

# Son of Long-Horned Beetles

## Scientists fight a wood-boring invader that could change the landscape of North America

By SUSAN MILIUS

**A**s alien invasions go, now could be the lull between sequels. Beetle taxonomist Joe Cavey admits to some childhood Godzilla viewing, so he's familiar with the law of invader plots. One overlooked alien spore, one baby lizard, or one mutating killer turnip always escapes the thermonuclear bombing at the end of one movie and rises again in the next.

Cavey has grown up to become the federal government's program director for defending the United States against a real-life alien invasion. In 1996, he raised the official alarm that the Asian long-horned beetle, a dark, star-spangled beauty about the size of a peanut shell, had gotten loose in the United States.

"This is a bad animal," intones Cavey, who is stationed at the Animal and Plant Health Inspection Service (APHIS) in Riverdale, Md. Known to kill a wide range of tree species, the beetle threatens the maple sugar industry, fall-foliage tourism, beloved backyard trees, and leafy public parks. One estimate puts damage at \$138 billion if Cavey and his colleagues lose the battle.



Beetles spend most of their lives hidden inside wood, chewing their way out only when they mature into dark, glossy adults.

Yet 3 years ago, when Cavey sounded the alarm, pathologists knew of no pesticide or natural enemy that would control the beetle and could not even make a decent trap to detect it. They could only recommend mounting a nationwide search and then quarantining, cutting, and burning the infested trees. Officials complied in

the two states that had found the beetles in trees, destroying more than 2,000 trees.

The scientists fear that some beetles might have escaped the eradication efforts, and others may still lurk in unexamined tree-lined suburbs. For that reason, researchers from many fields are studying long-horned beetles with new zest. Investigators are working late untangling taxonomy, observing beetle family life, exploring lures, testing pesticides, even recording the sounds of a beetle munching. Although they still lack a silver bullet, "I think we've made progress," Cavey says.

**L**ike any good alien invader, this one tried to eat New York.

In August 1996, residents in the Greenpoint section of Brooklyn described odd tree damage to a forestry inspector. Showy beetles collected from the neighborhood trees stumped the experts until Richard Hoebeke, assistant curator of Cornell University's insect collection, recognized it as *Anoplophora glabripennis*, a well-known menace in China, Korea, and Japan.

During the past 20 years or so, he's spotted about three dozen insect species that were invading the United States. Most of them turned out to be relatively harmless.

"This is the worst," he says. "This could easily be on the same level with the gypsy moth and the medfly."

The Asian long-horned beetle spends most of its life as a grub inside wood. It probably hitchhiked from China to the United States hidden in the cheap, untreated wood often used for pallets or packing material. APHIS' roughly 1,300 inspectors manage to check only about 2 percent of the goods sweeping into U.S. ports, and Cavey has been worried that the recent trade boom would start an international boom of alarming pests.

"We don't usually jump in as hard as we did," he says. Hoebeke had called Cavey when he recognized the Asian long-horned beetle, and within days, a federal quarantine forbade moving wood or plants out of an irregular area that eventually stretched some 16 miles across Brooklyn.

Nevertheless, in September 1996, beetles turned up in nearby Amityville, N.Y. They might have hitchhiked there compliments of a tree-pruning company that did many Brooklyn jobs for the telephone company. A year later, beetles appeared in Lindenhurst, N.Y.

Two years later, a Chicago man surfing the Web to identify beetles crawling out of his firewood tipped off authorities that the pest had reached the Midwest. Investigators found infested trees in Chicago's Ravenswood neighborhood and the communities of Addison and Summit.

This past February, beetle watchers discovered yet another hot spot, in the Bayside area of Queens.

"I fully believe we will find other sites in other urban centers in the United States," says Hoebeke. "The barn door's been open too long."

**E**fforts to fight back have had to start with the basics, like knowing the enemy. The beetle spends most of its life as a pale, plump grub, looking much like thousands of other grubs. Cavey and Hoebeke have recently published directions on how to spot an Asian long-horned grub. They recommend looking for a little patch of varied texture on the underside.

The Asian long-horned beetle, as an adult, belongs to what Hoebeke calls "a gorgeous group of beetles." Some of the 45 to 50 species in the genus shimmer iridescent blue-green, sometimes with polka dots or other sporty patterns. Hoebeke and Steven Lingafelter from the Department of Agriculture's Systematic Entomology Laboratory in Washington, D.C., are preparing a colorful identification guide to the beetles of this genus.

The genus itself belongs to a family of 30,000 species of wood-boring, long-horned beetles worldwide, Lingafelter explains. A mere 2,000 species live in the United States.

