Invaders can wreak havoc.

No, we are not referring to Attilla the Hun or Hagar the Horrible. In scientific context, invaders are plants or animals whose introduction by humans to a new environment allows them to displace native species and change the ecology of that area.

One particularly successful plant invader is bush honeysuckle. It forms a dense understory in many of our local forests, it borders roadways—Ladue Road being a good example—and it finds its way into many of our backyards and gardens. Its red berries taste good to birds, so seeds are readily spread into new territory.

Bush honeysuckle stays green after the trees have lost their leaves.
Photo courtesy of Robert Marquis

Conservationists and environmentalists have been concerned about honeysuckle's dominance for a long time, but many of us have not felt threatened by the pretty bush.

New research shows honeysuckle invasion affects human health

Now, however, a group of researchers from Washington University and the University of Missouri in St. Louis have shown that honeysuckle invasion affects human health. Their findings, published in the latest issue of the Proceeding of the National Academy of Science, show that areas with dense stands of honeysuckle have about ten times the population of lone star ticks as areas with native flora. This tick density results from the white tailed deer's preference for spending time in honeysuckle stands.

Basically, your chances of being bitten by a disease-carrying lone star tick are ten times greater in honeysuckle-invaded areas than in uninvaded areas.

The researchers, led by Brian Allan, Washington University Department of Biology and Tyson Research Center, already knew that deer are the primary hosts for the lone star tick. He and his colleagues, Robert Thatch, Lisa Goessling, and Gregory Storch had developed a molecular biological technique to analyze the residual blood meal in ticks; with this technique they can identify what animal species the tick fed upon, and identify whether the same tick is infected and by what. They found that about 80% of infected ticks had fed on

For tick aficionados only

One of Allan and colleagues most important findings is that tiny, pinhead larval lonestar ticks feed on deer. When the larvae molt into their next stage, nymphs, they can pass the disease on to either humans or other deer.

In contrast, the tick that carries Lyme disease, the black-legged tick, normally feeds on small mammals like mice and chipmunks in the larval and nymph stage, and attaches to deer only in the adult stage.

Lyme disease, by the way, is rare in Missouri. In the southwest part of the state, the predominant tick-borne disease is Rocky Mountain spotted fever, carried by the American dog tick.

deer. Therefore the white tailed deer is both the primary host for lone star ticks and the primary carrier of Ehrlichiosis, a bacterial infection.

Ehrlichiosis begins with flu-like symptoms, but can develop serious complications like seizures and renal failure if not treated. This disease, caused by two species of Erhlichia bacteria, was practically unknown before 2000, but since has accounted for about 45% of all tick-related diagnoses statewide, and nearly all in the St. Louis area. In its peak year, 2008, 226 cases of this disease were reported.

Allan and colleagues surveyed nine natural oak-hickory forest areas around Saint Louis. In each of these natural areas, they gathered data from three plots (at least 30 x 30 meters) invaded by honeysuckle, and three non-invaded plots.

They measured several parameters.

- Density of ticks per unit area
- Percentage of infected ticks per unit area
- The host animal whose blood carried the infectious bacterium
- Deer activity, as measured by clusters of feces per unit area

The Glamour of Science

Sometimes information comes from clean high-tech laboratories; analyzing tick bloodmeals with the molecular biology tool PCR (polymerase chain reaction) would be in that category.

But sometimes, data gets measured in low-tech, down and dirty ways.

To count the ticks in his plots, Allan and coworkers set up two dry-ice traps in each plot. The principle is that ticks are attracted to the carbon dioxide that animals breathe out. The traps consist of coolers of dry ice covered in double-sided tape. Hoping to find a hearty meal, the ticks move toward the carbon dioxide given off as the dry ice evaporates. They literally get trapped on the tape, allowing the investigators to classify them by stages and count them. Since one 24 hour collection can yield several thousand blood-seekers, classifying and counting could become tedious.

Counting deer dung clusters is even more low-tech. The investigator marks off a 20 x20 meter area in the middle of a plot, and then walks the rows, marking each pile with a flag so it doesn't get counted twice.

From these observational studies, they found that honeysuckle-invaded plots showed five times the deer activity as native plant plots. They also showed ten times the lone star tick census—those ticks knew where their next meal would come from! The percentage of infected ticks was the same in both types of area; hence the ten-fold increased risk in invaded areas.

Brian Allan and student check a white-footed mouse for ticks.
Photo courtesy of Brian Allan

Observational data was reinforced by experimental results. Robert Marquis and Humberto Dutra of UMSL's department of biology were also interested in the ecological consequences of honeysuckle invasion. Working at the Busch Wildlife area, they had gone into honeysuckle-invaded areas and cleared plots within them of the invader. They maintained these clear plots in a sea of honeysuckle for several years. During the course of their research, the UMSL researchers observed that ticks seemed less abundant in the cleared areas, and initiated a collaboration with the Washington U. tick team.

The tick data in the experimentally cleared plots were essentially the same as in the wild. That is, ticks were about ten times as abundant in the midst of honeysuckle as in the cleared areas, and deer activity was about five times as great.

"We were both excited and dismayed," says Marquis, "because this body of work demonstrates an unexpected and possibly dangerous indirect effect of an invasive plant species on human health."

What is going on?

Honeysuckle forms a very dense vegetative understory—about 18 times as dense as a native understory. Also, it is taller and bushier than the native plants it displaces. Deer can take shelter in the dense honeysuckle during the day, and "that concentrates the deer just as a magnifying glass concentrates the sun's rays" says John Orrock, one of the investigators. Ticks, of course, will move toward the carbon dioxide gradient the deer provide.

Deer do not eat the honeysuckle leaves to any degree (although they do eat the fruits.) They hide out, and forage the native vegetation in the surrounding area—providing space for the honeysuckle to spread.

> John Orrock has now seen this phenomenon in at least two species—deer and grassland squirrels. On the west coast, mustard is a pervasive invader that forms a monoculture. Like honeysuckle, it is taller and bushier than the plants it displaces. Squirrels do not eat the mustard, but hide out on the edges of the growth and eat the native plants around it.

What next?

The connection of honeysuckle, deer, and a serious human disease raises more questions.

Has the increase in the deer population caused the spike in Ehrlichiosis infections? Deer populations have been increasing for a long time, and the disease is a relatively new phenomenon. However, according to Allan, much of the increase of tick-borne disease is in

suburban areas where deer populations cannot be controlled by hunting. Honeysuckle eradication programs might have a great impact in these areas.

Have active attempts to control the deer population in suburban areas affected the tick-borne disease census? Experiments need to be done, but the reported cases of Ehrlichiosis have decreased from 220 in 2007 to 122 this year to date. At the same time, some suburbs have been pursuing what Erin Shank of the Missouri Department of Conservation terms "lethal control." Chesterfield has a bow and arrow deer hunting season, while Town and Country surgically sterilizes does.

Coincidence? Maybe. Allan and colleagues believe that tick numbers may follow some sort of cycle not necessarily related to their host population. As a result of their findings, however, they believe that honeysuckle eradication is a win-win strategy both for humans and for the ecosystem.

Note: Brian Allan is now at the University of Illinois in Urbana-Champaign, John Orrock is at the University of Wisconsin in Madison, and Humberto Dutra is at Life University in Atlanta.