HAVE TREE, WILL TRAVEL

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RIGHT
A torreya sapling growing in North Carolina and a photograph of its parent tree.

HAVE TREE, WILL TRAVEL

SOME IMPERILED PLANTS NEED HELP MOVING TO PLACES WHERE THEY CAN THRIVE.

BY KEVAN WILLIAMS

For more than 200 years, naturalists and plant enthusiasts have come to the woods along the Altamaha River in south Georgia, searching for a horticultural holy grail: a wild *Franklinia alatamaha,* William Bartram's "lost camellia." First discovered by the famed naturalists John and William Bartram in 1765 at a single site near Darien, Georgia, and seen only a handful of times since, a wild specimen of the plant was last conclusively identified in 1803. *Franklinia* is considered extinct in the wild, and the species has survived only in propagation: All living plants are descendants of seeds collected by the Bartrams and grown in their Pennsylvania garden. But many aficionados have continued the search for a surviving wild plant, ignoring the seeming finality of extinction. I'm wandering through woods repeating the exercise in the Altamaha Wildlife Management Area, but the *Franklinia* I'm seeking aren't wild, as such. They're an outplanting of two dozen nursery-grown plants, attempted by the staff of the Nature Conservancy to see whether *Franklinia* could still survive in Georgia.

My guides are Alison McGee, the Southeast Georgia conservation manager for the Nature Conservancy, and her husband, Rob Sutter, a conservation ecologist, who lead me down a dusty dirt road to the conservancy's experiment site. We park near a campground frequented by hog hunters and venture off into the woods, clad in orange. For a couple of hours we wander through a maze of saw palms, searching without success. All the signs seem to be there. There are tattered strands of survey tape hanging from a few of the trees, and machete wounds mark others, but there are no *Franklinia.* The planting should have had a marker—"That's the way we usually find rare species these days," Sutter says—but we can't find it. Was it kicked over, hidden under the saw palms, or are we looking in the wrong spot? McGee takes

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home two hog skulls as a consolation prize, signs of one migrant species that seems to be doing well here.

"In 2002, 10 plants were outplanted. They were grown by someone in Pennsylvania," McGee says. "Only one was alive in 2003." An additional 14 *Franklinia* were outplanted near the sole survivor. It appears that the second wave hasn't fared much better. "There are thousands of *Franklinia* all around," McGee says. Most are growing in containers or highly managed conditions. "I have heard that, at least in our area, if you plant the *Franklinia* out in the native soil, they die," she says.

The reintroduction experiment was described as a homecoming in the local paper, a long-due return for a species that only survived as an exile in the Bartrams' gardens, hundreds of miles north. But the home that *Franklinia* has returned to isn't exactly the same as the one it left, and there's still a question as to why the plant was so rare to begin with. It may be that *Franklinia's* homecoming actually happened 200-plus years earlier, when William Bartram first brought the plant up north.

"It's well-known that during the large continental glaciation of North America, many plants migrated south to refuges along southern river valleys and then gradually moved north as the climate changed and the ice receded," Joel Fry, the curator of Bartram's Garden, tells me via e-mail. "Likely *Franklinia* also moved south into a refuge along the Altamaha (and possibly other rivers) but never successfully migrated north afterward out of the refuge," he speculates. That refuge could have been much larger historically, stretching out onto a broad coastal plain until sea levels rose and it slowly flooded at the end of the last glaciation, leaving the notoriously fickle *Franklinia* trapped in a small patch of favorable conditions.

RIGHT
The Torreya Guardians document the health and growth of the seedlings they plant to determine optimal planting conditions for the species.

TORREYA GUARDIANS

Franklinia's 18th-century rescue was unintentional. "I don't know that [Bartram] necessarily thought the plant would go extinct," Fry says. But despite the genetic bottleneck that *Franklinia* faces, the species is doing okay in the Mid-Atlantic, in places like the Bartrams' garden in Pennsylvania. It may even have regained some of the wild character that the Nature Conservancy experiment on the Altamaha aspired to at Whitesbog, the New Jersey home of the agriculturist Elizabeth Coleman White. White, best known for her role in domesticating and commercializing blueberries, also experimented with the propagation of many other native species, including *Franklinia*. "There is anecdotal evidence that *Franklinia* did freely seed there and naturalized examples of *Franklinia* appeared there—a few of which are still alive," Fry says.

