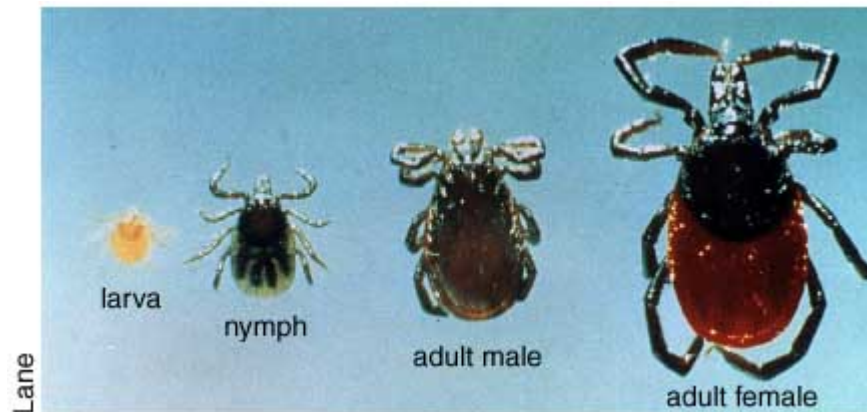


LYME DISEASE: A PRIMER FOR TOWN OF BEDFORD BOARDS AND COMMISSIONS



Ixodes Scapularis, commonly know as the deer tick
(actual larva size: “.”)

BY
THE BEDFORD CONSERVATION BOARD
OCTOBER 2004

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History

Early in the 20th century, European physicians observed patients with a circular, red, expanding rash which they called erythema migrans (EM). They associated this rash with the bite of ticks and postulated it was caused by a tick-borne bacterium.

In the 1940's, a similar tick-borne illness was described that often began with EM and developed into a multi-system, multi-stage, inflammatory illness. Spirochete-like structures were observed in skin specimens and penicillin was successfully used for treatment.

Lyme disease was named in 1977 when arthritis was observed in a cluster of children in and around Lyme, Connecticut. It was determined that Lyme disease was caused by the bacterium *Borrelia burgdorferi* and transmitted by an arthropod (tick). In 1982 these spirochetes were identified in the mid gut of the adult deer tick (*Ixodes scapularis*). Researchers linked the presence of EM rash lesions to preceding tick bites and determined that early treatment with penicillin not only shortened the duration of EM, but also reduced the risk of subsequent arthritis.

Conclusive evidence that *B. burgdorferi* caused Lyme disease came in 1984 when spirochetes were cultured from the blood of patients with EM, from the rash lesion itself, and from the cerebrospinal fluid of a patient with meningoencephalitis and history of prior EM. In 1991, Lyme disease was designated as a nationally notifiable disease.

In the late 1990's, a Lyme disease vaccine called LIMErrix was developed and approved for general use by the FDA. Based on a three-dose schedule over 12 months, the vaccine was considered effective in about 80%-90% of those treated. In 2002, the manufacturer withdrew the vaccine from the market because of lack of interest in the drug.

Medical Information

Within days to weeks following an infected tick bite, 89% of the patients will have the “bull’s eye” rash (EM) accompanied by general tiredness, fever, headache, stiff neck, muscle aches and joint pain. If untreated weeks to months later, patients may develop arthritis, intermittent episodes of swelling and pain in the large joints, swollen lymph nodes, aseptic meningitis, facial palsy, motor and sensory nerve inflammation and encephalitis. In rare cases there may be cardiac problems such as atrioventricular block, myopericarditis or enlarged heart.

According to treatment experts, antibiotic treatment for 3-4 weeks with doxycycline or amoxicillin is generally effective early in the disease. Cefuroxime axetil or erythromycin can be used for persons allergic to penicillin or who cannot take tetracyclines. Later disease, particularly with neurologic manifestations, may require treatment with intravenous ceftriaxone or penicillin for 4 weeks or more, depending on the severity of the disease. In late stages of the disease, treatment failures may occur and re-treatment may be necessary.

No evidence exists that pregnancy increases the risk for Lyme disease or its severity. Acute Lyme disease during pregnancy responds well to antibiotic therapy and adverse fetal outcomes have not been reported in pregnant women receiving standard courses of treatment. Transmission through breast milk has not been reported.

Lyme disease bacteria are **not** transmitted from person to person or with contact with infected animals. For example, you cannot become infected from touching or kissing a person who has Lyme disease, or from a health care worker who has treated someone with the disease, or by sexual contact.

Lyme disease is rarely, if ever, fatal.

Having had the disease doesn’t protect a person from re-infection.

Risk from transfused blood is considered minimal.

The black legged deer tick (*Ixodes scapularis*) is also the vector for ehrlichiosis and babesiosis.