Eastern-U.S. beetle watchers should be able to distinguish between the natives and the shiny, jet-black invader with its distinctive white spots, he says. In the western United States, a few similar-looking natives confuse identification.



**T**he effort to figure out what U.S. trees the invader threatens is moving along, reports Vic Mastro of APHIS' Otis (Mass.) Methods Development Center. Maples, especially the Norway and sugar maples, "are like ice cream to them," he reports. Only Japanese maples, with their extraordinarily hard wood, seem less desirable.

A wide variety of other trees also attracts the beetles. They can eat horse chestnuts, white mulberries, willows, elms, black locusts, hibiscuses (including the rose of Sharon), and Russian olives. They also threaten the true poplars, like the upright Lombardy poplar, but not the so-called tulip poplars of North American forests.

This year, researchers plan to fill gaps in their knowledge of the beetles' diet, testing such common U.S. trees as beeches and lindens. Experiments are checking both the adults' feeding interests and the willingness of females to lay eggs on a tree.

**A** sampling of techniques, both low and high tech, are revealing the daily life of Asian long-horned beetles.

Michael Smith, who works full-time on the species at the Agricultural Research Service's Beneficial Insects Research Laboratory in Newark, Del., is surveying the current scientific literature. Since almost all of it is in Chinese, he and Chinese scientists have teamed up to write a state-of-the-art review article in English. "It takes a lot of E-mailing," Smith says.

Smith goes to China himself to videotape beetle behavior, and he's hopeful he can find points in the insects' life cycle that would be easy to disrupt.

Mating among these beetles means more than a one-twig stand. Males hang around for hours, guarding their mates from other suitors.

"They don't like each other much," he says, after watching adult males clip each others' legs or antennae during territorial tiffs.

Females spend considerable time laying their eggs. The female chews a nice, comfy groove into tree bark and then injects a single egg the size of a rice grain into the inner bark. Smith has seen a female devote an hour to a single egg, but he's not sure that's representative.

"Lots of species lay eggs in the bazillions," Smith notes. Yet Chinese scientists report that an Asian long-horned

beetle lays only about 35 eggs during her 42 days of adult life.

Eggs usually hatch in about 11 days, and the blobby grubs start eating the tree's cambium. This zone of nutrient-transporting vessels gives the larvae soft, rich food, "like breast milk for a baby," says Smith.

After shedding their skins twice, the larvae start gnawing into the tougher, water-transporting vessels farther inside the tree. Snug in the tree's heartwood, the larvae spend the winter. By the following spring, after months of steady chewing, the larvae are "pretty robust," about 5 centimeters in length.

They then transform into pupae, a soft-toy version of their adult selves. When their body structures have matured and hard-

some questions about long-horned beetle mobility. Smith and his colleagues plan to coat infested logs with a fluorescent powder, so emerging insects pick up a mark. Then, as many researchers as can be marshaled will systematically check an ever-widening area for marked beetles. "It takes an army," Smith says.

The flight issue has attracted a number of other scientists. Forest Service researcher David Williams of Radnor, Pa., is fitting individual beetles with tiny wires that should allow him to track their movements with radar. Meanwhile, back in the Forest Service's, Hamden, Conn., lab, workers have plans to test beetles on flight mills, essentially treadmills for the airborne.

**F**lying prowess aside, everyone agrees that the beetles are great chewers. That observation inspired another one of Smith's projects: developing an acoustic beetle detector.

Currently, the science of detecting an infestation requires that somebody stare at a tree, looking for insects or telltale holes and sawdust.

The most high-tech inspector might stand in a bucket truck for a better view. Even the federal managers who direct these efforts estimate that inspectors find only perhaps 30 percent of the beetle-infested trees.

Smith observes, however, that a beetle's primary lifework is chewing, and "they're very loud." He thinks some gadget could pick up the sound of tunneling beetles, if scientists knew what to listen for.

Current libraries of insect sounds specialize in mating calls, such as cricket choruses, so Smith had to develop his own archive of munching noises. From logs that he brought back from the Chicago infestation, he's recording the chewing sounds of beetles, carpenter ants, and whatever other insects emerge from these logs.

To find software to detect the characteristic beetle chewprint among the various noises, Smith is turning to bird-song researchers. Daunting as the effort may sound, Smith has successfully recorded the beetles and says, "I'm encouraged."

