

typically have ample time to feed and transmit the infection (ticks need at least 24 hours to transmit the infection).

Ticks search for host animals from the tips of grasses and shrubs and transfer to animals or persons who brush against vegetation. They usually attach themselves in areas that are more hidden or hairy, such as the groin, armpits, and scalp. Ticks feed on blood by inserting their mouthparts into the skin of a host animal. They are slow feeders; a complete blood meal will take several days.

After more than 30 years of research, there is no convincing evidence that Lyme disease can be transmitted through means other than a tick bite.

Wooded, brushy places are common blacklegged tick habitats. Campers, hikers, outdoor workers, sportsmen, and others who frequent such areas are at risk. Because new homes are often built in wooded areas, transmission of Lyme disease near homes has become an important problem in some areas of the United States. The risk of exposure to ticks is greatest in the woods and garden fringe areas of properties.

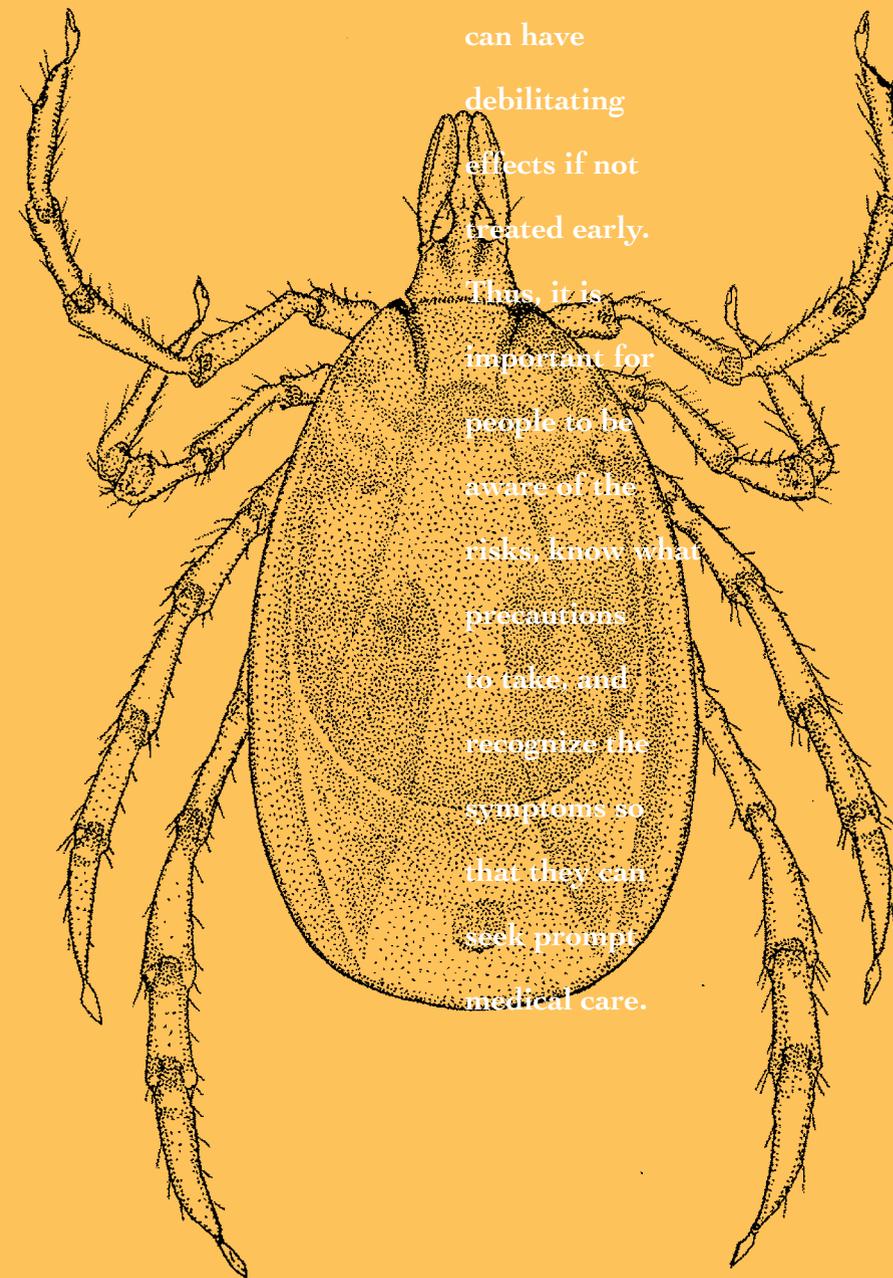
### **GEOGRAPHIC DISTRIBUTION**

In the United States, Lyme disease is concentrated in three areas: the Northeast from Massachusetts to Maryland; the north-central states, especially Wisconsin and Minnesota; and the West Coast, particularly northern California.