Deer Tick Life Cycle

Ticks are arachnids, which include mites, scorpions and spiders. They are divided into two groups – hard bodied and soft bodied – both of which are capable of transmitting diseases. The deer tick is possibly the only known transmitter of Lyme disease in the United States.

The *Ixodes Scapularis* (black legged tick) is a three host tick. Each feeding stage (larva, nymph and adult) requires one vertebrate blood meal for its development.

Each stage attaches to a vertebrate host, feeds to repletion, detaches, drops to the ground and molts to the next stage. Typically, the tick takes about two years to complete one life cycle. Adults, resulting from spring nymphs, emerge in the early fall and undergo a fall breeding period. While on the host animal (primarily white tailed deer), the female feeds to repletion and the male mates repeatedly with several females. The females then lay a cluster of one to two thousand eggs before dying.

Stages

1. In the fall, large acorn crops attract adult tick-infested deer and mice infected with *B. burgdorferi* bacterium to oak forests. Humans can become infected at this stage
2. Adult ticks lay eggs the following spring.
3. The mouse population booms. Eggs hatch into Larvae, which feed on infected mice and mice transmit the bacteria to the Larvae.
4. Infected Larvae molt into infected Nymphs.
5. Infected Nymphs feed on deer and humans from spring through summer, transmitting the Lyme disease bacteria to humans

Larvae

Eggs laid by an adult female deer tick in the spring hatch into larvae later in the summer. These larvae reach their peak activity in August and are no bigger than a newsprint period. They wait on the ground and attach themselves to a small mammal or bird which brushes up against it. They then begin feeding on the host until repletion. If the host is already infected with the Lyme disease bacteria, then the larva becomes infected as well. If the host is not infected, then the larvae do not become infected and thus are not able to infect humans. Having fed once, an infected larva will not seek another host, human or otherwise until it reaches the next stage in its life cycle.

The first larval activity peak is seen in May and results from females that successfully mated and deposited their eggs the previous fall. The second and much greater larval activity peak is seen in August and results from females that successfully mated and deposited their eggs earlier that spring.

Nymphs

Most larvae, after feeding, drop off their hosts, molt and transform into nymphs in the fall. They remain inactive throughout the winter until May. Host-seeking nymphs wait on vegetation near the ground for a small mammal or bird to approach, then latch onto the host and feed for 4-5 days. They become engorged with blood and swell to many times their original size. If previously infected during its larval stage, the nymph may transmit the Lyme disease bacteria to its host. Conversely, if the host is already infected, the uninfected nymph will become infected.

In highly endemic areas of the northeast, 25% of the nymphs have been found to harbor the Lyme disease bacteria. Although the nymphs' preferred hosts are small mammals and birds, humans and their pets are suitable substitutes.

Adult

Once engorged, the nymph drops off its host onto leaf litter and molts into an adult. The adults actively seek new hosts throughout the fall, waiting up to 3 feet above the ground on stalks of grass or leaf tips to latch onto deer, humans, dogs, cats, horses and other domestic animals. Peak activity for adult deer ticks occurs in late October and early November. In highly endemic areas of the northeast, 50% of the adult ticks have been found to carry the Lyme disease bacteria.

Generally, winters in the northeast are cold enough to keep adult ticks at bay until late February or early March when temperatures begin to rise. At that time, they resume the quest for hosts in a last-ditch effort to obtain a blood meal allowing them to mate and reproduce. The females then drop off the host, lay their eggs and die.

Hosts

Deer ticks have been reported on at least 125 different species of hosts. The adults appear to prefer medium to larger sized mammals and are only moderately host specific. They have been recorded on at least 27 different mammalian and one lizard host species. They appear most abundant in areas where deer are numerous.

The Lyme disease bacterium (*B. burgdorferi*) is transmitted from the tick to the host via salivation and regurgitation, both processes combined or through destruction of the tick due to host grooming. The spirochete is most likely transmitted through the saliva, as these ticks salivate excessively during feeding. A minimum of 24 hours of tick feeding is required for spirochete transmission.

It has been reported that wildlife hosts never get sick from Lyme disease – only humans and domestic animals do.

Deer Information

Deer are primarily local in their range, and normally do not migrate throughout a region. They move slowly from one adjacent area to the next to continue grazing and consume 1 ½ to 2 tons of food annually.

Fifteen to twenty years ago, deer were being discussed as candidates for the threatened species category. Fragmentation of the forests, resulting from road and highway construction as well as energetic land development, industrial land clearing and farming operations, all contributed to reducing the continuous woodlands of the eastern United States and thus the deer habitats. The result was “multiple forest islands”. In the process of denuding so much land, so fast, familiar habitat and food sources were destroyed and the deer population dwindled.

