THE STATE OF MASSACHUSETTS'S DEER-DENSITY GOAL IS NO MORE THAN *10* PER SQUARE MILE. THE REALITY:

The Deer-Lyme Disconnect

WHY NEW HUNTING PROGRAMS AREN'T GOING TO CHECK THE SPREAD OF THE DISEASE.

By Elizabeth Gehrman

Scott Brady had been in the big oak for only about an hour when he spotted his quarry. The wind was out of the southwest, and Brady, a stocky, round-faced 59-year-old ad salesman from Holliston, was well hidden among the branches 20 feet above the ground, sitting stone-still in a camo-covered perch called a climbing tree stand. He was dressed head to toe in camouflage that had been stored with pine boughs to obscure human scent, and he was so silent that the four deer never looked up when they emerged from a swampy area, nosing along the ground and, Brady says, "chewing some buds and bark and stuff like that." The big female – Brady guesses she was about 2½ years old and 140 pounds – offered the best shot.

He slowly raised his Hoyt AlphaMax 32 compound bow, a contraption of cables and pulleys that he'd already loaded with a Montec broad-head arrow, the kind with a 1½-inch-long point of three razor-like blades. He drew back and released. The deer, he says, ran with "total abandonment for maybe, oh, 50 yards at the most and then just went down."

Brady hunts because he loves it; he did it with his father and now does it with his children. He dresses the game himself and makes, as he did with this doe, sausages, salami, jerky, and steaks.

But this kill also had another purpose: It was part of a pilot program begun in Dover last fall that opened public lands to bow hunters to cull the town's deer herd. Because everyone knows fewer deer equals fewer ticks, and fewer ticks equals less Lyme disease, right?

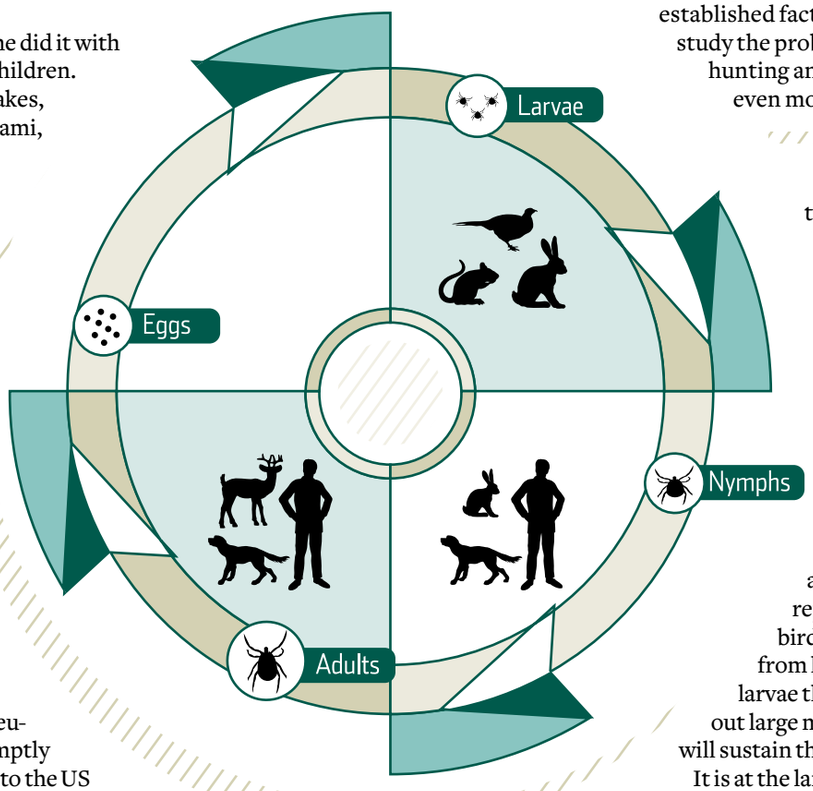
It's actually far from clear.

There's no question that Lyme disease, named for the rural Connecticut town where it was first identified in 1975, is on the rise. Nationwide, reported cases of Lyme – an acute inflammatory disease that can leave lasting neurological damage if not treated promptly – have tripled since 1992, according to the US Centers for Disease Control and Prevention in Atlanta. There is particular cause for concern in the Northeast, including Massachusetts, which, after Delaware, Connecticut, and New Hampshire, has the fourth highest Lyme rate in the country, with 61 confirmed cases for every 100,000 residents in 2009, more than twice as many as in 2006.

