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the tick-borne disease equation, with dr. rick ostfeld of cary institute

(https://i1.wp.com/awaytogarden.com/wp-content/uploads/2015/04/ticks-with-cary-institute.jpg)NOW THY ENEMY, right? But how much (beyond the general fear and loathing) do you actually know about ticks? For example: that a tick isn't born infected with Lyme or other disease, and that we should thank fox, opossums and even raccoons for their positive roles in reducing tick populations?

Longtime disease ecologist Dr. Richard Ostfeld (http://www.caryinstitute.org/science-program/our-scientists/dr-richard-s-ostfeld) of Cary Institute of Ecosystem Studies took me through the complex system of animal interactions, the effects of a warming climate, and other factors in the tick-borne disease equation, including advice on when and how to be alert.

Admittedly, most of the pests readers ask me about are ones that feast on plants, but this one is not phytophagous but rather hematophagous, feasting on blood:

“Ticks: the foulest and nastiest creatures that be.”

So said Pliny the Elder, the Roman scholar who wrote a massive natural history of the world in the first century AD. Ticks have been on the planet far longer; some experts say for about 120 million years.

For about the last 20, scientists at the nearly 2,000-acre Cary Institute (http://caryinstitute.org) in Millbrook, New York, have collected hundreds of thousands of ticks, seeking to understand how environmental conditions influence the infectious-disease risks that ticks are implicated in. Ostfeld heads that tick research at Cary Institute (http://www.caryinstitute.org/discover-ecology/lyme-and-other-tick-borne-illnesses), and I was happy to welcome him to my public-radio program, just as what gardeners and others who love the outdoors often call tick season begins.

Listen in to our conversation on ticks and tick-borne disease using the player below, or at this link (it’s the April 27, 2015 show), or read along—or both.

(https://i1.wp.com/awaytogarden.com/wp-content/uploads/2012/08/tick-on-fingertip.jpg)

read/listen: understanding ticks

a q&a with dr. richard ostfeld

Q. How long have you been researching ticks?

A. It's been going on almost ever since I arrived at the Institute in 1990. I was trained as a mammal ecologist, and what we mammal ecologists do is that many of us go out and trap small mammals and other kinds of creatures. Here at the Institute I noticed back in 1991 or so that the mice (http://www.caryinstitute.org/science-program/research-projects/lyme-disease) in the Hudson Valley were just covered with ticks.

That was alarming and interesting to me, and I have been pursuing it ever since.

(https://i1.wp.com/awaytogarden.com/wp-content/uploads/2015/04/KS5Iu3rnQtc0LMmoooop88Q_gjCEGhDx3WqTGIq7PWgUmeIBbafBOkByq7kZCps-7wszGydYueERhy3uRdZ8Hw.jpg)**Q. What's the current direction of the work—do new things keep revealing themselves?**

A. All the time; I would get bored if the same thing were going on for 23 years. **[Laughter.]** There are new things all the time: We've made some discoveries of how acorn production by our oak trees that are so common in our forests are driving the mouse and chipmunk populations through ups and downs, and how that drives the tick and pathogen population (http://www.caryinstitute.org/science-program/research-projects/pulsed-resources-and-consumer-communities-terrestrial-systems) through ups and downs.

Recently we've been getting very interested in how predators control our risk of exposure to Lyme disease and other tick-borne diseases—and that reminds me of yet another interest:

We always seem to be discovering new tick-borne diseases (http://www.cdc.gov/ticks/diseases/) every few years, a new pathogen. They're not actually new, but just newly discovered, and they make people sick. Each time one is discovered, we start to pursue it.

Q. Let's backtrack to a little basic tick biology, and how many tick species there are. They're not insects, for instance, are they?

A. A lot of people do think they're insects, even people who know a lot of natural history. They're more closely related to mites and spiders, so they're not insects at all. The adult stage has eight legs, not six as insects do.

There are dozens of species of ticks in North America and hundreds more throughout the world, but only a handful of them are really important vectors (http://www.cdc.gov/ticks/geographic_distribution.html) of human disease.

The main one in the Northeast and Upper Midwest and other parts of the Eastern half of the U.S. is the black-legged tick, *Ixodes scapularis*. There's a Western relative of the black-legged tick that lives in California.

Q. I've been reading work from UC-Berkeley lately exploring animals' relationships to the Western black-legged tick.

A. I've been involved in some research in California that looks at the importance of the Western fence lizard (http://rspb.royalsocietypublishing.org/content/278/1720/2970) and more recently research about birds (http://entomologytoday.org/2015/03/10/birds-identified-as-hosts-of-lyme-disease/), which seem to be importing these Western black-legged ticks into some urban and suburban neighborhoods in the Bay Area and elsewhere.