In Pennsylvania, the highest incidence of Lyme disease occurs in the southeastern corner of the state and the northwest-central counties. Tick submissions to Penn State, along with cases of Lyme disease reported to the state health department, indicate that these counties are at highest risk: Adams, Berks, Bucks, Cameron, Chester, Clearfield, Elk, Montgomery, Northampton, Pike, and York. However, it is important to realize that Lyme disease may be contracted in any county.

**LYME DISEASE EDUCATION**  
LYME DISEASE EDUCATION  
DEPARTMENT OF ENTOMOLOGY  
THE PENNSYLVANIA STATE UNIVERSITY  
501 AGRICULTURAL SCIENCES AND INDUSTRIES BUILDING  
UNIVERSITY PARK, PA 16802

# LYME DISEASE



can have debilitating effects if not treated early. Thus, it is important for people to be aware of the risks, know what precautions to take, and recognize the symptoms so that they can seek prompt medical care.

## LYME DISEASE

was recognized in Sweden as long ago as 1908. It was first identified in the United States in 1975, after a mysterious outbreak of juvenile arthritis among the residents of Lyme, Connecticut. Since then, case numbers of Lyme disease have continually increased, and the disease has become an important health problem in some of the most populated areas of the United States.

### **CAUSE**

Lyme disease is an infection caused by *Borrelia burgdorferi*, a member of the family of corkscrew-shaped bacteria known as spirochetes.

### **DISEASE TRANSMISSION**

Lyme disease is transmitted by ticks infected with *Borrelia burgdorferi*. In the Northeast, the tick most commonly associated with the disease is the blacklegged tick (deer tick), *Ixodes scapularis*. Closely related ticks in Washington, Oregon, and California and ticks from other parts of the world have been identified as transmitting the disease to humans.

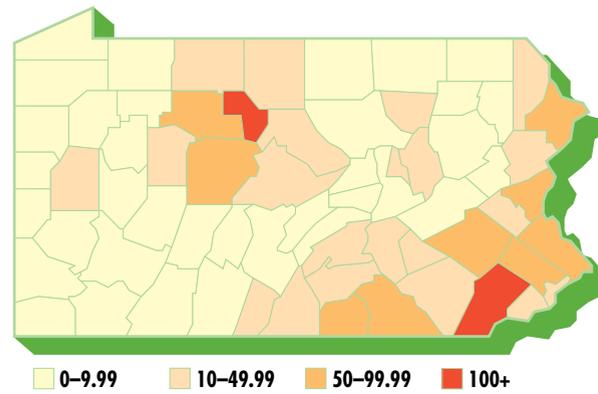
The larval and nymphal stages of the tick are no bigger than a pinhead (0.75 to 1.5 millimeters on average). Adult ticks are only slightly larger, with females averaging about 2.5 millimeters. Research in the eastern United States has indicated that, generally, ticks transmit Lyme disease to humans during the nymphal stage, probably because nymphs are rarely noticed on a person's body due to their small size. Thus, the nymphs

PENNSTATE



COLLEGE OF AGRICULTURAL SCIENCES  
AGRICULTURAL RESEARCH AND  
COOPERATIVE EXTENSION

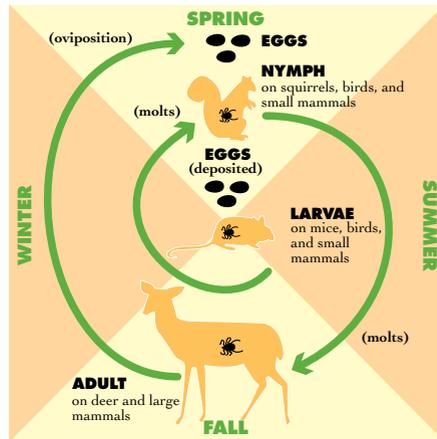
*Pennsylvania Lyme disease five-year averages of incidences, 2002–2006 (cases per 100,000 population)*



**LIFE CYCLE OF THE DEER TICK**

Knowing about the tick’s life cycle is important in understanding the risk of acquiring Lyme disease and finding ways to prevent it.

Adult female ticks lay eggs in the spring. The eggs hatch into larvae during the summer. Larvae feed on mice and other small mammals and birds in the summer and early fall. They then are inactive until the following spring when they molt into nymphs. Nymphs feed on small rodents and small mammals and birds in late spring and summer. They molt into adults in fall and seek hosts, usually deer, completing the two-year life cycle.



Larvae and nymphs typically become infected with Lyme disease bacteria when they feed on infected small animals, particularly the white-footed mouse. After molting, these infected nymphs and adults feed again and may transmit the spirochete to their new host.

Nymphal ticks are most likely to be found during the early summer months (May through July). Adults may be found nearly year-round but particularly in the fall and early spring.

