

Kate Cahow



Grandfather G&CC has succeeded in protecting its 1,100 forested acres from the dreaded hemlock woolly adelgid. Success is evident in the abundance of hemlocks thriving on the property, such as these giants lining the fairway. Photos by Kate Cahow

(tree management)

Saving a giant

If we were to lose this tree species, what else might we lose? What kind of trickle-down effect would such a loss have on the biology of the creeks and wildlife? What would such a loss do to the forest?

— Peter Gerdon

Biological predators of the hemlock woolly adelgid are saving hemlocks at Grandfather Golf & Country Club in Linville, N.C.

It's a slightly overcast day on the greens of Grandfather Golf & Country Club in the highlands of North Carolina. Dramatic silver-tinged clouds frame iconic Grandfather Mountain as a backdrop to the scene. In the lush forest surrounding the club property, there's no sign of the devastation left in the wake of a notorious insect pest that's wreaking havoc on hemlock stands up and down the East Coast—and for good reason.

From the vantage point of the seventh hole on the club's Championship Course, Grandfather G&CC superintendent Peter Gerdon spins his tale of "saving a giant."

"We have a tremendous number of hemlocks on this property, and literally thousands of them are comparable in size to these on either side of the seventh hole," Gerdon says, gesturing toward two magnificent specimens of one of the region's keystone tree species, each towering nearly 70 feet high.

"Hemlocks contribute so much to our environment at Grandfather Golf & Country Club. If we were to lose this tree species, what else might we lose? What kind of trickle-down effect would such a loss have on the biology of the creeks and wildlife? What would such a loss do to the forest? These are important questions to consider when dealing with the problem."

The problem the 32-year GCSAA Class A member is referring to is the threat posed to hemlocks in the eastern United States by an aphid-like insect called the hemlock woolly adelgid (*Adelges tsugae* or HWA). Its common name refers to the insect's resemblance to tiny tufts of cotton clinging to hemlock needles. The adelgid weakens and, unless interrupted and controlled,



The efforts of Peter Gerdon and Richard McDonald, Ph.D., at Grandfather G&CC show that a biologically based pest management program for hemlocks is practical and effective for large-scale acreage.

kills hemlocks by feeding on the sap of tender hemlock shoots. It has been decimating eastern and Carolina hemlock populations up and down the eastern seaboard for nearly three decades.

Gerdon, with the support of his staff, the Grandfather G&CC general management, club members and local entomologist Richard McDonald, Ph.D., has led the charge against the adelgid for the past 12 years, employing chemicals for the short term, but focusing on the long-term benefits of biological predators. The sweet success of their efforts is evident in an abundance of hemlocks thriving on the club's 1,100 acres and even miles beyond its borders.

"We're excited to be on the cutting edge of a very successful approach to the HWA problem," says Gerdon. "We've allocated a lot of funding and resources to save our hemlocks, and as a golf course superintendent, I feel fortunate that our membership has chosen to be proactive in the saving of this giant."

On the trail of a killer

In the fall of 2002, Gerdon and his employees noticed a white, waxy substance on hemlock trees on the course and surrounding property. The Avery County Cooperative Extension Service identified samples as hemlock woolly adelgid. This was the first verified outbreak of the pest in the county.

A native of China, Japan, Taiwan and the U.S. Pacific Northwest, hemlock woolly adelgid was accidentally introduced into the eastern U.S. in the early 1950s in shipments of weeping hemlocks from Japan. It was not considered a pest insect until the late 1980s, when foresters began to observe hemlock death in Virginia's Shenandoah Valley.