Deer numbers have also increased since the 1970s, accelerating a rise that began earlier in the century, when conservation legislation was enacted to protect the animals from overhunting. The spread of suburbia, too, with its wooded lots and tasty landscaping, has provided the perfect environment for deer to thrive. "The fact is the stuff that we like to live in, deer like to live in, too," says Allen Rutberg, an assistant professor of environmental and population health at the Cummings School of Veterinary Medicine at Tufts. "Shrubberies, parks, et cetera – we provide all this food for deer."

Dover, where Brady bagged the doe, is not the only town that's looking to control Lyme disease by allowing bow hunting. A hunt similar to Dover's took place in Andover last year, Medfield is considering instituting its own program, and residents of other towns are speaking up in favor of such initiatives. Several state legislators have introduced bills recommending wider action on Lyme.

But the idea that deer are the main culprit in the spread of Lyme disease is far from an established fact, according to scientists who study the problem. And the link between hunting and controlling the disease is even more tenuous.



When tick eggs hatch, the larvae need a blood meal. (Later, as nymphs and adult ticks, they'll feed again on mammals.) If the larvae feed on white-footed mice, they're almost certain to pick up the bacteria that cause Lyme, which they'll pass along to their next host.

There are three times in a tick's two-year life when it needs a blood meal, which is where animals – and humans – come in. After hatching in the spring or summer, the 2,000 or 3,000 larval ticks produced by each female fuel their transition into nymphs by feeding mainly on birds, mice, and other small rodents. They drop to the ground and overwinter on the forest floor, appearing the following summer as nymphs that need a second repast – again most often from birds and small mammals, but also from humans. By fall, the 1 percent of larvae that make it to adulthood seek out large mammals for a final feeding that will sustain them through reproduction.

It is at the larval stage that ticks pick up *Borrelia burgdorferi*, the bacterium that causes Lyme disease. Scientists estimate that about 30 percent of ticks in New England get infected, picking up the pathogen primarily from forest-dwelling white-footed mice. "They infect almost all the ticks that feed on them," says Richard Ostfeld, a senior scientist at the Cary Institute of Ecosystem Studies in Millbrook, New York, and the author of *Lyme Disease: The Ecology of a Complex System*. It is when infected ticks become nymphs and are ready to feed again that they carry the Lyme

GRAPHIC BY RYAN HUDDLE/GLOBE STAFF

WHAT YOU CAN DO

• Protect your property with insecticide. If you don't like the idea of spraying, place Damminix, cardboard tubes stuffed with cotton balls soaked in the pesticide permethrin, around the perimeter of your yard. With luck, mice will bring the cotton back to their nests and lay in it.

• To avoid ticks in your yard, keep play and socializing areas away from shrubs, bushes, and other vegetation. Regularly remove leaf litter and clear tall grasses and brush around your property. Create a barrier between the lawn and any wooded areas with wood chips or gravel.

• Modify your landscaping to discourage deer. Remove plants that attract them, such as yews, burning bush, hybrid tea roses, magnolia trees, crocus, day lilies, hostas, impatiens, phlox, trillium, and tulips. Plant the edges of your garden with things they don't like, instead: catmint, chives, lavender, mint, sage, thyme, foxglove, and daffodils. If selective gardening doesn't work, install a fence.

• Treat your dog and any cats that go outdoors with flea and tick prevention products.

• When hiking, stay away from the edge of the trail. Use an insect repellent containing DEET or permethrin and wear pants, socks, and long sleeves. After being in a wooded or grassy area that might be infested, check yourself, your clothing, and your children or dog for ticks.

bacterium to larger mammals.

So how did deer become the bad guys?

Of course, they aren't blameless in the cycle that spreads Lyme. When adult ticks have plenty of deer around – that's where they like to mate, says State of Connecticut entomologist Kirby Stafford – they, in turn, grow healthy, abundant populations. And two summers later, when you're out for a walk in the woods, a new nymph, infected by a white-footed mouse and looking for a meal, just might find its way to your ankle. But some scientists say that the role of deer has been oversimplified and overstated.

There are approximately 850 tick species found throughout the world. In the northeastern and midwestern United States, the one that transmits Lyme disease is *I. scapularis*, the *I.* being short for *Ixodes*, which means hard-shelled. First described in 1821, *I. scapularis* ranges in size, depending on its life stage, from the diameter of the period at the end of this sentence to the approximate mass of a ladybug; it can be found from Ontario to Florida and as far west as Texas, and its common name is the black-legged tick.

Deer became associated with ticks thanks, in part, says Ostfeld, to a 1979 scientific paper that described what was believed to be a new species of tick, *I. dammini*. *Dammini* seemed more common in northern latitudes and appeared to be abundant at all of its life stages on white-tailed deer, thus showing what scientists call a "preference" for the animal over other hosts. But the study was done on Nantucket, which had a scarcity of other mammals such as coyotes and foxes on which ticks might feed. By 1993, many scientists were beginning to believe that *I. dammini* was in fact identical to *I. scapularis*. *Dammini* was eventually scrapped as a separate species, but its common name – deer tick – has lived on.