**SYMPTOMS AND SIGNS OF LYME DISEASE**

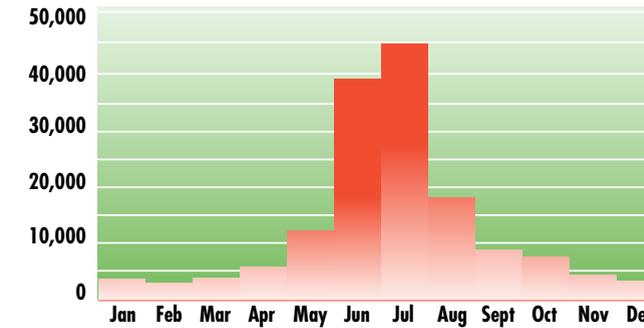
The early stage of Lyme disease is usually marked by flulike symptoms (fatigue, chills, fever, headache, muscle and joint pain, swollen lymph nodes) and a rash. The rash, called erythema migrans, is the most characteristic symptom of Lyme disease, occurring in 60 to 80 percent of patients. It begins as a red circular patch, generally at the site of the tick bite, which appears 3 days to 1 month after the bite. The patch then expands to a diameter of 2 to 12 inches or more. Common areas for the rash to appear are the thigh, groin, trunk, and armpits. The center of the rash may clear as it enlarges, resulting in a ringlike appearance. It is usually not painful. Some people with Lyme disease have multiple erythema migrans. This is termed early, disseminated Lyme disease.

In late-stage Lyme disease, symptoms may occur weeks, months, or even years later. These symptoms include arthritis; migratory pain and swelling in the large joints, especially the knees; and nervous system abnormalities including numbness, pain, Bell’s palsy (paralysis of the facial muscles, usually on one side), and meningitis. Occasionally, irregularities in heart rhythm may occur.



*Bite site of Lyme disease-carrying tick*

*Reported cases of Lyme disease by month of illness onset, United States, 1992–2004*



**DIAGNOSIS AND TREATMENT**

Lyme disease is often difficult to diagnose because its symptoms mimic those of many other diseases. Diagnosis of Lyme disease should take into account a history of possible exposure to ticks, especially in areas where Lyme disease is known to occur; clinical symptoms and signs; and the results of blood tests. Blood tests are most useful during the later stages of illness, but even then, they may give inaccurate results.

The disease is treated with antibiotics under the supervision of a physician. Patients treated in the early stages usually recover rapidly and completely. Most patients who are treated later in the disease also respond well, and full recovery is the rule. In a few patients who are treated for Lyme disease, symptoms of persisting infection may continue or recur, making additional antibiotic treatment necessary.

**PREVENTION**

*Tick detection and control*

Sweeping or dragging your yard using a white cloth can help determine if you have a high tick population. Attach the cloth to a dowel and sweep or drag it over the vegetation, then inspect the cloth for ticks.

Removing firewood and clearing leaves, brush, and tall grass from around houses and at the edges of gardens may aid in reducing the blacklegged tick population.

In some areas, acaricides (chemicals toxic to ticks) are applied to gardens, lawns, and the edges of woodlands, but questions remain regarding their effectiveness and environmental impact on nontarget

organisms. A licensed professional pest control expert should supervise large-area acaricide applications.

**Protecting yourself from tick bites**

The chances of being bitten by a deer tick can be reduced with a few precautions:

- Avoid tick-infested areas, especially in May, June, and July.
- Wear light-colored clothing so that ticks can be spotted more easily.
- Wear long-sleeved shirt and pants.
- Spray insect repellent containing DEET on clothes and exposed skin (not the face).
- After being outdoors, remove clothing and wash and dry it at a high temperature. Inspect body carefully. Remove attached ticks with tweezers, grasping the tick as close to the skin surface as possible and pulling straight back with a slow steady force; avoid crushing the tick’s body.

**IF YOU’RE BITTEN BY A TICK...**

Antibiotic treatment to prevent Lyme disease after a known tick bite may not be warranted. Physicians must determine if the advantages of using antibiotics outweigh the disadvantages in any particular instance. If antibiotics are not used, physicians should alert patients to the symptoms of early Lyme disease and advise them to return for reevaluation if symptoms occur.

For further information, contact the Penn State Department of Entomology at 814-865-1895, your physician, the Penn State Cooperative Extension office in your county, or the local health department.

*Prepared by Steve Jacobs, senior extension associate.*

Visit Penn State’s College of Agricultural Sciences on the Web: [www.cas.psu.edu](http://www.cas.psu.edu)  
Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

This publication is available from the Publications Distribution Center, The Pennsylvania State University, 112 Agricultural Administration Building, University Park, PA 16802. For information telephone 814-865-6713.

This publication is available in alternative media on request.

Penn State is committed to affirmative action, equal opportunity, and the diversity of its workforce.

Produced by Ag Communications and Marketing

© The Pennsylvania State University 2008

Code# UF006 REV6/08-acg 3862