

Biology and Public Policy of Lyme Disease at Fire Island

By James G. Northrup

In 1975, two women from Lyme, Conn., called their State Health Department to report a strange phenomenon. The first said her daughter had been diagnosed as having juvenile rheumatoid arthritis and that 11 other children in the same community had been similarly diagnosed. The second woman said four members of her immediate family had arthritis, from children to adults. Investigating these and other reports, medical researchers discovered a new, rapidly spreading zoonosis, now known as Lyme Disease.

Transmitted by the bite of an infected tick, Lyme Disease (LD) now affects several NPS areas, and others are certain to be affected as the disease spreads and awareness increases. The disease has been reported primarily from three recognized endemic areas; the coastal areas of the northeast (Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island); the midwest (Minnesota, Wisconsin); and the west (California, Nevada, Oregon, Utah). Isolated cases have been reported in Arkansas, Florida, Georgia, Indiana, Kentucky, Montana, North Carolina, Tennessee, Texas and Virginia.

In addition to causing serious medical problems, LD poses a whole series of questions for managers of public lands, particularly NPS areas. What can be done to control the disease? What scientific research is needed before sound management decisions can be made? In a National Park, what environmental manipulations, if any, are reasonable to manage this public health problem? What obligation do park managers have to warn visitors and employees about this "natural" hazard? To what degree is the government liable for visitors and employees who contract LD while working or recreating in the park?

Cause

The causative agent of LD is a microscopic spiral shaped bacteria, the spirochete *Borrelia burgdorferi*. In the east and midwest the tick vector is *Ixodes damini* (Northern Deer Tick), in the west *Ixodes pacificus* (California Black-Legged Tick). These species are much smaller than common wood or dog ticks. There is strong evidence that Lone Star ticks (*Amblyomma americanum*) can also transmit the disease and that deer flies, horse flies, mosquitoes and other blood-feeding arthropods serve as secondary vectors. Needing tissue fluids and blood for development, ticks spend their entire lives as parasites. Immature *Ixodes* ticks attach to a variety of hosts, although the white-footed mouse (*Peromyscus leucopus*) is the most frequently parasitized. The vast majority of adult *Ixodes* ticks however, are found on white-tailed deer (*Odocoileus virginianus*), and thus the common name. While both the nymph and adult can transmit the disease to man, it appears the nymph is the more common vector, as it is actively feeding during the warm months, when people are also active outdoors, and because of its small size, which makes detection difficult.

Distribution

The presence of *Ixodes* ticks seems to depend upon white-tailed deer, although there is some evidence of transport of the ticks to new areas by birds. In the east and midwest for example, wherever *Ixodes damini* is abundant, deer are abundant as

well. Some researchers now hypothesize that *I. damini* was once widely distributed across the northeastern quadrant of the U.S., but virtually disappeared with the demise of the deer herds caused by deforestation and overhunting, surviving only in certain isolated areas where deer remained abundant. Consequent to the relatively recent explosion in deer populations in the country, the tick population appears to be regaining its original broad distribution. It is ironic that what has been a widely heralded success of state wildlife agencies – the proliferation of deer herds to greater than pre-Columbus levels – may turn out to be a disaster for public health. While there is strong evidence that the abundance of *I. damini* is limited largely by the abundance of deer, ecologists warn against the apparent quick fix of reducing or eliminating deer herds. By eliminating the preferred host, ticks may seek out another large mammalian host, increasing the incidence of Lyme Disease in man even further. Other environmental factors that may limit tick distribution, such as temperature, humidity, vegetational and physiographic features, must be evaluated as well.

Symptoms

The most characteristic sign of Lyme Disease is a skin lesion (known as an erythema chronicum migrans, or ECM), appearing 3 to 25 days after the victim has been bitten by an infected tick. Although highly variable, the lesion usually begins as a red spot, approximately two inches in diameter, often with a clear center, giving it a bullseye appearance. Within a few days, the rash can expand up to 10 to 15 inches, and in some patients will expand to where it is no longer recognized as a ring. Several lesions may appear simultaneously; some patients never develop the lesion. The ECM may be accompanied by fever, chills, headache, malaise, and enlarged lymph nodes, but will generally subside, even without treatment, within a few weeks.

