LYME DISEASE IN CALIFORNIA

Lyme disease is a potentially debilitating and sometimes chronic infection transmitted to humans and other animals by certain ticks. The disease is caused by a spirochete, *Borrelia burgdorferi,* a corkscrew-shaped kind of bacterium. Of the 48 tick species found in California, the western black-legged tick, *Ixodes pacificus* (Fig. 1), is the only tick thought to be responsible for transmitting the spirochete to people. On average, only about 1 to 2% of the adult *I. pacificus* ticks and 2 to 15% of the nymphs are infected in California. In one woodland site in Mendocino County, however, 41% of the nymphs were found to contain Lyme disease spirochetes. A different but closely related tick species, *I. scapularis*, transmits spirochetes that cause Lyme disease in the northeastern and upper midwestern United States, but that tick does not occur in California.

First recognized in the mid-1970s in Lyme, Connecticut, Lyme disease has been reported in the United States, Canada, and in many European and Asian countries. The first Californian report of the disease appeared in 1978. State health authorities began monitoring this disease in 1983 and designated it a reportable disease in 1989. Since then, 1,938 cases have been reported in California through 1999 (Fig. 2). Of the 140 cases reported in 1999, the highest incidence per 100,000 people was in Trinity and Humboldt counties.

All ticks have three stages that feed on the blood of vertebrates: two immature stages (larva and nymph) and the adult stage. In California, only the nymph and the adult female are important in transmitting the Lyme disease spirochete to humans. People appear to be most at risk in spring until about midsummer, especially from April through July, when nymphal ticks are abundant. The nymphs (Fig. 1) live in leaf- and fir-needle litter areas in mixed hardwood forests. Unlike the adult ticks, nymphs do not climb on low vegetation while seeking a blood meal. The nymphs live within and beneath litter on the forest floor so any activity that places people in direct contact with shed leaves or fir-needles (e.g., gardening, picnicking, sitting, or lying down) may elevate the risk of contracting this disease. Nymphs are especially attracted to lizards but also feed on birds or small mammals. Once they attach to a host, the nymphs feed for about 3 to 5 days before they detach and drop off. They molt to the adult stage weeks or months later.

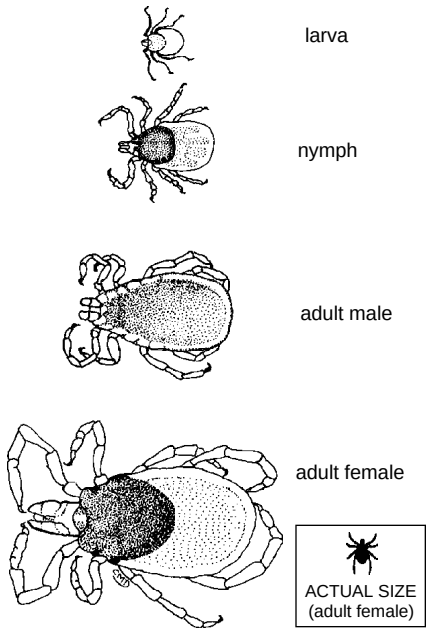

Figure 1. Western black-legged tick.

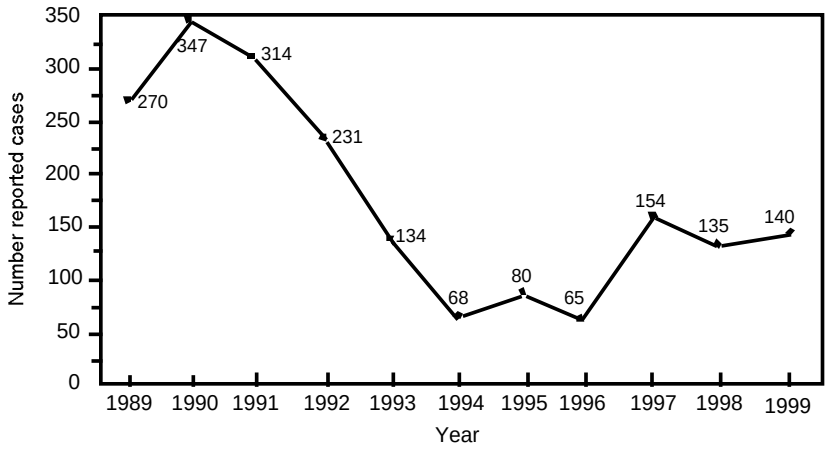

Figure 2. Lyme disease cases reported to the California Department of Health Services, 1989–1999.

