class within the phylum Arthropoda. Arachnids include spiders, scorpions, pseudoscorpions, and opiliones or *daddy-long legs*. The class Arachnida is further divided into smaller groups called orders. The Acari is a name for one of these orders. All mites and ticks belong to this order. Ticks comprise two main groups: hard ticks (family Ixodidae) and soft ticks (family Argasidae).

Tick mouthparts are located on the capitulum (or head) and can be easily seen from a dorsal view. Specialized structures called stylets (chelicerae and hypostome) are used to penetrate and remain firmly anchored in the host skin during feeding. The idiosoma is the tick body region that greatly expands with blood during feeding. Attached to the idiosoma are the legs. Hard ticks have a thickened plate on the idiosoma that is called the scutum. The male tick's scutum covers the entire dorsal surface restricting expansion when blood feeding, As a consequence, males ingest smaller meals. Soft ticks lack a scutum, the integument is textured in appearance, and the capitulum can only be seen ventrally. Soft ticks are primarily a concern in arid regions. Information in this fact sheet pertains specifically to hard ticks because they are of public health importance in the northeastern United States.

Biology and Behavior

Ticks undergo four developmental stages: egg, larva, nymph, and adult. Nymphs and adults have four pairs of legs, while larvae have three pairs. All developmental stages of ticks are obligate blood feeders. They must obtain



An image of a hard tick, *Amblyomma americanum*. The scale along the left side is in millimeter increments.



Argas persicus, a soft tick. The scale along the left side is in millimeter increments.

a blood meal to molt to the next life stage and for female ticks to develop eggs. Males remain on their host and mate with several females; they too will eventually drop from their host.

Most hard ticks exhibit a three-host life cycle.^{21,23} This means the tick will feed on three separate hosts. Ticks typically feed only once during each developmental stage. Duration of time larvae, nymphs, and adults spend feeding varies among species and developmental stages but typically takes several days.^{21,23} After feeding, the larvae and nymphs drop from their host into the leaf litter to molt and then seek a new host. During favorable conditions the molting process can be completed in one to three weeks. Upon obtaining a blood meal adult females detach and drop into the leaf litter to lay a single batch of eggs. Adverse environmental conditions or a decline in day length may cause ticks to enter diapause where they may delay host seeking, development, or oviposition. Depending upon the species of tick, the number of eggs laid may range from a few hundred to several thousand. In most cases, the larger the volume of blood taken, the more eggs the female will be able to produce.²¹ The egg-laying process may take from several days to two or three weeks to complete. The female dies shortly after laying her eggs. The developmental period for each tick stage varies, and the entire life cycle may take up to two years or more to complete.

Ticks spend periods of arrested development (quiescence) in the leaf litter, burrows, or in nests of their hosts.^{21,22} These types of microhabitats provide adequate moisture and protection against adverse environmental conditions. This helps to ensure that a certain segment of the tick population is able to withstand a colder than normal winter or survive during dry spells.

Overall, ticks exhibit a wide range of host preferences from specialist feeding on one type of animal to generalists. Cues for host seeking include changes in temperature and day-length, and detection of carbon dioxide, ammonia, and host body heat.²² Host finding strategies vary depending upon tick species and developmental stage. Ticks either crawl toward the potential host or stretch out the front legs waiting to attach to a passing host (questing behavior).²² The front legs have specialized organs on them to detect carbon dioxide gradients from approaching hosts. Field studies have shown that some ticks will travel 23 yards (21m) toward a potential host while others do not move any appreciable distances.²² Ticks do not jump or fly and must literally come in contact with a host. Favorite vegetation sites for adult ticks that quest include tall grass and shrubs. Immature ticks are more likely to remain near the leaf litter or lower in the vegetation where they are more likely to encounter small rodents and ground-visiting birds.

Tick Species in New York State

New York state has several species of ticks.¹² Those of greatest public health importance are the American dog tick, the brown dog tick, the lone star tick, the groundhog tick, and the blacklegged tick.

American dog tick females are about 1/4 inch (6.35mm) long and are chestnut brown with a silvery-gray or creamy-white scutum. Male ticks are slightly smaller, and are chestnut brown with similar light-colored vertical markings on the dorsal surface. Larvae feed on small mammals, and nymphs feed on small-to medium-sized mammals. Adults, sometimes called wood ticks, occasionally attack humans but are more common on dogs and other medium-sized animals.¹²

Dermacentor variabilis is a known vector of *Rickettsia rickettsii*, a bacterium that causes Rocky Mountain spotted fever in humans. Most Rocky Mountain spotted fever cases are reported from the south Atlantic and south central states, but cases do occur each year in New York state, especially on Long Island. The average incubation period after an infected tick bite is seven days and results in fever, severe headache, and joint and body aches.^{9,23} Within a few days a spotted rash appears on the wrists and

American Dog Tick (*Dermacentor variabilis*).

