

Nature bites back

An ounce of biodiversity worth a pound of cure?

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June 8 — Preserving biodiversity, the infinite variety of all life forms on Earth, keeps nature's rich ecosystems intact and healthy, we are told. However, new research on Lyme disease shows that preserving biodiversity may also keep humans healthier, by reducing our risks of infectious diseases.

NOTHING sounds healthier than a walk in the woods, amid grassy meadows rich with deer, squirrels and chipmunks. Yet throughout the Northeast, in places from Dutchess County, N.Y., to Old Lyme, Conn., where Lyme disease was first discovered, a walk in nature is viewed as a walk with the dreaded deer tick.

Since it first made news in Connecticut, the disease has since been reported in 49 states, with most cases occurring from Massachusetts to Maryland, in Wisconsin and Minnesota, and in California and Oregon. It now accounts for 90 percent of all insect-borne diseases in the United States. Between 10,000 and 17,000 cases are reported each year by state health departments to the Centers for Disease Control and Prevention (CDC) and those cases have grown about 25 times since national surveillance began in 1982.

Why Lyme has exploded so virulently is largely a mystery, though, early on, the disease was traced to ticks that feed on deer and mice, among other hosts. Few Lyme sufferers understand the complex microbiology of this disease, caused by a spirochete, or spiral-shaped, bacterium that invades the body much like syphilis. But its usual hallmark is unmistakable: a red skin rash spreading in a "bull's-eye" from the site of a tick bite. It produces flu symptoms that often lead to arthritis, joint diseases and depression, as well as even severe neurological, cardiac and ocular damage.

ECOLOGICAL CLUES

Tantalizing clues in the mystery of this disease are coming not from medicine but ecology, with a new study suggesting that the roots of the disease may lie in disrupted natural cycles and land changes wrought by man. In an article in the June issue of the journal *Conservation Biology*, ecologists Richard S. Ostfeld and Felicia Keesing suggest that people are less likely to contract Lyme disease if they live in areas with a greater diversity of small mammals.

Scientists have long maintained that preserving biodiversity preserves the stability of ecosystems and interactions between species that have yet to be thoroughly explained or understood by human beings. Many believe species should be preserved for no other reason than the ethical principle that they have a right to exist that goes beyond their use to us.

Others have advanced arguments that biodiversity ultimately works to the benefit of human beings, using catchphrases like "nature's pharmacy" and "nature's supermarket" to describe how nature supplies us with most prescription drugs and certainly the basis of our food supply. But there has been little study to date on the complex role biodiversity may play in reducing infectious diseases, though many suspect it could play a big role.

“As we mess around with the web of life, we have to expect big changes in our susceptibility to disease,” said Gretchen Daily, a biologist at Stanford University.

Ostfeld and Keesing, researchers at the Institute of Ecosystem Studies in Millbrook, N.Y., took the long view in examining the exploding incidence of Lyme disease. They asked: why is the infection prevalence hitting the Northeast so much more fiercely than Europe or other parts of the United States? What differences in habitat might account for this?

SPECIES DIVERSITY

The boom in tick populations, they hypothesized, might be related to the area’s overall species diversity. If an area had less diversity of species, they supposed, and a smaller assemblage of potential hosts for ticks, there might be a greater chance of people becoming infected. To test this theory, they tallied the numbers of ground-foraging and nesting birds, small mammals and lizards along the eastern seaboard from Maine to Florida, where the deer tick occurs, and compared the species density to cases of Lyme disease reported. They found that the incidence of Lyme disease dropped in areas of the East Coast with greater diversity of small mammals.

“It was a simple exercise in logic — when there was a whole range of hosts available, the ticks didn’t have to take their “blood meals” from humans,” said Ostfeld.

Most research on the disease so far, says Ostfeld, has consisted of medical studies looking at its diagnosis and treatment. While there is a wealth of ecological studies on ticks, none have looked at the ecology of ticks and the ecology of the host community (the whole group of mammal, bird and reptile hosts for ticks) as well as epidemiology (the study of disease in human populations).

Lyme disease was first discovered in the mid-1970s when it began to strike young children of upper middle-class families, who championed the cause of fighting the illness. Once the deer tick was isolated as the culprit, researchers lost interest in the other hosts in the forest, says Ostfeld, “but to us, this was the important part.” Birds, lizards and other small mammals of the forest, largely unaffected by the tick bite, kept the disease safely within their communities.

In the Northeast, the white-footed mouse has been the primary host because 40 to 50 percent of larval ticks feeding on the mouse acquire the disease. And these mice are growing in numbers, as their predators have disappeared. The “*Ixodes scapularis*” ticks of the East are often referred to as “deer ticks” because they latch on to deer in the adult stage, but they also attach to mice in their larval and nymph stages, when they have a greater chance of being infected by the mice and transmitting the disease to people.

In the West, ecologists have found a lower incidence of these ticks where a particular lizard, the western fence lizard, carries a protein that gives it a particular immunity.

If areas more infected by Lyme are also more abundant in white-footed mice, typically the most abundant vertebrate, how do we reduce their numbers? The answer, says Ostfeld, is to try to preserve the species richness of residential areas. “If developers of new housing have a choice between carving up land into fragmented lots versus clustering them to keep larger areas of continuous forest or natural habitats, they might choose the latter as a hedge against Lyme disease.”

POSSIBLE SOLUTIONS

Restocking the forest with wild animals that are natural predators may be difficult, if not impractical, says Ostfeld. Reforesting would be a solution, “because once an area is reforested, the creatures usually return from nearby habitat.” Though difficult, Gretchen Daily argues, reintroduction can be done. “In parts of Italy, they’re consciously reintroducing wolves and other species to rebalance populations,” she said.