Adult ticks are most active from late fall to early spring, but particularly in winter. They climb low vegetation such as grass or brush and lie in wait for hours or days while seeking their preferred medium- to large-sized hosts (e.g., rabbits, dogs, deer, and occasionally humans). It has been shown that about 85% of the adult ticks that infest the clothing of people walking through grassland do so between the ankle region and the knee. Therefore, when outdoors, individuals should frequently inspect their pant legs to detect and remove ticks before they have a chance to attach to skin. After attach-

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ing to a host, adult females ingest blood for about a week, engorging up to nearly four times their original body length. They then drop off the host and eventually deposit about 900 to 1,000 eggs in soil. Adult males rarely attach to people, feed little, and therefore are unimportant as carriers of disease organisms to humans or other animals.

People are more apt to be exposed to the adult ticks at certain times of day (morning/late afternoon versus midday); in fringe areas where two vegetational types merge (e.g., where grassland abuts with either brush or forest); and, in hilly areas, on low vegetation bordering the uphill instead of the downhill margins of hiking trails and on southern versus northern-facing slopes.

Besides the bacterium that causes Lyme disease, various ticks in California occasionally transmit at least eight other microbial agents of human disease such as those causing Colorado tick fever, Rocky Mountain spotted fever, relapsing fever, tularemia, or babesiosis. Mounting evidence suggests that the western black-legged tick is a primary transmitter of another recently recognized bacterial disease, ehrlichiosis, which is sometimes fatal. Thus, if a tick is tested for presence of Lyme disease spirochetes and is found to be uninfected, the possibility still exists that it could have been infected with another disease agent.

Commonly used antibiotics usually cure Lyme disease if administered within the first few weeks of infection. If treatment is delayed, however, the disease may progress to arthritic, neurologic, or cardiac problems weeks to months later. A vaccine to protect against Lyme disease was approved for human use in December 1998. However, the vaccine is registered for use only by individuals 15 to 70 years of age, it is about 76% effective after three doses, and it does not afford protection against other tick-borne diseases. In addition, the spirochetes are quite diverse in California, and research is underway to determine if more than one kind of spirochete can infect people. For these reasons, vaccinated individuals should continue to employ personal protective measures whenever they venture outdoors. If you spend much time outdoors in tick-infested areas, you can significantly reduce the risk of disease by taking a few simple precautions:

- Know how to recognize the western black-legged tick (Fig. 1). The nymph is about the size of a poppy seed (1/25 inch long) in its unfed state. It has four pairs of legs, a dark brownish black plate on its back, and a light-colored abdomen. The unfed female is about 1/8 inch long, has long mouthparts, brownish black legs, a dark brownish black plate that covers the anterior half of its back, and a reddish orange abdomen. Attached females may expand to 3/8 inch or longer while feeding. At 1/10 inch, adult males are smaller than females, somewhat oval shaped, and brownish black.

- Know where the ticks occur. The western black-legged tick is the most widely distributed of the 48 species of ticks known to occur in California. In fact, it has been recorded from 55 of the 58 counties. The adults are commonly encountered in grassy or brushy areas and along the margins of trails in parklands and wildlands, in semi-rural communities, and even in some suburban areas that support peri-domestic populations of deer and other wildlife, particularly in coastal counties and the foothills of the Sierra Nevada Range. The nymphs have been found exclusively in leaf/fir-needle habitats in deciduous, mixed hardwood forests.

- Dress appropriately. Wear full-length pants and a long-sleeved shirt in tick-infested areas. Ticks are easier to spot against light-colored clothing. Tuck your blouse or shirt into your pants, and tuck pant legs into boots or socks.