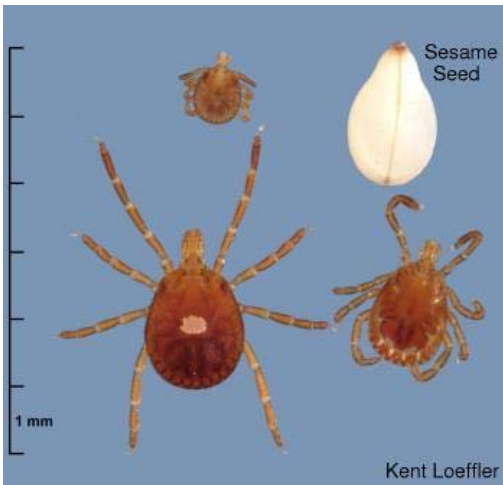


The American Dog Tick, *Deracenter variabilis*. Clockwise: nymph, larva, male, female.

ankles and spreads to the palms, soles, and eventually to the rest of the body. Rocky Mountain spotted fever is treatable with antibiotics but can be fatal if not treated promptly.^{9,23} *Rickettsia rickettsii* can be transmitted to eggs. Consequently unfed larvae are capable of transmission, in addition to nymphs and adults.

The American dog tick plays a secondary role in the disease cycle of human monocytic ehrlichiosis. Please refer to the lone star tick section for details.

Lone Star Tick (*Amblyomma americanum*).



The Lone Star Tick, *Amblyomma americanum*. Clockwise from upper left: nymph, male, female.

All stages of *Amblyomma americanum* will aggressively attack people and other medium-to-large mammals.¹² Females are 1/4 inch (6.35mm) long and reddish brown in coloration. A distinctive white spot or "star" on the scutum is characteristic of females. A reticulated pattern is apparent on the outer margins on the upper body surface of males. Lone star ticks have long mouthparts but with care the stylets can be completely removed from the host skin. Even with successful removal of mouthparts the cementing substance is left in the bite wound. This cement material can cause itching, skin irritation, and localized swelling immediately around the bite. Please refer to the guidelines for safe tick removal in this fact sheet.

Several cases of human monocytic ehrlichiosis are reported annually in New York State with most cases reported from Long Island and the lower Hudson River Valley. The causative agent is *Ehrlichia chaffeensis*, a type of bacterium.⁷ After an incubation period of 5 to 10 days nonspecific symptoms appear, including a high fever, severe headache, chills, aching muscles and joints, and fatigue.^{8,9} Patients may exhibit a rash, but it is not a common clinical feature of the disease. Usually infection with *Ehrlichia chaffeensis* is mild, but severe manifestations of the disease may result in death. Human monocytic ehrlichiosis is treatable with antibiotics.^{8,9,24}

Ixodes cookei (*Ixodes cookei*).



Ixodes cookei. Clockwise from upper left: female, nymph, larva.

Ixodes cookei has no official common name but it has been called the groundhog, woodchuck, or carnivore tick. Groundhog ticks are very similar in appearance to black-legged ticks (*Ixodes scapularis*), thus microscope examination is required to properly distinguish between these two species. *Ixodes cookei* has been found to parasitize a wide variety of carnivores and rodents but can be especially abundant on groundhogs (*Marmota monax*).^{4,11} The groundhog tick rarely quests for hosts on vegetation. Rather, they are found in the burrow of their host. This tick is primarily considered a nuisance, but it has been associated with the transmission of a virus that causes Powassan encephalitis.^{4,5} Powassan encephalitis is rare, and just a handful of cases have been reported in New York state since its discovery in North America in 1954. This is probably a reflection of the low contact rate between humans and infected vectors.^{5,11} Infection with Powassan virus can cause inflammation of the brain (encephalitis) and sometimes meningitis.^{4,5,13}

Blacklegged Tick or Deer Tick (*Ixodes scapularis*).



Blacklegged Tick or Deer Tick (*Ixodes scapularis*).



The Blacklegged Tick, *Ixodes scapularis*. From left to right: female, nymph, male.

percent of infected people develop a spreading rash (erythema migrans).^{8,9} The rash slowly spread and has a distinctive bulls-eye appearance. The risk of contracting an infection from a tick is virtually nil during the first 24 hours of attachment, so promptly removing ticks can reduce your chances of contracting Lyme disease.^{15,16,25} Untreated cases may resolve or progress to chronic joint, neurological, or cardiac problems. Lyme disease is treatable with antibiotics.^{8,9,24} Serological tests are used to support the clinical diagnosis of Lyme disease. These tests are designed to detect antibodies against *Borrelia burgdorferi*. The reason that serological tests are not performed until several weeks after the appearance of symptoms is because it takes time for the immune system to develop detectable antibodies. Most cases of Lyme disease are reported from Long Island and the lower Hudson River Valley.

Human granulocytic ehrlichiosis is caused by infection with the bacteria *Ehrlichia phagocytophilia*. The incubation period and symptoms are similar to human monocytic ehrlichiosis, except a rash rarely occurs.^{8,9} Unlike Lyme disease, prompt removal of ticks does not seem to decrease one's chances of contracting an infection.²⁵ Dual infections of *Borrelia burgdorferi* and *Ehrlichia phagocytophilia* have been documented in single populations of ticks and in individual ticks. Infections are treatable with antibiotics.^{8,9}

Brown dog ticks are reddish-brown with a dark brown scutum. Unfed females are about 3/16 inch (4.76mm) long. All stages feed almost exclusively on dogs and can become established in kennels. Although brown dog ticks can be found crawling on humans they rarely attach and feed on humans. This tick is considered a nuisance species and is not known to transmit disease-causing organisms to humans in the United States.