Q. So there are many tick species on the planet, but a relatively small number are implicated in the diseases that are of concern to us. Can we talk about how mammals, like the white-footed mouse, are part of the disease cycle? People always talk, especially when it comes to Lyme disease, about "deer tick." And that's not really the right association, is it?

A. That's the common name that many people use, but it's not actually a correct one. There are rules for naming species—certainly gardeners know this well, and there can be a lot of confusion without such rules. In the animal world we have rules, and deer tick is not the correct name—it's actually the black-legged tick.

The reason it was called the deer tick is because shortly after the emergence of Lyme disease in New England in the 1970s and early 80s, scientists thought they were dealing with a brand-new, newly described species of tick, and so they named it: They gave it a scientific name and a common name, the deer tick.

Only about 10 years later was it realized that it wasn't in fact a new species at all, but just a Northern population of a species that had been described 200 years ago, the black-legged tick. There's a rule of precedence, and so it was the black-legged tick.

Interestingly, in terms of the role of animals and the life cycle of importance of the disease agents, it turns out that all the ticks that transmit diseases to humans, fail to transmit these pathogens from the mother to her babies.

Every new generation of ticks hatches out of eggs free of infection.

Q. So interesting.

A. So in order to become dangerous to us, they need to acquire these pathogens somewhere. The place they get them largely is mice and other small mammals (http://www.caryinstitute.org/newsroom/small-fast-and-crowded-mammal-traits-amplify-lyme-disease-risk).

Q. So we are blaming the tick, but the tick is a messenger?

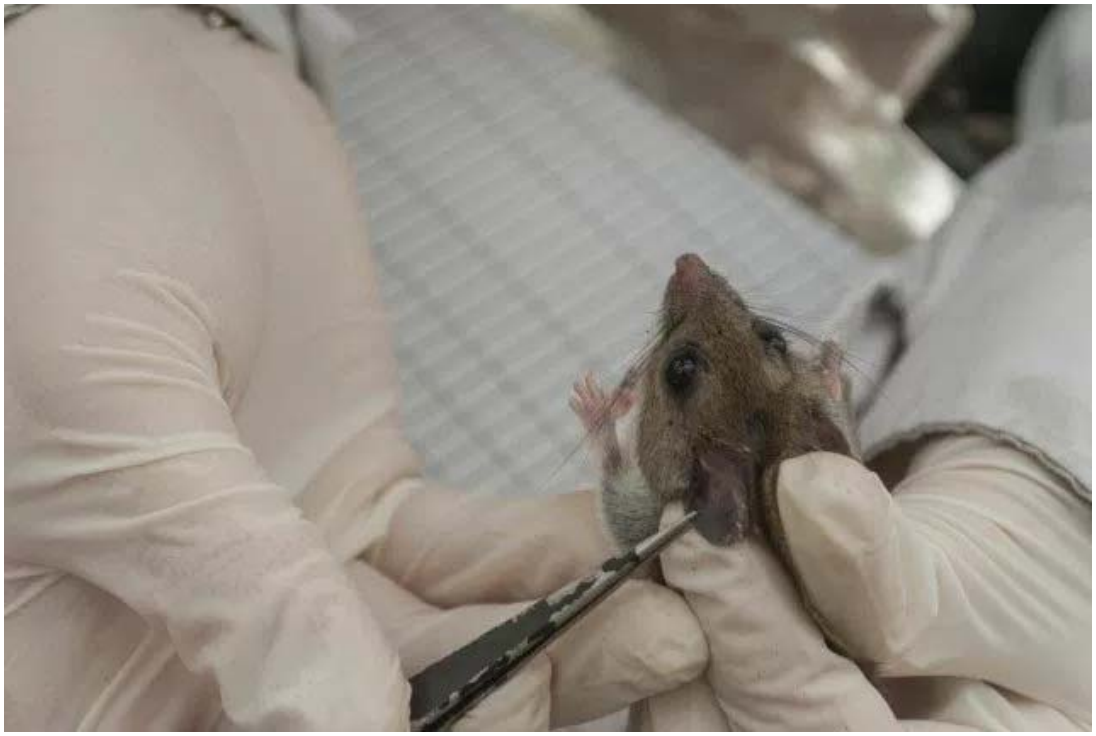
A. It's a chicken-and-egg question: The tick is the vector, the creature that's transmitting it to us, and it's acquiring it from these cute little white-footed mice.

Q. I don't think they're cute, so you don't have to be polite with me about them.

A. I wonder what Pliny the Elder thought about mice. **[Laughter.]**

I've trapped and handled tens of thousands or maybe hundreds of thousands of mice through my career, and I guess I no longer find them cute, either, but a lot of people do.