**C**hemicals that coax beetles into traps could also help detect beetle infestations, if only people had a clue as to what Asian long-horned beetles



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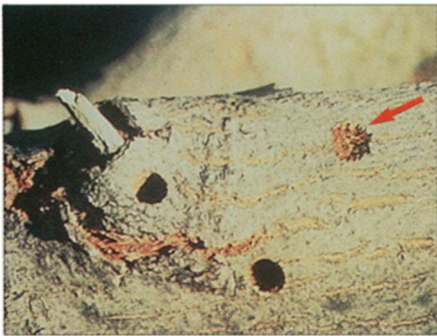
*White star bursts spangle the coal-black body of the distinctive Asian long-horned beetle.*

ened, the adults bore tunnels out of the tree, leaving beautifully round holes a bit smaller than a dime.

Newspaper articles reporting on the destruction of infected trees portrayed the Asian long-horned beetles as lead-rumped flyers that can barely struggle across a suburban lot. Yet, Smith grumbles, nobody knows what the beetles will do. He's watched beetles in China soar literally out of sight. Scientists don't have enough data on beetle flight, he says, to predict the invader's spread.

An ambitious experiment scheduled for this summer in China may settle





Telltale signs of a beetle attack include round holes a little smaller than a dime. The orange wound (arrow) is a beetle cradle where a female laid one of her eggs.

find alluring. No long-range attractants have shown up in related beetles, but that doesn't faze Stephen Teale of the State University of New York College of Environmental Science and Forestry (SUNY-ESF) in Syracuse.

After all, he found an attractant chemical secreted by pine shoot beetles after other researchers had concluded that these beetles did not produce any. In that case, Teale discovered the attractant only by removing all traces of a slight variation of the compound, which happened to repel the beetles.

In the search for attractants for the Asian long-horned beetle, Teale has returned to the equipment that allowed

him to crack the pine shoot beetle problem. He filters air from the beetle cages to collect volatile compounds and then feeds those compounds through a gas chromatograph to separate them. As bursts of various substances emerge, he passes them over a beetle antenna wired to monitors. By watching for spikes of electrical activity in the antenna nerve, Teale can figure out which compounds the beetles detect.

His laboratory has selected about 30 compounds that long-horned beetles sense, though he can't tell yet whether the compounds spark lust or disgust.

Lures could also come from odors of the insect's food plants. Scientists are searching for the beetle equivalent of the smell of baking cookies, explains Jeff Aldrich of the Agricultural Research Service in Beltsville, Md.

Like Teale, he has high hopes for extracting plant compounds from the air. He muses about putting oven-roaster bags for turkeys—famously inert sacks with little odor of their own—over tree limbs to trap volatile compounds to test on the antenna-detector.

**A**ssuming Teale, Aldrich, and like-minded colleagues will find practical ways to detect the beetles, other researchers are already working on means to wipe out infestations.

Pesticide tests have begun on more than 600 trees in China, Mastro reports. In the United States, the beetle has struck in highly populated areas, so researchers are focusing most of their efforts on systemic pesticides they can inject into trees or apply to the soil, thus avoiding drift-prone aerial sprays. Several systemic treatments already used in the nursery trade for other pests show promise against adult beetles, Mastro says.

This summer, the Forest Service lab in Hamden, where Kathleen Shields works, plans to test strains of the insect-killing bacterium called *Bacillus thuringiensis*, or Bt. Several commercial formulations of this microbe work against other beetles. Shields, however, warns that their effectiveness on Asian long-horned beetles is by no means certain, considering the extraordinary variation in beetledom.

Some researchers have already started looking for natural enemies to control the pest. Smith is collaborating with Chinese scientists who have identified three potential enemies, including a parasitic wasp. He's also eagerly watching a wasp and some other species that have emerged from the Chicago logs. He hopes that an insect that already preys on something in the neighborhood might expand its diet to include Asian long-horned beetles.

**T**he U.S. government in December 1998 required that China treat all U.S.-bound, wood packing material to kill insects. Other wood-import rules, now under revision, are also intended to reduce the risks of invasions by Asian long-horned beetles and other pests.

"It's those [organisms] we don't know about that could be extremely dangerous," warns Dale Bergdahl of the University of Vermont. At the turn of the century, in its native Asia, "the chestnut blight was relatively nondescript. But within 50 years, it killed every chestnut on the face of North America," he points out.

Bergdahl chaired the committee of the American Phytopathological Society that prepared a resolution in January urging strict government requirements for treating wood brought into the United States.

James Worrall of SUNY-ESF shepherded a similar letter of concern through a committee of the American Mycological Society. "A lot of people have been grouching about this for a long time," he says.

Cavey, from the government camp, echoes their worry. He, too, wants to focus more attention on the menace of hidden invading aliens, whether a microscopic fungus, tiny thrips, or a deep-burrowing grub.

"It's hard to convince people that a thrips you can hardly see is a problem," he laments. At least, his current worry is big enough for a television camera to film.

Cavey says, "The Asian long-horned beetle is the flagship insect for stating our case." □

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