The Brown Dog Tick, *Rhipicephalus sanguineus*. Starting with the upper left and going clockwise: fully blood-engorged female, female, larva, male.

The blacklegged tick is the officially accepted common name for *Ixodes scapularis*, but many people refer to them as "deer ticks". Adult females are dark brown in appearance and are less than 1/8 inch (3.12mm) long. Larvae and nymphs feed on small mammals and birds. The white-footed mouse is an important host for the immature ticks, while adults are more common on deer. All stages will bite humans, but due to their small size, attachment by larvae and nymphs often goes unnoticed.

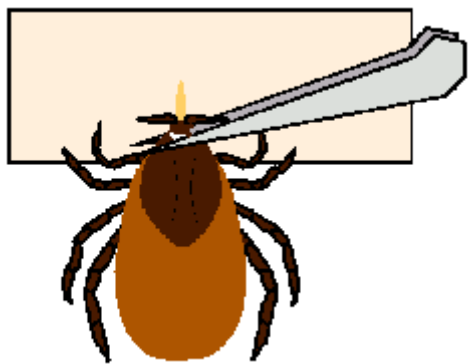
The blacklegged tick is a vector of two bacterial diseases and one protozoan disease in New York state. Lyme disease is caused by infection with the bacterial spirochete *Borrelia burgdorferi*. Nymphs are considered to be the most important stage for transmission because they are easily overlooked due to their small size. Signs and symptoms of Lyme disease usually appear within 1 to 2 weeks (range 3-30 days) following an infected bite. In addition to flu-like symptoms roughly sixty to eighty

Human babesiosis, caused by the protozoan *Babesia microti*, is rare but does occur in New York state, primarily on Long Island. Babesiosis causes a malaria-like illness after a 1 to 4 week incubation period. Symptoms include fever, chills, profuse sweating, headache, and muscle aches.⁹ The disease can range from relatively mild to, in rare cases, death. Ticks must acquire the protozoan through feeding on an infected host. Treatment includes antimicrobial therapy.^{9,24}

Other species of *Ixodes* occur in New York state and occasionally attack humans. Due to their small size and lack of distinguishing markings it is best to have *Ixodes* species identified by a trained professional. Additional information on *Ixodes scapularis* can be found in the fact sheet "*Integrated pest management for the deer tick*" by Carolyn Klass. The fact sheet is available through the Cornell University Insect Diagnostic Laboratory. <http://www.entomology.cornell.edu/MedEnt/TickBioFS/TickBioFS.html>

Guidelines on Safe Tick Removal

It is important to periodically check yourself, your children, and pets for ticks. Promptly removing a tick could reduce the likelihood of contracting certain types of tick-borne diseases such as Lyme disease.^{15,16,25} It takes time for ticks to insert their mouthparts and secrete a glue-like substance called attachment cement. The cement will harden and helps to further anchor the tick firmly in place.



Using thin tweezers, grasp the tick as close to the skin as possible and pull gently and slowly away from the skin. Do not twist, jerk, or pull hard on the tick or you risk leaving the mouthparts in the skin. After tick removal, disinfect the bite wound. If you find yourself scratching the bite consider covering it with a bandage to prevent a secondary bacterial infection. It is a good idea to save the tick in case it is necessary for later identification. Place the tick in a vial. Label the container with a date and note the attachment site of the tick. If you experience a rash, headaches, fever and flu-like symptoms after a recent tick bite consult your physician.

Proper grasp on a tick with forceps for removal.



NEVER use petroleum jelly, fingernail polish, a lit match, rubbing alcohol, or similar substances to remove a tick. These methods are not effective and may cause the tick to regurgitate into the bite wound.¹⁵

Identification of Ticks

Ticks can be submitted to the Insect Diagnostic Laboratory at Cornell University for identification. A \$25.00 identification fee applies per sample. Please do not mail ticks in alcohol due to mail regulations.

The Diagnostic Laboratory does not test ticks for any disease agents. If you want the tick tested please check with your physician or local county health office for the names of laboratories performing tick-testing services. Be sure to ask for information regarding price, response time, and proper procedure for mailing. Some laboratories perform tests only on living or recently dead ticks, while other laboratories test ticks preserved in alcohol.

Personal Protective Measures

Currently there are no protective vaccines for humans for the tick-borne diseases discussed above; consequently avoiding tick bites is the best disease-prevention strategy. You can take several to reduce your chances of being bitten by a tick.

- Avoid known or suspected areas of tick infestation, especially during tick season.
- Walk on cleared trails and avoid brushing up against vegetation and tall grass.

Wear proper clothing while in tick habitat. Clothing should be light in color to allow you to spot crawling ticks more easily. Wear closed-toed shoes, socks, long pants, and a long-sleeved shirt. Tuck pant legs into the socks and the shirt into the pants in order to slow crawling ticks.

Apply a tick repellent to exposed skin, around the tops of socks and waistband according to **product label directions**. Be sure that you understand the directions on the label. Some products can only be applied to clothing while others are applied to the skin. The label also contains important information on special precautions for children, hazards, and first aid. Carefully read and follow the label directions before each and every use.