If left untreated, serious complications may appear weeks, even months after the initial lesion, including arthritic, neurologic and cardiac complications. The

arthritic complications, which afflict two thirds of the patients, generally involve one or more of the large joints, and are often migratory. Attacks typically last about a week and can recur for several years. The neurological symptoms mimic other diseases and can occur from two days to three months after the appearance of the skin lesion. Typical symptoms include headache, stiff neck, intolerance to light, nausea, vomiting, sleepiness and a feeling of laziness, partial facial paralysis (Bell's palsy), spasmodic movements and incoordination and laziness of the eyes. Patients with LD who develop cardiac problems may have no prior history of heart disease. Cardiac complications almost always include some form of heart block and may include shortness of breath, rapid and strong heart beats and temporary heart and respiratory stoppage.

Diagnosis

Diagnosis is generally based on the presence of the ECM lesion and the associated symptoms. Cases outside the endemic area, atypical cases or cases presenting only late manifestations are difficult to diagnose, since many physicians are not familiar with the disease. Misdiagnosis is common. Several laboratories have developed a serologic test that measures the presence and level of antibodies against the spirochete. When the ECM is present, only about 50 percent of patients will have a positive test, as the body has not yet produced the antibodies to a level that can be detected. Patients with advanced symptoms, almost always react positively to the test.

Treatment

The optimal treatment for Lyme Disease has not yet been fully defined, and there is some disagreement among medical practitioners. Treatment with high dosages of broad spectrum antibiotics such as penicillin, tetracycline or erythromycin have proven effective in reducing the duration of the skin lesion and in reducing the onset of later complications. Intravenous administration of antibiotics has been required for a number of patients who either did not respond to the initial treatment or who display advanced symptoms.

Public Policy Questions

The public policy questions are complex and involve divergent public interests. NPS management policies concerning health and safety, natural re-



The vector for Lyme Disease in the east and midwest is the Northern Deer Tick, here shown with the female on the right, the smaller male on the left.

source and wildlife management, integrated pest management, use of pesticides, vegetation management, wilderness management and a variety of legal liability questions all come into play.

To address these issues, Fire Island NS, in cooperation with the Centers for Disease Control, The New York State Department of Health, and local authorities, has implemented a management comprehensive program. Scientific research is underway. A public education program has been initiated; a regular program for testing and treating employees has been established; research is being conducted on prevention methods, and a policy for treating affected employees and family members is in place.

Dr. Howard Ginsberg, a research entomologist with the NPS Barrier Island Research Unit at Rutgers University is currently studying the ecology of *I. daminni* on Fire Island. By examining the tick's relationships to various areas and vegetation types, trapping small mammals, collecting ticks and examining individual specimens for the presence of the LD spirochete, park management will gain useful information for decision making and planning visitor activities and future development, with an aim towards reducing exposure. As part of an on-going deer ecology study, tick and blood samples are being collected from white-tailed deer on the island and similarly examined. Dr. Ginsberg plans to study a number of eastern parks next season.

Prevention is viewed as a critical factor in the management of the LD threat, and the Centers for Disease Control is conducting a study of Seashore employees, their personal habits and actions that may increase or decrease the likelihood of attracting ticks or contracting LD.

A public education program has been initiated and a joint NPS/U.S. Public Health Service brochure on Lyme Disease has been written and will soon be available for nationwide distribution.

Legal questions surround the Service's obligation to test and treat employees, and their family members. Employees in required occupancy situations and their family members are at particular risk, and even employees who live "off-island" have accidentally brought ticks into their homes. Complicating the liability question is the difficulty of proving the disease was contracted on the job. Although the Office of Workman's Compensation has not yet denied a treatment claim by a Seashore employee, this issue may one day be challenged in the courts. Some legal experts have argued that the Service has no obligation to test an employee's family members, but park management has countered that we have at least a moral obligation, and the current policy is to do so. In cooperation with the State Department of Health and researchers at the Stony Brook University Hospital, NPS employees and family members, concessioners and cooperating researchers are tested twice each year for LD.

One unanswered question is that of legal liability for park visitors who contract LD. It is probably just a matter of time before a court is looking at the Park Service's efforts to manage this spreading public health problem.

The Seashore would be pleased to share the results of our research, public information program elements or any additional information with interested parks.

Northrup is a Natural Resource Specialist at Fire Island N.S.