"Deer tick is a discredited, incorrect, obsolete name," says Ostfeld. "But as long as you're calling it the deer tick, what animal are you going to accuse of fostering it?" In his book, Ostfeld analyzes more than a dozen studies comparing deer numbers with tick numbers. In most, deer were either eradicated or nearly eradicated in the area being studied. Overall, the results were startling.

In the first study, done on Great Island, Cape Cod, beginning in 1982, a reduction in the deer herd from at least 30 to less than 10 not only didn't decrease the number of larval and nymphal ticks scientists found on the white-footed mice they collected, but seemed to increase them. It wasn't until the herd was down to a lone doe that the number of ticks on the mice decreased significantly. At Crane Reservation in Ipswich, after the deer population was reduced from 350 in 1985 to 50 in 1991, larval and nymphal tick numbers did decline – but soon increased again to pre-hunt levels, "despite the vastly reduced deer density," says Ostfeld.

When researchers eliminated deer from Maine's Monhegan Island in 1999, where the next-largest animal with a significant population – besides humans and dogs – was the Norway rat, the number of ticks did decline to near zero. But a 1994 study that surveyed 22 natural areas, seven of which had no deer, on New York's Long Island found the number of nymphs in the deer-free zones "within the range seen in areas with rampant Lyme disease," Ostfeld writes.

Researchers have also found that where deer are eliminated or reduced, even if the number of ticks declines, the number of infected immature ticks often increases, in part, it's believed, because the small mammals that remain are likelier to transmit the *B. burgdorferi* bacterium.

"I'm not ethically opposed to hunting deer at all," says Ostfeld. "I would argue that deer are a public-health menace in the sense of car accidents, and I know as an ecologist that they can cause enormous damage to forest health. So there are a number of legitimate reasons for controlling deer populations. But the scientific evidence as I've reviewed it, without any preconceived notion or political agenda or any other agenda, does not support the notion that tick numbers and Lyme disease risk are strongly correlated with deer numbers, and the data do not suggest that if you manage deer by hunting, you'll reduce the number of Lyme cases."

THE IDEA THAT DEER ARE THE MAIN CULPRIT IN THE SPREAD OF LYME DISEASE IS FAR FROM AN ESTABLISHED FACT, ACCORDING TO SCIENTISTS WHO STUDY THE PROBLEM.

Most scientists agree that if the number of deer is driven to zero – and other mammal hosts are lacking – it will disrupt the tick population's life cycle enough that their numbers will be "substantially reduced," says Ostfeld. But there is less accord on just how low a number of deer will make a meaningful difference. "At Crane Beach," he says, "they reduced the deer quite dramatically, and, lo and behold, the ticks crowded onto the remaining deer."

The state of Massachusetts would like to see the deer population limited to no more than 10 per square mile, but Sonja Christensen, deer project leader for the Massachusetts Division of Fisheries and Wildlife, chooses her words care-

fully when discussing numbers. "At lower densities we can hopefully have some deer and also mitigate Lyme disease risk to some degree," she says. But density in much of the state is higher, up to more than 50 deer per square mile in Nantucket. In parts of Western Massachusetts where there are fewer people, a higher density is not considered a problem. But in the forested areas around near-Boston suburbs like Dover, where the state estimates there may be 28 to 30 deer per square mile, many believe that something needs to be done. The bow hunters in newly opened areas of town got 19 out of 265 or so over the winter – a culling unlikely to make a dent in Lyme disease cases no matter how precisely correlated with deer populations. And, says Sam Telford, a professor of biomedical sciences at the Cummings School, "for people to believe that if they start doing something now they'll see a return on their investment tomorrow is unwise. This thing took 30 years to develop, and it may take 10 years for any effects to be seen."

Though Telford is in favor of hunting as a means of controlling deer, and therefore tick, populations, he concedes that there are problems with the plan. For one, if a town gets its deer population from 50 to 25 per square mile, he says – stressing that "these are example numbers, not real numbers" – "that does not mean half the ticks are going to go away." Reducing the deer population from 50 to 10 per square mile, research suggests, would lower the tick population by 80 percent within 10 years. "It's not a linear effect, but a threshold effect." And, Telford points out, no one has been able to study the impacts of open hunting as opposed to controlled kills, which measure pre- and post-hunt deer and tick counts, because of a lack of funding.

With more towns starting to form deer committees to look at the problem, hunting can sound like an appealing solution because of cost: Unlike many other options, it actually makes money, both for the state in the form of fees, and for the town, when hunters descend and start spending in restaurants and hotels.