Products containing synthetic chemicals work best against ticks. Two such products have as active ingredients DEET (*N,N*-diethyl-*m*-toluamide) or permethrin. The decision of using or not using a repellent would depend upon whether you want to reduce your risk of being bitten, the species of ticks present in the habitat, the potential for tick transmitted diseases, and whether you will be in an area subjected to heavy tick pressure.

DEET.

DEET can be applied directly to the skin or clothing. However, DEET can damage some types of fabrics, watch faces, painted and varnished surfaces. DEET cannot be applied to skin that is covered with clothing. The United States Environmental Protection Agency (EPA) has completed an extensive reevaluation of DEET and has *"concluded that as long as consumers follow label directions and take proper precautions, insect repellents containing DEET do not present a health concern."*

The range of protection provided by DEET varies among tick species, developmental stages.^{1,2,10,14,18,19,20} In a field study, an aerosol application of 20% and 30% DEET applied only to clothing provided 86% and 92% protection, respectively, against the blacklegged tick.²⁰ The degree of protection of DEET formulated as a lotion was more variable. A 33.25% DEET extended lotion formulation afforded an average protection of 19% and 88% against nymphs and larvae of the blacklegged tick.¹⁰ Separate research has concluded that treatment of skin with DEET is not effective in repelling the blacklegged tick.^{1,18} As a result, ticks will continue to crawl until unexposed skin is encountered. A 20% concentration of DEET applied as an aerosol to clothing provided 85% protection, and a 33.25% extended-duration formulation (lotion) provided an average of 60% protection against lone star ticks.^{10,14} The same extended-duration formulation of DEET showed a 50% protection against the American dog tick, and aerosol application of 20% DEET gave 94% protection.^{10,14}

Permethrin.

Permethrin cannot be applied directly to the skin. It should be applied to clothing and allowed to dry before the clothes are worn. Permethrin (0.5% concentration) provides a high level of protection and effectively kills all tick species and developmental stages that have been tested.^{10,14,19,20} In one field study, most ticks removed from per-



Avoid game trails.



Apply repellent before entering tick infested habitat.

methrin treated clothing were dead or had impaired mobility while 99% of ticks removed from DEET (33.25% lotion) treated and untreated clothing did not show any ill effects.¹⁰ Tick species tested in these studies include the blacklegged tick, the lone star tick, and the American dog tick.

Botanical Repellents.

There are non-DEET and non-permethrin repellents labeled for use against ticks but they do not provide the same degree of protection.^{1,2} Active ingredients of these products include: oil of citronella, oil of eucalyptus (p-menthane-3, diol), and IR3535 (found in products sold by certain catalog cosmetic distributors).

Conduct frequent tick checks while you are outside and examine yourself thoroughly once you come indoors. It takes time for a crawling tick to find a suitable feeding site. Thus, the more frequently you examine yourself for ticks the greater is likelihood that you will find them before they attach. Check your children thoroughly. Favorite sites for ticks to attach include but are not limited to the hairline, shoulders, armpits, waist, inner thighs, and groin area.

Check your pets after they come indoors. Your pets are more likely to come in contact with ticks and bring them indoors.

A recent study suggested that ticks could survive the cold/cold and hot/cold wash cycles of automatic washers. However, a one-hour high heat cycle in the dryer was sufficient to kill all developmental stages tested.⁶

See "*Integrated pest management for the deer tick*" by Carolyn Klass for additional information on personal protection and *Ixodes scapularis*. The fact sheet is available through the Cornell University Insect Diagnostic Laboratory at <http://www.entomology.cornell.edu/IDL>.

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This publication may contain pesticide recommendations. Changes in pesticide regulations occur constantly, some materials mentioned may no longer be available, and some uses may no longer be legal. All pesticides distributed, sold, and/or applied in New York State must be registered with the New York State Department of Environmental Conservation (DEC). Questions concerning the legality and/or registration status for pesticide use in New York State should be directed to the appropriate Cornell Cooperative Extension Specialist or your regional DEC office. **READ THE LABEL BEFORE APPLYING ANY PESTICIDE.**

Updated 2007

Integrated Pest Management for the Deer Tick

A complete integrated management program for the deer tick should take a multifaceted approach. This includes surveillance (the detection of tick infestations); identification and reduction of tick habitat; personal protection using light-colored clothing, checking frequently for ticks, and using repellents; behavioral considerations such as avoiding tick-infested areas, removing leaf litter in your yard, and cleaning up borders; and perhaps targeted control applications for hosts as well as tick habitat.

The Deer Tick: The deer tick, *Ixodes scapularis* (formerly named *Ixodes dammini*) is the principal vector of Lyme disease in the northeastern and north central United States. Lyme disease is an illness caused by a spirochete (a corkscrew-shaped bacterium) infection. The Lyme disease spirochete *Borrelia burgdorferi* is transmitted primarily by the deer tick which normally feeds on mice, deer, and other small and medium-sized mammals and birds. If a human is bitten by an infected tick and consequently infected with the spirochete, the individual may develop Lyme disease.

Lyme disease is the most common tickborne disease in the United States and is an increasing national public health problem. In 1992 Lyme disease was known to occur in 45 states but is most prevalent in eastern coastal areas from Massachusetts to Maryland. In humans and some animals, especially dogs, *Borrelia burgdorferi* infection can produce skin, arthritic, cardiac, and neurological symptoms.