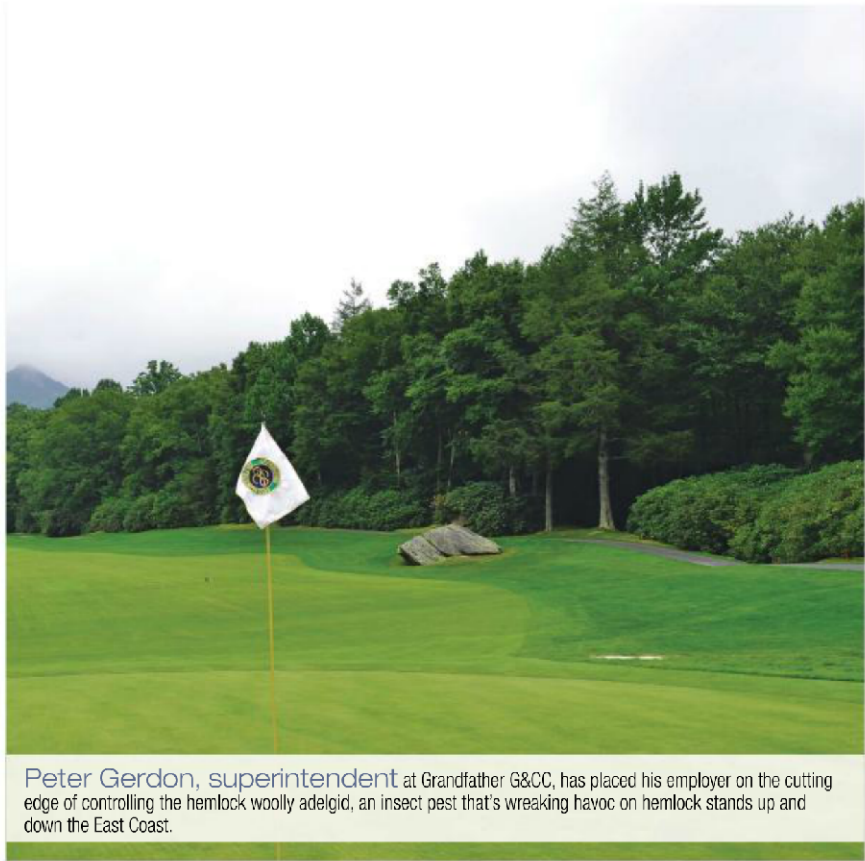
Today, more than 80 percent of the hemlocks in the Shenandoah region are dead, and hemlock woolly adelgid is in outbreak mode from Georgia to Maine, continuing its attack on hemlock trees and devastating natural ecosystems.

"By the time HWA was recognized as an aggressive pest, it was already in outbreak stage up and down the East Coast," says McDonald, owner of Symbiont Biological Control and Pest Management. He's been involved with adelgid control efforts since 1999.

"In the late 1990s I began hearing that HWA was going to be a terrible pest and a threat to the entire hemlock ecosystem," says McDonald. "Hemlocks are a critical keystone species, particularly in the Southern Appalachians where some of the region's oldest and largest stands are located. There's no other tree that can replace the hemlock in this environment."

Hemlocks play an integral role in the health and stability of mountain ecosystems like those at Grandfather G&CC by providing habitat for wildlife and botanical diversity. Their willowy, shade-producing branches help maintain cool mountain streams that are home to trout, other native fish and a wide variety of aquatic life forms.

The logical answer to Gerdon's question, "What kind of trickle-down effect would such a loss have on the biology of the creeks and wildlife?" is that it would be devastating. The U.S. Forest Service has warned of an ecological disaster comparable to the chestnut blight,



Peter Gerdon, superintendent at Grandfather G&CC, has placed his employer on the cutting edge of controlling the hemlock woolly adelgid, an insect pest that's wreaking havoc on hemlock stands up and down the East Coast.

Top left: *Laricobius nigrinus*, a winter-active beetle, is the primary weapon in the battle to control the hemlock woolly adelgid. The *L. nigrinus* larvae hatch and feed on adelgid eggs and crawlers, causing 90 percent or greater mortality of the pest. Photos courtesy of the U.S. Forest Service

Top right: *Scymnus coniferarum*, the summer equivalent of *L. nigrinus*, completes the perfect tag team for aggressive hemlock woolly adelgid control.

Bottom: Hemlock woolly adelgid infestations are clearly visible and resemble tiny tufts of cotton that cling to hemlock needles.

which eliminated chestnut trees from the Southern Appalachians and radically changed the forests of the Southeast in the mid-1900s.

Formulating a battle plan

Once Gerdon and Grandfather G&CC former general manager Norris Clifton became aware of the dangers of hemlock woolly adelgid infestation, they took aggressive action. And, wisely, they never gave up hope.

They attended an informational meeting on the pest and potential control methods at Appalachian State University in August 2002. Entomologists from Virginia Tech were present to discuss a predatory beetle, *Laricobius nigrinus*, they were lab rearing for adelgid control. At that point, nobody in the industry knew *L. nigrinus* and hemlock woolly adelgid were both native to the U.S. Pacific Northwest. This discovery soon became the big game changer in fighting the pest.