In essence their bodies are a filthy breeding ground for pathogens of various kinds, and the ticks are simply—as you put it—the messenger that transmits them to us.



(https://i1.wp.com/awaytogarden.com/wp-content/uploads/2015/04/CFwtcLQ77VsTHN4N_64rTZpUdT4VgtlHS8K8Ag-48Fo.jpg)Q. A tick doesn't come into the world infected—so when in its multistage life cycle does it get infected?

A. They hatch out of eggs into the larval stage. Those are the most tiny creatures; they're barely visible. You have no idea if they're crawling on your skin, or even if they're embedded in your skin and sucking your blood. They're that small.

If those larval ticks happen to bite a white-footed mouse, then they're highly likely to first of all survive the experience—there are other hosts that tend to kill those larval ticks by grooming. Mice are not good groomers. And those larvae feeding on mice are highly likely to acquire an infection, because mice have these pathogens floating around in their bloodstreams.

So those larvae, after feeding on a mouse or to some extent also chipmunks or even shrews, molt the next year into the nymph stage—and that's the stage that's most dangerous to people. Those are the critters that come out in May and June—coming right up—and if there are a lot of mice available for the larvae to be biting, then there will be a lot of infected nymphs about a year later.

Q. You didn't mention voles—you said chipmunks and shrews, in addition to white-footed mice. Why not voles?

A. Voles tend not to be good reservoirs for these pathogens.

Q. In my head, I would have lumped the voles with the others.

A. There is some degree of habitat segregation between them. The most common voles in North America are open-habitat critters. They like fields, meadows, open grasslands. That tends not to be where ticks are.

Q. Ticks like leaf litter.

A. They do, with an overstory of trees or at least shrubs. So there's some degree of separation.

Q. Sorry to detour us—but that made me curious.

You mentioned predators earlier. Did you mean predators of the ticks, or of the mice and chipmunks who help in the transmission equation?

A. Both would. Predators on ticks, and predators on small mammals have both been poorly studied with respect to Lyme disease. What we're focusing on now is the predators on the small mammals, the mice and chipmunks.

There are a couple of ways that these predators—and I am thinking of foxes, bobcats, raccoons, opossums (http://www.caryinstitute.org/discover-ecology/podcasts/why-you-should-brake-opossums)—some of these are really good at reducing the abundance of mice and chipmunks. That does us a huge favor, because we know that Lyme disease risk is related to how many mice and chipmunks there are running around in the woods.

The other thing that some of these predators can do, especially opossums and raccoons, is that in addition to eating some mice, they attract some ticks away from mice, and on to them.

It turns out that opossums and we suspect also raccoons, though we haven't studied them as well, are very good at killing ticks. They groom them off, swallow them, and kill them. Any tick that survives to feed on an opossum or raccoon has a very low probability of becoming infected. So even if they survive, they won't be dangerous to us.

(https://i0.wp.com/awaytogarden.com/wp-content/uploads/2015/04/pc_opossum.jpg)Q. I read an article where you used the phrase "hoovering up ticks"–that opossums hoover up ticks. They are the most curious of creatures—so prehistoric-looking, with such interesting behaviors—but I had no idea that in their diet was ticks.

A. They do the hoovering in a couple of ways—and I think I borrowed that phrase from David Attenborough, actually. They move slowly and deliberately along the forest floor.

One thing folks should realize is that ticks are a sit-and-wait parasite. They don't move very well on their own. Especially these black-legged ticks; they are wimpy crawlers. They pretty much just sit there. They are waiting for something warm-blooded…

Q. …something with a pulse? [Laughter.]

A. Something with a pulse, and feathers and fur help. If they come close, then the tick will climb on board. Opossums are this big, slow-moving, warmth-radiating, CO2-blowing creature. All of those things are attractive to ticks, so the ticks will climb onto the opossum. And then each individual opossum will hoover up hundreds or even thousands of ticks, and kill the vast majority of them because they go licking off their fur. It's curtains to those ticks, and the ones that survive—for reasons we don't understand—don't pick up the infection very readily.

Q. The other part of the predation equation are creatures that eat animals that do infect the ticks—like fox.

A. What we're looking at now is places whether there are good, healthy fox populations the same places where we see fewer infected ticks.

Q. Well, of course not being a scientist, I always want to either anthropomorphize an animal or offer anecdotal proof of something. I'm outside all the time my whole adult life, crawling around in the leaf litter, and I have been bitten by ticks but never infected with a tick-borne disease. And one of my favorite things about my garden property: I normally have a fox family. Not that it's cause and effect—just anecdotal and not scientific.