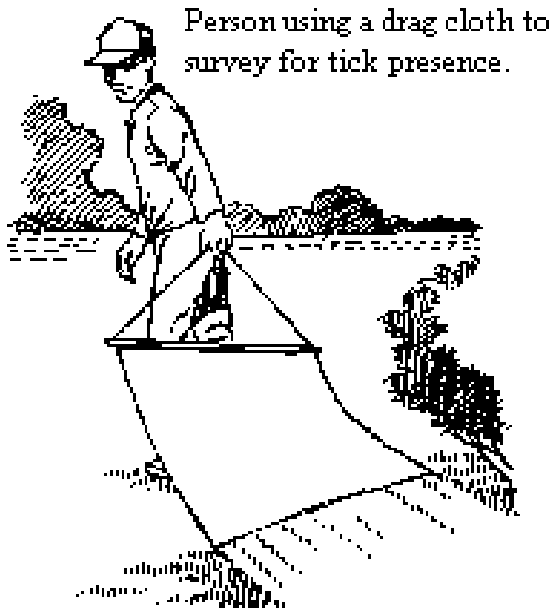
Research has shown that it usually takes 24 hours or more of feeding on a person for a nymphal-stage tick to transmit the spirochete. Adult ticks need to feed for 36 or more hours before transmitting the spirochete. Larval-stage ticks are not infected with the spirochete until they take a blood meal from an infected host animal, and thus do not transmit Lyme disease to humans.

Distribution: In New York State Lyme disease is endemic in Suffolk, Nassau, Westchester, Rockland, Putnam, Orange, Ulster, Dutchess and Albany counties. The deer tick has been found in 42 counties. The deer tick does not appear to be a resident of New York City, although the American dog tick (*Dermacentor variabilis*), the vector of Rocky Mountain spotted fever, does occur in coastal areas of the city and is common on Long Island and in downstate counties.

In infested areas, the deer tick is common wherever deer and woodland mice frequent. White-tailed deer thrive where suburban lawns adjoin woodland or open fields. Open areas provide deer grazing areas, woods offer shelter and browse, and homeowners provide tasty ornamental plantings. People are increasingly establishing their home sites in wooded areas, raising the potential for wildlife-homeowner conflicts. In so doing, they create a habitat that attracts deer, mice and ticks into their backyards. On Long Island, ticks are often found in beach grass near seashores in addition to the above-mentioned areas.

Description, Life Cycle, and Biology of the Tick: The deer tick passes through four life stages (egg, larva, nymph, and adult) over a period of two years. It is known as a three-host tick which means that it feeds on three different hosts during its life cycle (All life stages besides the egg must take a blood meal to develop, and the adult female must feed to mature the eggs. The adult deer tick is about the size of a sesame seed (2.5 mm), oval, with four pairs of legs and a flattened body. Adult deer ticks are most active in October and November and again during April and May. They commonly attach to white-tailed deer, dogs, horses and humans. During fall and spring the adults may be found "questing" -- waiting in ambush on vegetation from ground level to about 18 inches high (deer belly height) for a suitable host to pass by. Unfed females are brick red with a small black shield on the back, and males are smaller and uniformly dark. Adults prefer to feed on deer, but will feed on other medium to large mammals including dogs and humans.

Adult females feed on a host for seven to ten days, swelling to the size of a small pea, and becoming blue-black. **Males feed intermittently but do not stay attached long enough to transmit infection. Female ticks may transmit Lyme disease to humans, but their larger size and longer feeding period make them easier to detect before they have an opportunity to do so.**



Person using a drag cloth to survey for tick presence.

After feeding and mating, females drop off their hosts and deposit eggs on the ground in the fall and early spring. Fall eggs overwinter, and eggs hatch into larvae in the summer.

The larval deer tick that hatches from the egg in late June or July is very tiny, 0.5mm (about the size of a period). The larva has only three pairs of legs. Larvae attach to white-footed mice (*Peromyscus leucopus*) and other small and medium-sized mammals and birds and feed for about three to five days. After feeding they drop from the host, seek a protected site under leaves or in dense vegetation, and overwinter.

Larvae pick up the spirochete from infected animals (reservoir hosts). The larvae molt to the nymphal stage in the fall and remain inactive as nymphs until the following summer.

Nymphs are the most important vectors of Lyme disease to humans because they are difficult to detect (they are small and have a relatively short feeding period) and because hu-

mans are most active outdoors during the summer when nymphs are present. Nymphs occur from late May through July and are about the size of a poppy seed (1.5mm). Nymphs may attach to humans, dogs, horses, cattle, rodents and other small to medium-sized mammals and birds. When an infected nymph feeds on an animal, it may transmit the Lyme disease spirochete. This animal then serves as a reservoir host capable of transmitting the spirochetes to other deer ticks.

The nymphal stage quests on vegetation and when a host brushes against vegetation, the tick clings to it and searches for a suitable feeding site. Ticks do not fly, jump, or actively pursue a host. Nymphs feed for three to five days, drop from the host, and again find shelter under leaves or other vegetation. They molt into adults in the fall..