As the lab-reared *L. nigrinus* beetles (biological control agents) would not be available to the private sector in adequate numbers for several years, Gerdon and Clifton settled on using chemicals to stem the tide of Grandfather G&CC's infestation.

"We knew we'd experience a high mortality rate on our trees if we didn't act quickly," Gerdon says. "We just had to figure out how

to control chemically without adverse effects on the environment."

Starting in the spring of 2003, they began treatment on the 18-hole championship and executive golf courses, then incorporated other areas of the 1,100-acre property, including member residences.

On both courses they applied soil injections of Merit in two concentric rings around the hemlocks. Near the lake and waterways they secured a 100-foot buffer around trees to be treated, then inserted capsules with Merit and a micronutrient package earmarked for hemlocks into holes drilled in the trees (see sidebar for details). From 2003 to 2007, a four-man crew applied the treatments from early spring into the fall.

"The process was extremely labor-intensive and expensive, and involved thousands and thousands of trees. Our guys frequently had to crawl through rhododendrons to reach the trees. But it was well worth the effort," says Gerdon. "Treating chemically made our trees less susceptible to HWA stress and death for the short term, and likely gave us three to five years of control before we began working with the biological control predators."

Bring on the biologicals

In 2006, the U.S. Forest Service discov-



Hemlocks play a critical role in conserving mountain ecosystems: their branches supply much-needed shade to cool streams that are home to trout, other native fish and a variety of aquatic life forms.

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— Richard McDonald

ered through DNA analysis that the hemlock woolly adelgid was native to the Pacific Northwest. According to McDonald, whose entomological focus is biological control of insects, “This changed everything.”

“It meant both the adelgid and *L. nigrinus* are native to our country, and we could begin collecting *L. nigrinus* and bringing it back to the East Coast to use as a predator in HWA-infested regions,” he says.

He explained that in the Pacific Northwest, hemlock woolly adelgid is not a problem for hemlocks because it is kept in check by a natural system of insects. It has become a pest on the East Coast because no natural predators are present in the environment. Once the adelgid infestation spreads to 45 percent of a tree’s needles, the tree begins to decline, making this the ecological threshold for taking action.

“We’re attempting to recreate that balance here by introducing HWA’s natural predators, and we’ve identified *L. nigrinus* as one of the best,” says McDonald. “When present, this beetle lowers the infestation rate of HWA on hemlocks well below the threshold, enabling them to regrow normally.”

Laricobius nigrinus is a tiny black beetle that McDonald describes as an “oddball” be-

cause it’s active in the winter, the inverse of most insects, which complete their life cycle in the spring and summer then go dormant in the fall.

“Both *L. nigrinus* and HWA are unusual in this regard,” he says. “The adelgid is in a resting stage in the summer, and around mid-October, when temperatures begin to cool, it comes out of its dormancy.”

That’s when *L. nigrinus* arrives on the scene. It feeds on all life stages of the adelgid throughout the late fall and winter and into early May. It dramatically lowers the infestation rate of the adelgid, allowing trees to regrow and thrive even in the continued presence of the pest. This makes *L. nigrinus* a perfect match for controlling the adelgid.

In 2008, McDonald and Gerdon received support from the Grandfather G&CC board of directors to collect *L. nigrinus* beetles in the Pacific Northwest for introduction to their property. Over the past six years, they have collected about 14,000 *L. nigrinus* beetles for release at more than 40 sites on Grandfather G&CC grounds, making the club the largest *L. nigrinus* release site on the East Coast.

A second hemlock woolly adelgid predator, *Scymnus coniferarum*, a small black and gold ladybeetle, was discovered in the Pacific

Northwest by McDonald and a U.S. Forest Service researcher in 2006. This summer-active beetle is a natural complement to the winter-active *L. nigrinus*, creating an aggressive tag team for attacking the adelgid. Both *L. nigrinus* and *S. coniferarum* have been approved for release on the East Coast by the state of North Carolina and the U.S. Department of Agriculture.

A shining future for hemlocks

The work done at Grandfather G&CC shows how a biologically based pest manage-

ment program for hemlocks is practical and effective for large-scale acreage. McDonald calls the program a “shining success for the High Country.”

