Cary scientist reviews Lyme disease ecology

When it comes to Lyme disease, opossums are your friends and mice are your enemies. That was one of the messages imparted by Dr. Richard S. Ostfeld, a disease ecologist at the Cary Institute of Ecosystem Studies, in a public talk Friday night.

Ostfeld delivered a fascinating natural history of Lyme disease, starting with the life cycle of blacklegged ticks, moving through various animals that can provide the ticks' "blood meals," and finishing with a convincing argument for maintaining biodiversity in local forests. He also related his research to other emerging diseases such as West Nile virus and various parasites and fungi afflicting animals and plants.

Humans get Lyme disease from bacteria transmitted by blacklegged ticks, formerly known as deer ticks. These ticks are born free of the infection, though; they pick it up from infected mammals when they have their blood meal—a 3-day feeding frenzy that occurs once and on a single host during each of three life stages: larval, nymphal, and adult—3 meals in all.

A number of different mammals can carry the bacterium that causes Lyme disease, Ostfeld said, including shrews, chipmunks, and white-footed mice. Some birds are also hosts.

Since the mid-1990s, Ostfeld and colleagues at the Cary Institute and other academic organizations have conducted extensive research on the effectiveness of these various hosts producing infected ticks that can give us Lyme disease. They learned that for each host animal, certain factors are important: how many ticks they feed, how many ticks they kill, and the percentage of feeding ticks they infect. The difference between mice and opossums soon became evident: 50 percent of ticks on mice feed to repletion, while only 3.5 percent did so on opossums. A mouse would kill 50 larval ticks while an opossum would kill more than 5,000. And while 92 percent of ticks that successfully feed on an infected mouse become infected, less than 10 percent of ticks feeding on opossums do so.

It became clear to the audience that from a human point of view, it is preferable for ticks to feed on opossums than on white-footed mice. And that's where biodiversity comes in. Ostfeld and his colleagues ran computer simulations of landscapes with different animal populations. If we could remove white-footed mice from a landscape, his calculations showed, we would have a 75 percent reduction in infected nymph ticks. Those are the ticks most likely to infect humans, as they are smaller and less detectable on our bodies than adult ticks; they are also active in the summer when we are most likely to be outside.

But removing white-footed mice from a landscape is nearly impossible. They are resilient and thrive in small, disturbed fragments of forest where larger species, like opossums, have disappeared. And when opossums are removed, Ostfeld said, we see a 30 percent increase in infected nymph ticks.

Lyme disease, first identified in the mid-1970s, is one of an astonishing 335 infectious diseases that have emerged since 1940. In a map of the United States showing Lyme disease prevalence in increasingly darker colors, our region of southeastern New York was covered in black, meaning that it is one of the three hot spots for Lyme disease in the country. Another map showed Dutchess County as a mosaic of small patches of forest mixed with larger areas of non-forest landscape, precisely the type of landscape that supports mouse populations but not larger mammal species.

> Our region of southeastern New York [...] is one of the three hot spots for Lyme disease in the country.

A landscape with multiple species that host the Lyme disease bacterium will see fewer human cases of the disease than a landscape with just white-footed mice. Ostfeld called this the Dilution Effect, and he applied the concept to West Nile virus, a disease which is transmitted to humans from birds and which is prevalent in urban areas with reduced bird biodiversity. He also quickly reviewed other diseases, including a fungus that affects ryegrass, and showed the Dilution Effect at work when fields planted with multiple species had a reduced severity of the disease as compared to fields planted with just the ryegrass.

"The dilution effect is the protective role that biodiversity plays," said Ostfeld.

Friday's audience left with a new appreciation of why it is important to preserve the diversity of plants and animals in natural ecosystems.