Birds frequenting the forest floor where ticks are present may also serve as hosts for larvae and nymphs. Migrating birds are believed to contribute to the spread of the tick and to the risk of Lyme disease in endemic areas.

Deer are largely responsible for maintaining tick populations (but they are not the only animals). Deer are often present in large numbers in wooded sites and are the preferred host on which the adult ticks mate and the females acquire the necessary blood for egg development.

Surveying for Tick Presence: Survey at appropriate times. In the vicinity of Westchester County, NY, sampling should begin in late May, and if ticks are detected, immediate steps can be taken to minimize the risk of infection before early summer when people spend more time outdoors. Survey again weekly throughout June. The best time to survey is on calm days in early morning just after the dew has dried or on slightly overcast days. In general, ticks are not active on rainy days, and activity appears to drop off just before a storm, so avoid surveying then. Survey for adults weekly from mid-October to mid-November.

Dragging and flagging are two techniques used by researchers to find ticks in an area. The dragging technique may be used by individuals to survey for tick presence on home lawns. A drag consists of a one-yard-square piece of white or light-colored sturdy flannel cloth, such as corduroy, attached to a pole. Rope is attached to both ends of the pole to enable the user to pull the drag across a lawn or other area of low vegetation. The cloth is dragged behind the surveyor. This technique works well for nymphs and adults which quest for a host animal. The drag is kept low to the ground -- it must brush across the top of the lawn or leaf litter. Drag cloths should be inspected about every 30 seconds for ticks. Suspect ticks are grasped with a forceps and placed in alcohol or a pre-moistened sample vial for later examination.

Flagging is similar, but in this case a smaller cloth, the flag, is attached to one end of a pole with the other end used as a handle. The flag is pushed ahead of the collector and it is primarily used in areas of higher vegetation such as thick understory in wooded areas and brush and shrubs in open areas, or in edge habitats and along property borders where vegetation is thicker. Ticks are usually found within 18 inches of the ground.

When surveying always wear protective clothing. Tuck in everything, including pants into socks or boots, to help keep ticks, if present, on the outside of the clothing.

If you find deer ticks, you need to decide what to do.

Continued surveying will help you determine if the tick was an isolated individual or if you have a larger population in the area.

Drag or flag sampling will collect only one of ten ticks inhabiting an area. Repeated sampling at different times will increase the likelihood of finding a tick.

Landscape Management: Studies on residential properties show that deer ticks are more likely to be found in certain habitats. Deer ticks require high humidity; therefore, they seek out habitats that offer this condition. Heavily shaded, damp (but not flooded) areas covered with leaf litter are ideal. Sites where host animal activity is concentrated are also important. Deer ticks, therefore, are often found in woodlots or wooded areas between yards, along edge habitats, and especially in unmaintained borders. High-risk areas are also found along rock walls, woodpiles or brushpiles. All stages are rare on maintained lawn, and deer ticks are rarely found in open, sunny areas.

Landscapes may be managed to manipulate wildlife activity patterns, to lower the humidity in habitats where ticks are likely to be found, and to push back the danger zone where tick exposure is likely to occur by manipulating edging and mulching borders.

Where possible, keep deer away by reducing deer habitat or fencing them out. Studies show that immature ticks are most abundant in areas where deer are abundant.

Mice, the principal reservoir host of the spirochete, and other small mammals can be kept away by reducing cover and thereby having more open areas in the lawn, along walls, and along borders so that mice are less likely to find cover. If possible, eliminate wooded brush-covered habitat or fence it off so people and pets do not have ready access to it. Vegetative screens between properties may harbor all types of animal activity and therefore provide a potential habitat for ticks. Pruning off the lower branches of a vegetative screen will help reduce habitat but still will provide a screen. Using a light mulch, one to two inches deep, or bare soil around shrubbery also helps reduce habitat. When mowing along edge habitat, direct the mower discharge into shrubbery rather than onto the lawn. Clean up storage areas, woodpiles, and junk piles. If you feed birds, position the bird feeders away from rodent habitat, clean up loose seed, and stop feeding by April and do not resume again until after larval tick activity has decreased in October or November. Removing leaf litter and planting grass under shade trees will help reduce tick abundance.

Behavioral Considerations: If you can conduct major activities involving tick habitat at tick-free times of the year, you may avoid the ticks. For example, cutting wood might be done in the winter rather than in the early fall when adult ticks are most active. If you need to be in tick-infested areas, try to plan activities there during the driest part of the day.

Restrict children's activities to managed areas, those less likely to harbor ticks. If necessary, fence off areas for children to play in.

Keep pets either entirely inside or entirely outside during tick season. Use pet products to reduce tick exposure (check with your veterinarian). Adjust your habits regarding pets; for example, keep them out of human living or sleeping areas, or both. Groom and make a tick check of animals after each possible tick exposure.

Get into the habit of checking people for ticks right after ending outdoor activities. In infested areas it may be best to remove clothes before entering the living area and seal them in a plastic bag until they are laundered or put into a clothes dryer -- ticks cannot survive a 20-minute tumble in dry heat. Discovery and prompt removal (within 24 hours) of attached ticks can minimize the risk of infection. The longer you wait to remove an attached tick, the more you increase the chances of infection.