Unlike the past, deer today only need a place to shelter, with no concern for protection from predators. In this new predator-free environment, deer have the luxury of feeding anytime or any place during a 24-hour period. Additionally, the woods edges now are adjacent to lush residential landscape plantings, providing a smorgasbord of deer delicacies. Government estimates suggest that the present deer population is much larger than when Europeans first came to this country – and growing rapidly.

White tailed deer are herbivores and can eat 6-8 pounds of plants per day. An over abundance of deer may result in the clearing of vegetation from the forest floor and a “browse line” of up to 5 feet of leaves on trees. This feeding behavior prevents the growth of young trees, stunts natural forest regeneration and may completely eliminate some plants including rare or endangered species. The composition, distribution and abundance of plant species in an area become altered and the habitat and food for other animals is lost or reduced as a result.

Deer Control Methods

Hunting only males cannot control deer numbers. Does can begin producing when they are one year old and usually have two fawns a year. Thus, female as well as male deer must be removed to control deer numbers. In most of southern and western New York, about 40% of the adult does must be killed each year to keep deer numbers stable. More must be taken to reduce the deer population. The New York State Department of Environmental Conservation is presently giving

bowhunters in Westchester County an indefinite number of doe killing permits in an effort to decrease the overall deer population.

Assuming no deaths from disease, hunting or vehicle accidents, two deer, within 7 years, could lead to 40 deer.

1. Trapping and Relocating – Expensive and labor intensive. Survival rates for trapped and relocated animals is low and the practices are illegal in New York State
2. Birth Control – Expensive, labor intensive, experimental and difficult to administer to free-ranging animals; possible negative effects to humans eating the meat of drug-treated animals
3. Fencing – Expensive to install and maintain. Electric fencing is illegal in Bedford, but is the most effective. Unfair to unfenced property owners as the deer population is directed to those properties
4. Supplemental Feeding – Expensive, labor intensive and illegal by DEC law; actually increases deer population; transmission of disease increased at feeding sites, local vegetation degraded at feeding sites and the problem of predation by dogs.
5. Planting Deer Avoidance Vegetation – Most vegetable, fruit and flowering and non-deciduous plants are favorites for deer. Following is a partial list of deer-resistant plants and shrubs. Note: if the winter is especially harsh, deer will eat almost anything!

Barberry, Cotoneaster, Broom, Forsythia, Spirea, Pachysandra, Lily-of-the Valley, Coreopsis, Bleeding Hearts, Hydrangea, Euonymus, Firethorn, Lilac, Privet, Smoke Bush, Snowberry, Spicebush, Viburnum, Weigela, Willow, Witch Hazel, Foxglove, Sunflowers, Pinks, Baby's Breath, Hellebore, St. John's Wort, Marigolds, Snapdragons, Cosmos, Verbena, Lobelia, Nasturtium, Zinnias, Crocus, Grape Hyacinth, Daffodils and others.

6. Repellents – Effective only in spot locations, not regionally; expensive and labor intensive. Not as effective in winter and during periods of rain and don't work very well when alternative food sources for deer are scarce.
7. Firearm Hunting or Sharp Shooting – Illegal in Westchester County
8. Bow Hunting – Public fear of accidents to pets and humans, although there is no record of a bow hunter shooting a non-hunter. Non-lethal hits may cause deer to suffer. Bow hunting has the potential of being an effective means of

controlling the deer population, provided there is more public education and governmental cooperation. Presently bow hunting season in Westchester County runs from November 1st to December 31st.

9. Managed Hunts – These may be organized by the NYS DEC or other approved organizations and is a critical component of a comprehensive deer control program
10. Light or Noise Repellents – Products that use light or noise, such as ultrasonic sound waves, to scare deer are not as effective in suburban and residential areas where deer are already acclimated to loud noises and bright lights. With ultrasonic devices, once deer learn that they can pass through the offensive area and the sound goes away, the device is no longer a deterrent.
11. Do Nothing – Over population of deer degrade the environment by destroying plant undergrowth, by causing erosion and by killing off native plants and act as critical hosts for disease organisms.

Reducing the abundance of white-tailed deer in affected communities has been attempted, but near total elimination of deer is required to reduce the risk of Lyme disease significantly.

The NYS Department of Environmental Conservation's Bureau of Wildlife estimates there are more than 1 million whitetail deer roaming in New York State. The Cornell Cooperative Extension estimates there is \$130 million worth of crops and landscape damage done annually by deer and more than \$120 million in damage due to vehicle accidents during the same time.

Strategies to Reduce Tick Abundance

Lyme disease transmission risk generally depends on the spatial coincidence of ticks, their natural hosts, such as deer, small mammals and birds, the Lyme disease bacteria and humans. Tick, animal host and human are the components of the ecology of Lyme disease and are all associated with elements of the landscape. Therefore, the relative risk of Lyme disease transmission can be characterized by the structure and composition of the landscape within a given area.