Like *Franklinia*, some plants are survivors, narrowly avoiding extinction as they hide in refuge habitats through accidents of geography, while the larger world they once inhabited—and its climate—changed around them. Some of these remnants, like the ginkgo and the dawn redwood, both of China, survive in a wild or semiwild state only in a few isolated mountain pockets. But today they have migrated much farther, achieving a global range thanks to the assistance of botanists, horticulturists, and landscape architects.

The stories of these climate refugees, far from being just curious botanical anecdotes, raise important questions about what will happen to currently well-established species as human-induced climate change

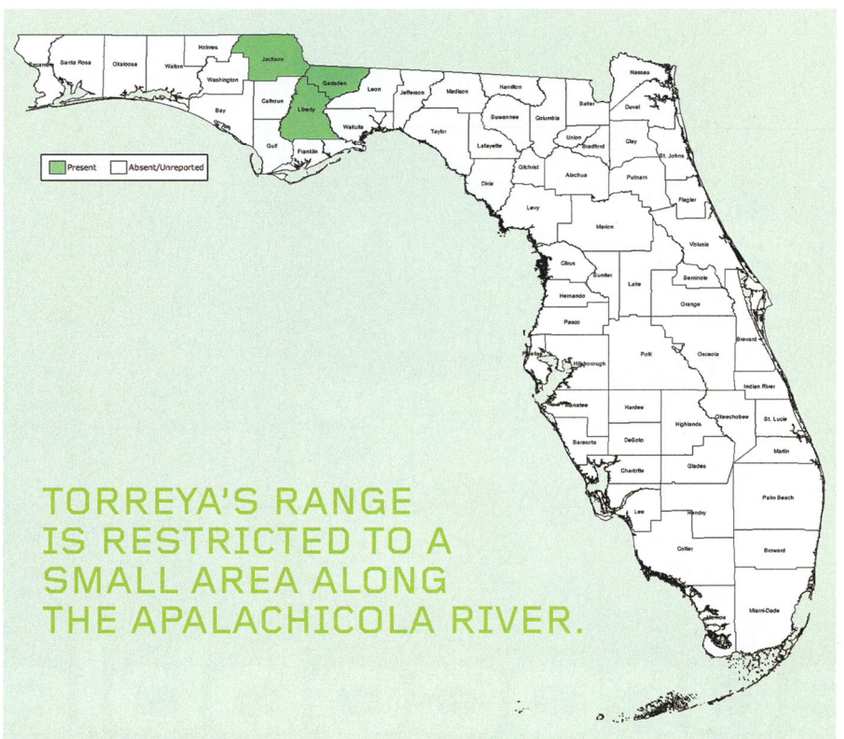
unfolds, and what we can do to help them survive it. The drastic impact of these climatic changes is revealed in documents such as the 2012 update to the USDA's Plant Hardiness Zone Map, last revised in 1990. This update reclassified huge swaths of the country in response to two decades of new temperature data. "The new map is generally one 5-degree Fahrenheit half-zone warmer than the previous map throughout much of the United States," a news release announcing the update stated.

Some activists and researchers have begun to argue that we should help species adapt to these rapidly changing conditions through a process dubbed "assisted migration," before their genetic material is lost. The poster child for assisted migration is the critically endangered *Torreya taxifolia*, sometimes known as stinking cedar. Fewer than a thousand torreya hang on along the ravines and bluffs above the Apalachicola River in the Florida panhandle.

Overharvested historically and plagued by a newly discovered fungal pathogen that limits its reproduction, the species has been the subject of extensive conservation efforts, but so far the decline has continued. The International Union for Conservation of Nature's Red List report on torreya says that "extinction within its native range is inevitable." In the 1950s, the population was estimated at around 600,000 trees. Today there are fewer than 600 trees in the wild.

For Connie Barlow, a science writer and founder of the group Torreya Guardians, the future of the species lies elsewhere. "Why is everybody still focusing on trying to get this tree to survive in a peak ice age refuge when we're not in a peak ice age?" she says. "Obviously, it's been left behind; let's get with the program and help it move back into the mountains." The Torreya Guardians have been attempting to do just that, with experimental plantings leading toward an eventual rewilding in the Southern Appalachians.