But the sport itself is losing its appeal. According to the US Fish and Wildlife Service, Massachusetts leads the 33 states in which hunting license sales have decreased over the past two decades, with a 50 percent drop-off since 1990. And there's another problem, admits Telford: "Hunters themselves; if it gets too hard to find the deer, they just give up."

Massachusetts towns that are considering whether to extend hunting seasons or areas might do well to consider the experiences of other communities working on the problem, says Rutberg, the Tufts professor. "I've been making a number of visits lately to Westchester, New York, which is about five-plus years down this road ahead of Massachusetts," he says, "and they're just realizing now, after trying these bow hunting programs for five or six years, that they don't really work. If people continue to perceive Lyme disease as an issue worthy of community attention, they will have to do something different."

There are, it turns out, many potential tools for controlling deer populations, lowering the number of ticks, and decreasing Lyme disease incidence. The first option usually cited is deer contraception. Critics call it costly and difficult to implement, but Rutberg, one of the few scientists studying deer birth control – which is usually delivered by dart vaccine – says it's improving. "We've gotten better at it, and will continue to get better at it," he says.

INSTITUTING HUNTING "LETS YOU EXTERNALIZE THE PROBLEM: 'THIS IS FOR THE TOWN GOVERNMENT OR THE HUNTERS TO DEAL WITH, SO I DON'T HAVE TO,' " SAYS ALLEN RUTBERG, A TUFTS PROFESSOR. "IT JUST SO HAPPENS IT DOESN'T WORK."

Then there are four-poster feeders, which don't alleviate, and possibly even aggravate, the deer problem, but do help control ticks. When a deer goes to feed at one of these odd plastic contraptions – baited with corn – its head, neck, and shoulders rub up against a couple of paint roller-like devices coated with the pesticide permethrin. Several studies have shown large reductions – up to 98 percent – in tick populations after a few years' use. The problem with the feeders, as with most tick-control solutions, is that they cost money.

"You need one every 50 hectares [about 123 acres]," says Telford, "and you need to replace the bushel of corn every two weeks, and the old corn has to be carted away." He estimates that Nantucket, for example, would have to spend $350,000 a year to build and maintain the devices, though Rutberg disputes that number. "I don't think we have the field experience to know how much it would cost," he says. "Four-posters have only been used experimentally for maybe five years. And you wouldn't do it for all of Nantucket – you concentrate it in the area where people and ticks are likely to encounter each other."

Another solution targets rodents using bait boxes that contain fipronil, the same ingredient in Frontline, a tick repellent for dogs and cats. According to entomologist Kirby Stafford, their use "basically wiped out the ticks" on Mason's Island in Mystic, Connecticut, where they were first tested in 1999 and 2000. Results were not as good in Fairfield and Litchfield counties, which are larger, more rural areas. But, Stafford says, "if you put [bait boxes] on stone walls, which are essentially mouse hotels, and between yards and woods, they can be effective."

Natural botanical compounds – including a garlic product that has shown surprisingly good results, according to Stafford, and nootkatone, a compound found in both grapefruit and Alaska yellow cedar – have also proved effective but can be "horrendously expensive." A lower-cost method is a spray-on fungus Stafford and others have used experimentally. It occurs naturally in soil at low levels, killing ticks, and seems, so far at least, to have low toxicity in humans and animals. It does kill some insects in addition to ticks, but the fungus doesn't harm beneficial bees or spiders, Stafford says, and may soon be available commercially.

Other scientists think that preventing the disease is more practical than targeting its cause. Vaccines against Lyme are available for dogs and were once marketed for humans. But GlaxoSmithKline, the manufacturer, eventually discontinued the human product – officially because it wasn't considered commercially viable, but also, say both Telford and Rutberg, because of consumer lawsuits alleging a risk of arthritis. Taking the vaccine off the market did not close the debate on the concept, though. A supplement to the February issue of the journal *Clinical Infectious Diseases* "is devoted to the theme 'Let's bring back the vaccine,' " Telford says.

If one thing is clear in the muddled battle against Lyme disease, it's that scientists – even those, like Telford, who support hunting as tick control – believe the approach must be multi-pronged and include efforts by homeowners and those who spend time outdoors to protect themselves.

"People like simple solutions," says Rutberg, "and killing animals seems like a very simple solution. It lets you externalize the problem: 'This is for the town government or the hunters to deal with, so I don't have to.' It just so happens it doesn't work." ■

Elizabeth Gehrman, a frequent Globe Magazine *contributor, is working on a book about the Bermuda petrel, once thought to be extinct. Send comments to magazine@globe.com.*