Chemical Management: Tick populations occasionally can be extremely numerous or persistent on residential property. Homeowners may find that routine flagging of vegetation does not remove the majority of ticks on the property and, therefore, may wish to pursue more aggressive tick-control measures. Certain chemical acaricide (tick-killing) products are commercially available and may be used to reduce tick populations. Individual homeowner control efforts may be relatively ineffective, however, if neighboring property owners do not take similar aggressive measures. Unless homeowners take the additional precautions to exclude birds and mammals from entering their properties, ticks may eventually reinvade chemically treated properties. More promising results may occur when several adjacent property owners diligently take measures to exclude animal hosts of ticks and to treat their properties with registered acaricide products. Registered products include certain formulations of some insecticides.

In work done in Westchester County, NY, researchers at the New York Medical College's Lyme Disease Center (Valhalla) have shown that in areas where the deer tick is abundant, it may be present on home lawns. Studies show that in those areas, 70 percent of humans who get Lyme disease are bitten by ticks in their yard. In these circumstances, given the presence of ticks on residential properties, the high infection rates of ticks with spirochetes, and the lack of feasible alternative control strategies, pesticide applications are currently the most effective means for reducing deer ticks.

Surveying by dragging will help determine if the ticks are present in lawn areas, or in edge or border areas only. If ticks are present only in lawn areas, limiting chemical treatment to edges and borders and to selective habitats is preferred over entire lawn treatment.

Control measures should be aimed at the nymphal stage because it is the most likely stage to transmit Lyme disease to humans. Researchers have shown that one application of a certain insecticide made at the peak of nymphal populations (very early in June for Westchester County) has reduced tick populations 68 to 97 percent. Certain formulations of **carbaryl**, **cyfluthrin**, **deltamethrin**, or **permethrin** are registered for the control of ticks. Follow the manufactures directions.

Based on these results, where nymphal populations exist determined by surveying the property, one application of a registered insecticide in early June during peak nymphal activity may be recommended in endemic areas. There is no need for repeated applications at regular intervals during the summer. Liquid or granular formulations registered for tick control may be used; liquids should be allowed to dry thoroughly before humans or pets reenter the area. Be especially careful using such materials near bodies of water -- do not contaminate water. Wear gloves and eye protection and do not eat or smoke when applying any pesticide. Wash skin and clothing after application, and always launder pesticide-contaminated clothing separately.

The research showed a second application in late September or early October controlled the fall and spring adults. Ticks of the same stage will not reappear until after they have fed and molted. Reinfestation takes several months to a year to occur.

Research on control of ticks is ongoing. Workers have shown that by using registered insecticides at the proper time, tick contact may be greatly reduced. Treating with an insecticide does not guarantee, however, that no ticks will be present. People still need to protect themselves by dressing appropriately, using repellents when in potentially tick-infested areas and checking daily for the presence of ticks (and removing them if found).

Reprinted from: Integrated Pest Management for the Deer Tick, 139IFS100.00, prepared by Carolyn Klass, Department of Entomology, Cornell University, 12/93. (Slight revision 10/98, TK)

Pesticide recommendations obtained from: *Part II -- Pest Management Around the Home, 2003-2004 Pesticide Guidelines*, Miscellaneous Bulletin 139S74II, a Cornell Cooperative Extension Publication. Contact our office for information on ordering copies.

The Pesticide Management Education Program (PMEP), in cooperation with the New York State Department of Environmental Conservation (NYSDEC), maintains a web site with a searchable database for pesticide products currently registered in New York State. Homeowners who have Internet access can locate currently registered products at <http://pmep.cce.cornell.edu/pims/current>. Several different queries are available that will produce a summary for the product(s) that the system locates. If the system fails to locate the product in question, then that product is not currently registered in New York State. The database also provides a summary of important information related to every product currently registered. Two data fields "Status" and "Expiration Date" are provided in each summary. Products with a status of "Registered - Discontinued" are currently registered but will probably be discontinued for use, sale, and distribution in New York State after the date noted in the "Expiration Date" field.

Every effort has been made to provide correct, complete and up-to-date pest management information for New York State in this publication. Changes in pesticide regulations occur constantly, and human errors are still possible. These recommendations are not a substitute for pesticide labeling. Read the Label before Applying Any Pesticide.

For more information contact: Tom Kowalsick, Extension Educator - Horticulture, CCE - Suffolk County

New York State Department of Health Tick Identification Service

Tick identification services are available through the NYS Department of Health and some county health departments. The NYS Department of Health Tick Identification Service will tell you the species of the tick, whether it is engorged with blood and, if so, how long it may have been feeding. The Tick Identification Service will also report whether the mouthparts are present (if not, they may have remained in the skin and need to be removed, as you would a splinter). There is no charge for this service.

The NYS Tick Identification Service **will not** tell you whether the tick is infected with disease-causing organisms. Once you send a tick to be identified it will not be returned. If you wish to have a tick identified, place it in a small jar containing rubbing alcohol. Seal the container to prevent leakage. Complete the Tick Identification Submittal Form. Mail the tick in the sealed container, along with the completed Tick Identification Submittal form to:

The New York State Department of Health
Tick I.D. Service
c/o HVCC Central Receiving
80 Vandenberg Ave
Troy, NY 12180
518-629-4695

Couriered or hand-delivered tick specimens should be taken to:

Hudson Valley Community College
Central Receiving Dept.
Lapan Hall (behind McDonough Hall Sports Complex and Ice Rink)

Deliveries will be accepted between the hours of 8am and 3pm when the college is open for business. The college is closed on holidays.