Rather than waiting for a gradual change in scientific consensus and conservation practices, the kind of shift in policy necessary to allow for large-scale migration of a species, the Guardians decided to move the torreya on their own. "Let's go ahead and find a way to be legal about it and move the tree," she says of their approach. She points to a paper by the conservation biologist Patrick Shirey and others in *Conservation Letters* that says that federally recognized endangered species may be moved between states as long as the plant came from, and ends up on, nonfederal lands. These endangered species can also be given to people in other states, so long as there's no profit involved. The Endangered Species Act, recognizing the role that botanical propagation can play in preserving species, does allow the sale of species it lists as endangered, but doing so requires a permit from



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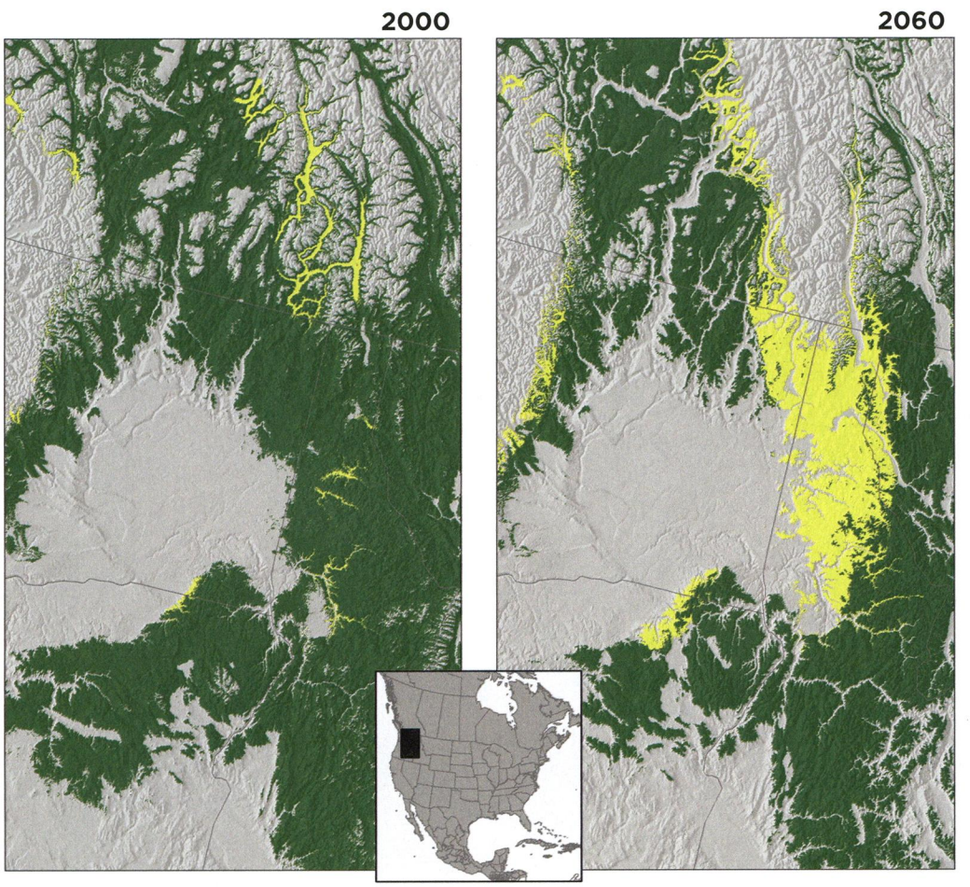

ABOVE
Between now and 2060, the range for certain climate-adapted varieties of the Rocky Mountain Douglas fir (yellow) will increase, but as a whole the species' range (green) will shrink.

GERALD REHFELDT

the U.S. Fish and Wildlife Service—a rule that is rarely followed by commercial growers.

When the Torreya Guardians first began publicizing this approach and planting saplings out in the woods of North Carolina, there was significant skepticism in the scientific community, and concerns about creating a new invasive species or altering the balance of established communities were frequently raised.

But the planting experiments seem to be going well, and the Torreya Guardians are slowly learning how best to propagate the species. "The first couple of crops, we just didn't know how to handle them; now we're learning quite a bit more, and we're getting quite a bit of success," Barlow says. On its website, the group posts results and observations from its planting experiments with rewilded torreya. Among its speculations is that beneficial soil fungi in the Appalachian forests may help the species overcome the challenges it faces in Florida.

