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As N.E. warms, tiny pests take root

Insect's assault on trees growing

Richard Schulhof, deputy director of the Arnold Arboretum, stood among hemlocks infested with the woolly adelgid in the Boston arboretum. Entomologist Brenton Teillon studied a branch infected with the woolly adelgid at Purgatory Chasm in Sutton. Scientists walked through Purgatory Chasm in Sutton to examine infested hemlock trees. Extremely cold temperatures will kill the responsible pests. (DINA RUDICK/GLOBE STAFF)

By Beth Daley
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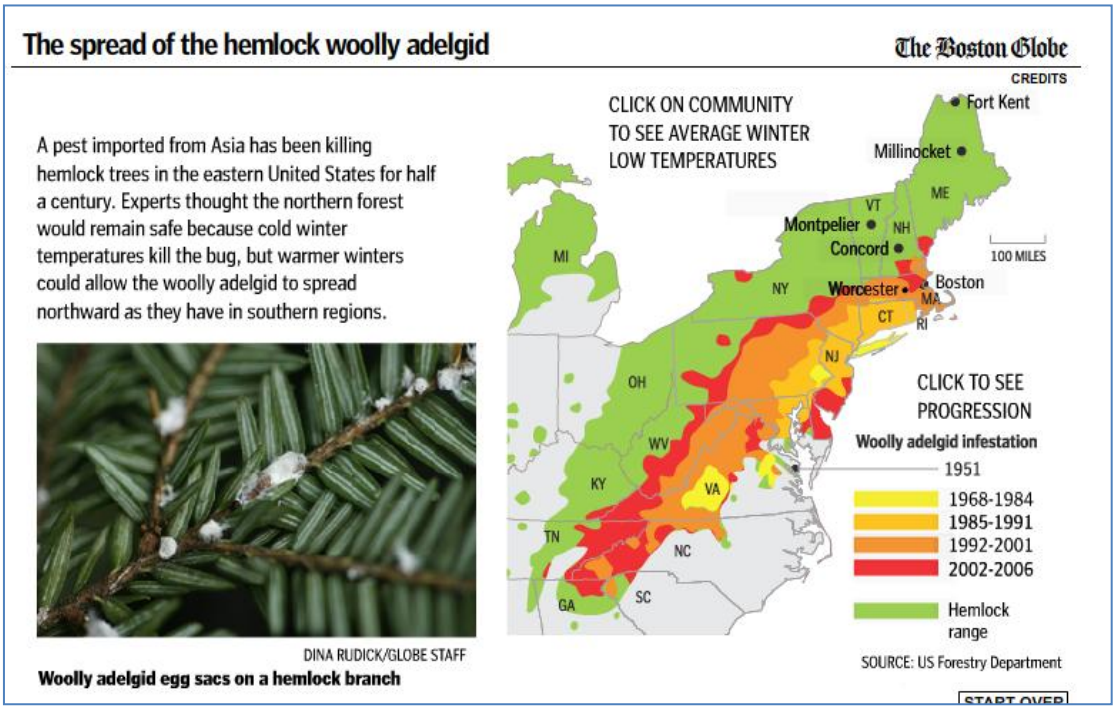
BOSTON, MASSACHUSETTS - The woolly adelgid is turning Hemlock Hill in Boston's Arnold Arboretum into a hemlock graveyard.

The voracious insects, which feed on the trees' sap, can transform century-old conifers into brittle gray skeletons in as little as four years. Hemlock Hill has lost about 350 trees in the last decade, and arboretum officials estimate that almost all of the more than 1,500 trees that remain have some level of infestation.

Since the invasive pest's discovery in Virginia in 1951, it has advanced about 20 miles a year, and was discovered in Massachusetts in 1989.

Scientists were confident that Mother Nature had the answer to protecting the woods further north: the cold. Hemlock woolly adelgids die if hit with even a short blast of northern New England's frigid winter temperatures.

But it does not get as cold as it used to in New England and the rest of the world. And as temperatures continue to rise, researchers believe the tiny adelgid and dozens of other pests could dramatically expand their range and abundance.



One of the most sobering projections about global warming is that species - including those that bring disease or harm - will reach a climate "tipping point" that will allow them to survive in new locations. Now, researchers are racing to unlock exactly what temperature, humidity, and other climate thresholds could drive the spread of scores of species. The answers are critical, these researchers say, because even a tiny change in temperature could have an exponential effect on some populations.

"The fact that there is a threshold is the big fear," said Michael F. Antolin, a biology professor at Colorado State University who studies links between climate and infectious disease. "There could be no change for a long period of time and then you go over the falls."

Going back as far as ancient Greece, people noticed that changes in the weather could be followed by outbreaks of pestilence. But modern science has focused more on preventing - not predicting - outbreaks. Now, as infectious diseases undergo a resurgence and global warming worries intensify, scientists are looking for stronger links between the two. If researchers could better predict disease and pest outbreaks, scientists reason, they could better focus precious dollars on public awareness campaigns, vaccinations, and other controls.

In the 1990s, researchers linked periodic spikes in sea surface temperatures to cholera outbreaks. This winter, scientists connected warmer winter temperatures in Russia to exploding rodent populations that transmit a potentially lethal hemorrhagic fever to humans.

In New England, scientists are studying how climate changes may be affecting the northern expansion and abundance of ticks, mosquitoes, and other creatures that transmit deadly human illnesses. Researchers elsewhere are examining other organisms, such as corn pests and oyster bacteria, that can wreak economic havoc on this region's farmers and fishermen.