“Because Pete, Norris, club members and their board of directors were willing to take a chance on this until-now-unproven pest management approach, Grandfather Golf & Country Club’s 1,100 acres are lush with healthy hemlocks,” McDonald says. “And they’ve saved not only their own hemlocks, they’re helping to save and protect the entire region’s hemlock ecosystem.”

Chemical and biological control of hemlock woolly adelgid

Chemical control, 2003-2007

- Kiortz soil injections were used on large- to medium-sized trees at Grandfather G&CC: applied in two concentric rings around trees at 3-foot and 6- to 8-foot intervals from trees.
- Mauget injections were used on hemlocks within 100 feet of waterways and injected into 12-15 holes drilled 4 feet up from the ground.
- Visibly stressed trees were treated with Sternix, a micronutrient package earmarked for hemlocks; capsules were inserted into existing holes from Mauget injections.

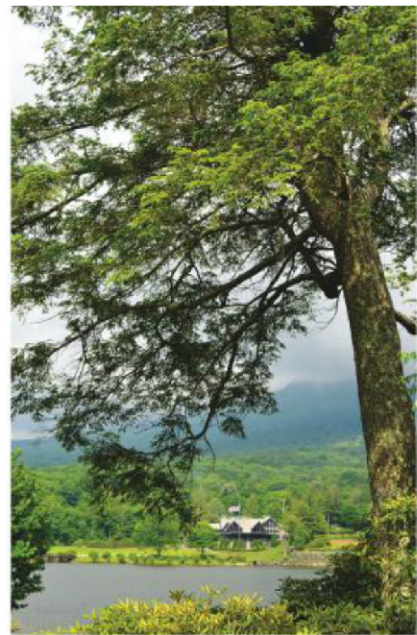
Biological control, 2008-present

Laricobius nigrinus, the winter predator

- *Laricobius nigrinus* females lay their eggs in adelgid egg sacs during the spring; *L. nigrinus* larvae hatch and feed on adelgid eggs and crawlers, causing 90 percent or greater mortality of the adelgid.
- As of 2014, approximately 14,000 wild-caught *L. nigrinus* adults have been released at more than 40 sites on Grandfather G&CC grounds.
- Within three years, *L. nigrinus* was established at Grandfather G&CC and contributing significantly to the mortality of the adelgid, both on the club property and in the surrounding region.
- Today *L. nigrinus* continues to be recovered throughout the Grandfather G&CC grounds and is spreading rapidly beyond the club’s borders.
- Grandfather G&CC holds the largest release record of *L. nigrinus* on the East Coast.

Scymnus coniferarum, the summer predator

- *Scymnus coniferarum* is a small black and gold ladybeetle that feeds specifically on hemlock woolly adelgid. It is the summer equivalent of *Laricobius nigrinus*. Having multiple predators that feed on successive generations of a pest is called “bracketing.” Both predators attack all life stages of the adelgid and hold it in balance.
- A release of 1,000 *S. coniferarum* adults was made in spring 2013; subsequent recoveries were made in April, May and June.



Bright green needles on the hemlock in the foreground indicate new growth, a sign of Grandfather G&CC’s success in controlling the hemlock woolly adelgid.

Today *L. nigrinus* can be found in a 35-mile ring around Grandfather Mountain. Its presence is a primary factor in the health and regrowth of hemlocks in the watershed of three river systems that have their headwaters on the mountain: the New, the Watauga and the Catawba rivers.

As for Gerdon and his list of what-ifs, “The answers are all around us,” he says with a sweeping gesture encompassing the grounds of Grandfather G&CC. “Wild beetle insectaries on this property continue to expand, and we are saving hemlocks.”

To the skeptics, those for whom only seeing is believing, Gerdon has these words: “I invite anyone who’s interested to come visit us at Grandfather Golf & Country Club. I’ll show you what we’ve done here, and then I’ll take you to places where the gray ghosts of hemlocks blight the view, a sad reminder of what might have been. For my part, I’ve got proof that this program works, and I’m just tickled pink.” Smile. Wink.

Kate Cahow is a freelance writer and photographer based in Boone, N.C. Her husband, Richard McDonald, Ph.D., is the entomologist working on the hemlock woolly adelgid biological control project at Grandfather Golf & Country Club. A version of this story previously appeared in the Jan.-Feb. 2014 edition of *Carolinas Green*, the publication of the Carolinas GCSA.