The Following information was obtained from Cornell Child Health Library Dept of Pediatrics

L yme Disease

What is Lyme disease?

Lyme disease (LD) is a multi-stage, multi-system bacterial infection caused by the spirochete *Borrelia burgdorferi*, a spiral shaped bacterium that is most commonly transmitted by a tick bite. According to the Centers for Disease Control and Prevention (CDC), Lyme disease continues to be a rapidly emerging infectious disease, accounting for more than 95 percent of all insect-borne illness in the US. The number of annually reported cases has increased 25-fold since national surveillance began in 1982. Since, a mean of approximately 12,500 US cases were reported to the CDC each year from 1993 to 1997. The disease takes its name from Lyme, Connecticut, where the illness was first identified in the United States in 1975.

Depending on the location, anywhere from less than 1 percent to more than 90 percent of the ticks are infected with spirochetes (bacteria that are usually carried by the tick).

Lyme disease is a year round problem, although April through October is considered tick season. Cases of LD have been reported in 45 states in this country, with most cases occurring in:

- the coastal northeast
- the mid-Atlantic states
- Wisconsin and Minnesota
- Northern California

Many cases have also been identified in large areas of Asia and Europe.

What are the symptoms of Lyme disease?

The list of possible symptoms for Lyme disease is non-specific, and symptoms can affect every part of the body. Symptoms usually appear within two to 21 days. The following are the most common symptoms of LD. However, each child may experience symptoms differently.

One of the primary symptoms is often a rash that can be pink in the center and a deeper red on the surrounding skin, but can vary in appearance. The rash:

- can appear several days after infection, or not at all.
- can last a few hours or up to several weeks.
- can be very small or very large (up to 12 inches across).
- can mimic such skin problems as hives, eczema, sunburn, poison ivy, and flea bites.
- can itch or feel hot, or may not be felt at all.
- can disappear and return several weeks later.

Several days or weeks after a bite from an infected tick, flu-like symptoms can appear, including the following:

- headache
- stiff neck
- aches and pains in muscles and joints
- low-grade fever and chills
- fatigue
- poor appetite

- sore throat
- swollen glands

After several months, painful and swollen joints (arthritis) may occur.

Other possible symptoms may include the following:

- neurological symptoms
- heart problems
- skin disorders
- eye problems
- hepatitis
- severe fatigue
- weakness
- problems with coordination

Symptoms of LD may resemble other conditions or medical problems. Always consult your child's physician for a diagnosis.

How is Lyme disease diagnosed?

LD may be difficult to diagnose because the symptoms may resemble other conditions. The primary symptom is a rash, but it may not be present in up to 25 percent of cases. Diagnosis is based on symptoms, a history of a tick bite, and blood testing to look for evidence of lyme disease.

Diagnosis of Lyme disease must be made by an experienced physician. Blood and laboratory tests may be performed to rule out other conditions.

Treatment for Lyme disease:

Your child's physician will determine the best treatment plan based on your child's individual situation. Lyme disease is usually treated with antibiotics.

How can Lyme disease be prevented?

Humans do not develop an immunity to LD and re-infection is possible. Some general guidelines for preventing LD include the following:

- Ticks cannot bite through clothing; dress your child and family in:
 - light-colored clothing.
 - long-sleeved shirts tucked into pants.
 - socks and closed-toe shoes.
 - long pants with legs tucked into socks.
- Check your family often for ticks, including:
 - all parts of the body that bend: behind the knees, between fingers and toes, underarms, and groin.
 - other areas where ticks are commonly found: belly button, in and behind the ears, neck, hairline, and top of the head.
 - areas of pressure points, including:
 - where underwear elastic waist band touches the skin.
 - where bands from pants or skirts touch the skin.
 - anywhere else where clothing presses on the skin.
 - Visually check all other areas of the body and hair, and run fingers gently over skin. Run a fine-toothed comb through your child's hair to check for ticks.

- Other helpful measures include the following:
 - Walk on cleared paths and pavement through wooded areas and fields when possible.
 - Shower after all outdoor activities are over for the day. It may take up to four to six hours for ticks to attach firmly to skin. Showering will help remove unattached ticks.
 - Use insect repellents safely:
 - Products that contain DEET are tick repellents, but do not kill the tick and are not 100 percent effective. Use a children's insect repellent and check with your child's physician if your child is younger than 1 year of age before using.
 - Treat clothing with a product that contains permethrin, which is known to kill ticks on contact. Do not use permethrin on the skin.
 - Check pets for ticks and treat as needed.

This publication may contain pesticide recommendations. Changes in pesticide regulations occur constantly, some materials mentioned may no longer be available, and some uses may no longer be legal. All pesticides distributed, sold, and/or applied in New York State must be registered with the New York State Department of Environmental Conservation (DEC). Questions concerning the legality and/or registration status for pesticide use in New York State should be directed to the appropriate Cornell Cooperative Extension Specialist or your regional DEC office. **READ THE LABEL BEFORE APPLYING ANY PESTICIDE.**

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