But I loved seeing this part of your research, because these are some of the animals—opossums, fox—that maybe people are afraid of, or confused by, and don't think they want around. They don't understand their place, their role, in the complex system, or the contribution these animals make.

A. I think that's a good point.

It's true that your own personal experience is an anecdote, but a whole lot of anecdotes make data, and that's what we go out and collect. If there are places like yours that have fox dens all the time, and a whole lot of other places that don't, we can compare those and actually make a strong inference using scientific methods.

One of the interesting outcomes of this: You've noticed that we've expanded from deer—many people think the tick population and Lyme disease is closely tied to deer, but we actually have not found that—to it being closely tied to mice, which it is.

But there are also a number of other players involved, protective animals. Our research has really been directed at asking: What's the role of animal diversity in influencing our health, particularly when it comes to tick-borne disease? What we find in general is that high animal diversity has a pretty strongly protective effect when it comes to tick-borne disease. Not just Lyme, but babesiosis, anaplasmosis, and these other tick-borne infections (http://www.caryinstitute.org/newsroom/small-fast-and-crowded-mammal-traits-amplify-lyme-disease-risk).

Q. So high animal diversity is good in many ways, and this is one more example.

A. That's right. Many people value diversity—we don't want to see species disappear, much less go extinct. In many cases the reasons for valuing it are ethical or moral, and rarely are they actually utilitarian: Is there something specific that this high diversity is doing for our benefit, for our well-being?

There is a lot of research going on in the ecological community asking that very question: Are there utilitarian values of biodiversity? And indeed, the more we look, the more we find examples.

Q. And these are some examples.

A. Examples that are close to home, yes.

Q. A recent paper (http://www.caryinstitute.org/publications/accelerated-phenology-blacklegged-ticks-under-climate-warming) you published looked at the effect of a shifting climate, and whether Tick Awareness Month should be pushed up to April in the Northeast, not May. Has "tick season" shifted since you started doing this research?

A. It has; we've been forced to go out earlier. This is one of the benefits of having a very long-term project. We have a weather station at the Cary Institute (http://www.caryinstitute.org/science-program/research-projects/environmental-monitoring-program), so we know from those data that our climate in this part of the world, as is true virtually everywhere, has been warming. Even over the last couple of decades, it's kind of surprising how quickly things can warm up.

We've been able to track when these ticks appear and when they peak on these mice and chipmunks that we trap between April and November every year, and we've found that the ticks are coming out earlier and earlier, the warmer it is. That's a fairly longterm trend and we expect that the peak will be up to three or four weeks earlier than it was just a few decades ago.

We think people need to be warned earlier; that May is probably too late.

Q. Your team goes out collecting ticks, but everyone else wants to repel them, so I feel compelled to ask: What's your advice, for those of us not studying ticks in the name of science? I'm big on vigilance—the body-check thing—more than DEET, but you know better.

A. The body checks do work. I would advocate for a multi-faceted approach (http://www.cdc.gov/ticks/avoid/on_people.html); there is no silver bullet. A lot of people don't like using DEET, but it is fairly effective and does repel ticks. There are sprays you can put on your clothing that are based on permethrin, and are effective in killing ticks that get onto your clothing.

Knowing what ticks look like, and where they tend to crawl—which is into soft, warm, vascularized skin, so looking all over but especially the armpit, the groin, the back of the neck. And then knowing what the early symptoms of these tick-borne diseases are like, so you seek medical attention at the early stage, and don't remain sick for long.

Q. Thank you for helping us make the bigger connection, and understand the whole cycle.

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smallest NPR station in the nation. Listen locally in the Hudson Valley (NY)-Berkshires (MA)-Litchfield Hills (CT) Mondays at 8:30 AM Eastern, rerun at 8:30 Saturdays. Or play the April 27, 2015 show right here, and also use the buttons below to subscribe to future shows, free.

more about ticks

- How the recent harsh winter with snow cover (http://www.caryinstitute.org/newsroom/harsh-northeast-winter-no-hindrance-hungry-ticks) may have protected, not killed off, black-legged ticks
- On acorn production and its effect (http://www.caryinstitute.org/science-program/research-projects/pulsed-resources-and-consumer-communities-terrestrial-systems) on small mammal populations
- On Lyme disease and mice (http://www.caryinstitute.org/science-program/research-projects/lyme-disease), from Cary Institute
- On biodiversity, and its impact on human health (http://www.caryinstitute.org/science-program/research-projects/biodiversity-community-ecology-and-dilution-effect)
- From the Centers for Disease Control, range maps (http://www.cdc.gov/ticks/geographic_distribution.html) of the important U.S. tick species
- CDC recommendations (http://www.cdc.gov/ticks/avoid/on_people.html) on repelling ticks and best practices for control

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