Keeping your yard tick-free:

1. Keep your yard clean of debris such as leaf litter and grass clippings and keep flower beds dry
2. Keep grass mowed, especially at the edges of the property
3. Trim bushes and shrubs, especially near paths and walkways

4. Create a 3-foot wide, 3-inch deep barrier using gravel, mulch, or woodchips to separate the lawn from any wooded areas
5. Make sure those areas where your children play, including swingsets and playhouses are in dry, sunny areas. You may also want to place gravel, mulch or wood chips around these areas
6. Any birdfeeders or wood piles that may attract tick-carrying animals should also be placed in gravel, mulch or woodchip- surrounded areas away from your lawn
7. The lawn area of your property should not contain anything designed to attract wildlife e.g. bird feeders, birdbaths and salt licks
8. Clear away debris from your stonewalls
9. Avoid attracting deer by planting plants they do not like to eat. Ask your local nursery or garden center for information on “deer proof” plantings
10. Apply a low-toxicity pesticide to your property once a year, preferably in May when tick eggs have just hatched
11. Prune bushes to let in more sunlight – ticks prefer shade
12. Consider allowing bowhunting on your property and joining up with your neighbors to make more space available for bowhunters.
13. Keep guinea fowl or chickens on your property (zoning permitted). They relish ticks as a food source.

A study published in the June 2000 issue of Conservation Biology notes that people living in areas with a greater diversity of small mammals may have an easier time dodging Lyme-carrying ticks than those living in regions that are home to a small number of distinct species. The white-footed mouse is believed to be the most abundant vertebrate in the forests of the eastern and central United States. The researches suggest that the mice prosper due to the absence of predators, such as owl and bobcats and competitors including eastern chipmunks and fox squirrels, all of which prefer more continuous habitat. Continued forest fragmentation of habitat could increase risk of exposure to Lyme disease because of a potential increase in the population of the white-footed mouse. Biodiversity may buffer against Lyme disease.

In 2001, Dutchess County received a \$300,000 federal grant to combine public education in tick avoidance with a new tick-control device. The device was designed to kill ticks by applying an insecticide onto the deer as they ate corn from a trough. This strategy could have wide-scale impact on Lyme disease. It would eliminate deer as hosts for adult deer ticks and would result in the loss of reproductive ability for the population and elimination of all stages within the one to two years encompassing the natural life span of one generation of ticks. The predation of dogs at the feeding stations could still be a problem

Devices that coat the bodies of mice with tick insecticide have been developed by the Center for Disease Control (CDC) and have proven effective in test trials. They reduce the amount of ticks within a treated area up to 80% the first year of use and up to 96% after the second year. The bait boxes are spaced along the edge of yards, where ticks, and the mice and chipmunks on which they feed, lurk among brush and trees. The bait boxes must be installed and periodically replaced by trained exterminators, at a cost of \$300-\$600 a year.

Aerial or ground application of acaracides (tick pesticides) has shown to be effective. However, large-scale application cannot be implemented in many areas because of environmental concerns.

A sure-fire tick repellent is rose geranium oil. This is usually carried in health food stores or can be ordered on line. Mix about 50 drops with 8-10 oz. of water and spray it on yourself before you go outside. It also works well on pets. Try it first on your inner arm to make sure you are not allergic to it.

References

1. Center for Disease Control and Prevention (National Center for Infectious Diseases, Division of Vector-Borne Infectious Diseases)
www.cdc.gov.ncidod/diseases/lyme/lyme.htm
2. Wildlife Habitats (provides comprehensive deer control management in the Metro DC and Baltimore areas)
KibbeAPLD@earthlink.net
3. Deer Busters (a company specializing in wildlife management and gardening specialty items)
www.deerbusters.com
4. New York State Department of Environmental Conservation. A Citizen's Guide to the Management of White Tailed Deer in Urban and Suburban New York, 1999
5. GlaxoSmithKline Vaccines (manufacturers of LYMERix, a now discontinued Lyme disease vaccine)
www.gskvaccines.com
6. Vidya Medical News Service (providing a detailed review and treatment of Lyme disease)
www.vidya.com/archives
7. American Lyme Disease Foundation (dedicated to the diagnosis, treatment, prevention and control of Lyme disease and tick-borne infections)
www.aldf.com
8. Guide to Urban Bowhunting: The guide for addressing urban deer problems with the use of responsible bowhunting. Contact: The National Bowhunter Education Foundation, 267-B East 29th St. #503, Loveland, Colo. 80538
9. Venison Donation Coalition (helping fight hunger with the wise use of our natural resources)

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Bedford Conservation Board, 2004

www.venisondonation.com