It is not clear if species in New England are spreading because of the effects of man-made global warming, caused by emissions from power plants, cars, and factories. In most cases, the detective work to understand these climate thresholds is in its infancy and highly complex because so many other influences can direct a species' movement and success.

"We need these answers to help predict how far and how rapidly these diseases will spread," said Richard S. Ostfeld, an animal ecologist at the Institute of Ecosystem Studies in Millbrook, N.Y.

Cold blast experiments

Global warming was not on Bruce Parker's mind in 1998 when he and colleagues at the University of Vermont's Entomology Research Lab hiked Mount Tom in Holyoke, Mass., and clipped hundreds of hemlock twigs infested with the woolly adelgid.

Earlier research had shown that cold seemed to limit the adelgid's spread and population, but Parker and Vermont forestry officials wanted to know exactly which temperatures the insects could tolerate to predict their spread into Vermont.

After spraying his truck with adelgid-killing alcohol and shaking out his clothes - entomologists are terrified of inadvertently introducing the insect to Vermont - Parker took the twigs to his Burlington, Vt., lab. There, he blasted them with temperatures ranging from 5 degrees to minus 31 degrees for up to eight hours.

"We just wanted to know how far north it could go," Parker said recently as he hiked through Purgatory Chasm State Reservation in central Massachusetts where an adelgid infestation is underway. Today the insect is at the Vermont-Massachusetts border and has crept into southern New Hampshire and Maine. Parker expects it to show up in southern Vermont, but researchers had hoped the cold would prevent its spread for the north.

At first, Parker's experiments were reassuring. Most bugs died when hit with even a few hours of minus 13 degrees. It almost always got colder than that for at least one winter night in much of northern Vermont, New Hampshire, and inland Maine. But that was before scientists realized how fast winters were warming.

Although the hemlock woolly adelgid is no bigger than a pinhead, it is easy to spot on the underside of a hemlock branch. Each adelgid produces a white, cottony mass at the base of the needle that protects the insect as it slurps the life out of trees.

Hemlocks are a key species in the forests and in suburbia. Although they comprise 4 percent of the trees in New England forests, the conifers congregate around streams, cooling the habitat of trout in summer. Deer huddle beneath their canopy to keep warm during the winter. And hemlock hedges are a New England suburban staple, separating properties and decorating yards.

"I used to say the adelgid would never come to my home in northern Vermont, I thought we were invulnerable," said Scott Costa, an entomologist at the University of Vermont. "Now I am not so sure."

Climbing temperatures

When temperatures soared to 69 degrees on Jan. 6, couples wearing tank tops in Boston's Public Garden took it as an ominous sign of global warming. But they also should have paid attention to the nighttime low: 51 - about 28 degrees above normal.

Minimum temperatures are critical gatekeepers in the natural world because they decide which crops and flowers survive the winter. Low winter temperatures keep populations of pests and disease hosts in check and halt their northern expansion.

And those minimums are climbing. Average global minimum temperatures have risen about 2 degrees since 1950, according to the National Climatic Data Center, with much of that warming taking place since 1970. That may not sound like much, but it could be enough to push a species over its tipping point.

Since 1970, in New England, growing seasons have lengthened, winters have begun arriving later, and the weather has become more erratic. While scientists cannot say unequivocally it is climate change, evidence is growing that the shifts are at least partly a result of global warming.

Scientists have not compiled much local data on minimum temperature trends, which could be important to predict a species' spread. But an analysis of average winter low temperatures in six locations for the Globe by AccuWeather, a weather analysis company, indicates a warming trend. A statistical review shows the changes in two of the communities could have happened by chance. But at four stations - Worcester, Concord, N.H., Millinocket, and Fort Kent, Maine - minimum temperatures have risen more than 3.3 degrees since 1970, a statistically significant change.

Of course, bugs and diseases that are held in check by cold temperatures don't respond to average winter lows - they respond to extremely cold days. But researchers say the change over time in winter lows will probably mean fewer days that hit frigid thresholds for diseases and pests.

And that may give organisms like the adelgid time to take root.

Officials take no chances

In 2004, woolly adelgids were discovered feeding on hemlock shrubs in a White River Junction nursery in central Vermont. State officials rushed to the property, gathered more than 800 trees, and burned them on the spot.

While it's unlikely the adelgid could have lasted through that winter, officials were taking no chances. If northern regions become warm enough for the adelgid to survive, New England officials say, they'll take even stronger action: Tighten quarantines for hemlock logs, conduct more inspections of nurseries for the bug, and enact stricter rules governing transport of hemlocks. Vermont has banned shipments of hemlocks from any state where there is an infestation.

If the bugs arrive in one spot, officials say they aren't sure what they'll do, but options might include cutting down swaths of trees or treating them with an insecticide.

"Most of all, we need the public," said Parker, whose work is partially funded by the US Forest Service. "People need to call us when they see it. It's the only way we are going to beat this thing."

Meanwhile, scientists will continue to try to predict the adelgid's future - though that is turning out to be harder than they thought. The bug isn't behaving in the wild the same way it did in the lab. Some

populations are dying in warmer temperatures, indicating another strong environmental factor is influencing the population. It is also apparent the adelgid is becoming more resistant to cold, allowing it to advance further.

"We don't know exactly what is going to happen," said Parker. "But we need to find out."

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