- As an added precaution, commercially available repellents or pesticides can be sprayed on skin or clothing. Follow the manufacturer's instructions carefully. Water or perspiration can wash repellents from your skin, so they may need to be reapplied after swimming or perspiring heavily.

- Inspect your clothing and exposed skin for ticks at least once an hour. Ticks may attach anywhere on the body, but on fully clothed persons they often attach to the scalp, behind an ear, or to an arm or leg. Pay particular attention to these areas when examining yourself or others.

- Check your pets after they have been outside because dogs and cats can carry ticks indoors. To protect your pets, use a commercially available tick collar or consult your veterinarian about some of the latest pesticides registered for controlling ticks on dogs or cats.

TICK REMOVAL

If you find an attached tick, remove it immediately. Prompt removal of infected ticks can prevent Lyme disease and other tick-borne diseases. Although research suggests that *I. pacificus* nymphs require 2 or more days of attachment to begin transmitting spirochetes to a host, other tick-borne agents (e.g., Colorado tick fever, Rocky Mountain spotted fever) may be transmitted within the first day.

Grasp the tick's mouthparts as close to the skin as possible with a pair of tweezers. If tweezers are unavailable, use your fingers, but protect them with tissue paper. Be careful not to squash a fed or partially fed tick because spirochetes released in fluids from a crushed tick may penetrate the unbroken skin or the bite wound.

Slowly and steadily pull the tick straight out. Remove any mouthparts that break off in the wound (consult a physician if necessary). The mouthparts may be contaminated with other bacteria that can cause painful secondary infections.

Do not jerk or twist the tick as you extract it. Do not apply alcohol, fingernail polish, heat from a lit match, or petroleum jelly to the tick; these methods are completely ineffective. Applying heat may actually propel disease

Figure 3. Erythema migrans, the skin rash common in the early stage of Lyme disease, is shown here developing in the knee area.

agents into the bite wound by inducing the tick to regurgitate or secrete saliva.

Clean the wound with soap and water. Apply a mild antiseptic such as povidone-iodine, if available.

Whenever an attached tick is removed from a person, it should be saved for later identification in case the person experiences an illness within a month of the bite. Most people who contract Lyme disease or other tick-borne diseases usually become ill within 1 to 2 weeks after being bitten. Acarologists (scientists who study ticks and mites) and entomologists employed by governmental agencies (e.g., state and local health departments, mosquito and vector control districts) or universities may be available to assist with tick identifications.

DISEASE MANIFESTATIONS

For light-skinned persons, Lyme disease begins in up to 60 to 80% of patients as a slowly expanding, reddish rash known as erythema migrans (Fig. 3) 3 to 32 days after the bite of an infectious tick. The rash, if present, may be obscure on dark-skinned patients. However, 50% or more of Lyme disease patients may not recall having been bitten by a tick. Attached nymphal ticks are particularly prone to be overlooked because of their smaller size and reduced feeding time as compared with adult female ticks. The rash typically begins at the wound site and may expand slowly to several inches in diameter before disappearing within 3 to 4 weeks. Antibiotic treatment hastens disappearance of the rash, which may vanish in about a week. Many victims experience fatigue, headache, fever, chills, and other flulike symptoms during the initial stage of illness.

Days to weeks later, a variety of other clinical manifestations may occur singly or in combination. These can involve the skin (secondary rashes), musculoskeletal system (migratory pain in joints, tendons, muscles, or bones), neurologic system (headache, facial palsy, memory loss), lymphatic system, heart, eyes, liver, respiratory system, or kidneys.

Finally, late (persistent) infection normally begins a year or more after onset of the disease, and may involve arthritic, neurologic or further skin manifestations, profound fatigue, or inflammation of the cornea in the eyes.

Dogs, horses, and other domesticated animals susceptible to Lyme disease may develop arthritis or lameness, lethargy, loss of appetite, disease of the lymph nodes, or other conditions after being infected. If you suspect that your pets or livestock have Lyme disease, or if you wish to consider protecting your dog(s) with one of the commercially available Lyme disease vaccines, consult a veterinarian.

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For more information contact the University of California Cooperative Extension or agricultural commissioner's office in your county. See your phone book for addresses and phone numbers.

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