Torreya, like *Franklinia,* is a charismatic example of the fluid relationship between climate and range. These two species, like the ginkgo, are quirky botanical conversation pieces, but not ecologically or economically essential. But modern-day climate change isn't affecting just these Pleistocene relicts.

Foresters are increasingly worried about the impacts of global climate change on key forest species out West, particularly aspen. Increased temperatures and lengthier droughts have made the aspen more susceptible to insects and diseases, killing vast swaths of the tree in a phenomenon known as "Sudden Aspen Decline."

Gerald Rehfeldt, a retired research plant geneticist with the U.S. Forest Service, recently published a series of papers in the journal *Forest Ecology and Management* on the vast shifts in range that can be expected in species like ponderosa pine and Douglas fir as climate change accelerates. Rehfeldt estimates that by 2060, up to 75 percent of the range of ponderosa pine would need to be converted, either to new warmer-climate-adapted variants or to different species entirely, as the hardiness zones shift north more rapidly than the trees are capable of spreading on their own.

In the middle of these vast northward shifting ranges, the forest composition might look similar to the way it does today, but on the margins things will look drastically different. "The leading edge for one species is the trailing edge for another," Rehfeldt says. The landscape shift as the receding species is replaced by the spreading one could be dramatic, and Rehfeldt thinks one well-known western landscape will look very different. "The type of vegetation projected for the Yellowstone area is what's currently on the Wasatch Front," he says, as the present-day forested land of northern Wyoming gives way to the more arid forest scrublands of Utah.

For Rehfeldt, current thinking about conservation isn't going to cut it. "There's a difference between making some plantations and developing a viable breeding population. Having a small number of trees in a reserve somewhere isn't going to do much in terms of perpetuation of a species," he says. "There's going to be an impact on productivity if we don't try to assist the migration of these species." That loss of productivity will come in the form of worsening performance for these increasingly less adapted timber species and declining biodiversity in the plants and animals that depend on them.

250,000 WESTERN LARCH HAVE BEEN PLANTED 100 MILES NORTH OF THE PRESENT RANGE.

Rehfeldt points to one example of what large-scale assisted migration might look like: the western larch in British Columbia. "They are transferring a species from its native range to areas slightly north of its northern range," he says. Foresters there have planted 250,000 trees over 100 miles north of the species' present range to safeguard the region's timber industry, a massive experiment in assisted migration.

Urban forests are not exempt from migration issues. "It's only been in the past 10 to 20 years that people have started to acknowledge the value of urban trees and quantify that value," says Christopher Woodall, a forest service researcher who has been studying migration in relation to urban forests and climate change. In addition to lower cooling costs, higher property values, and some of the more localized benefits of trees, there are larger benefits that urban forests provide, including carbon sequestration. But urban forests are going to have to adapt, just like forests in the West, if they're going to continue providing us all those benefits, and we'll have to change our approach to urban trees. "You're establishing trees in anticipation of a future climate that's different and preparing for climate variability," Woodall says. That means selecting species and genotypes capable of oscillations between record cold and hot spells, as well as drought. "We know that biodiversity in forests can mitigate risks of climate change and affords resiliency. The same thing should apply in urban areas," Woodall says. "Cities as a matter of economics need to have diversity."

Urban areas can also serve a second role: "In some respects you could see them as refugia across the landscape," Woodall says. The more intensive maintenance regimes and microclimates of urban and suburban sites can provide troubled species with a chance at survival that they wouldn't have in the wild. Woodall cites osage orange as an example of a tree that benefits from our help. Having lost the Pleistocene megafauna that once spread its seeds, that species now relies on us for wider dissemination beyond where its enormous green fruits fall. Without human management, the species could slowly decline, trapped in ever smaller and more isolated pockets. Another example: *Torreya taxifolia,* whose genetic material is held in carefully managed reserve plantings by the Atlanta Botanical Garden, far from its wild Florida origins.

Urban forests could be not only refuges for native species, but sources for their spread as well. Earlier understandings of species range tended to treat it as a moving line, like a storm front, Woodall explains. He compares the newer model to a disease being spread by someone taking a transcontinental flight, with scattered clusters of growth. And urban environments, which Woodall argues are already a vector for the spread of invasives, could play a similar, more proactive role for native species.

Woodall and Rehfeldt both emphasize the hard decisions that land managers will soon have to make, as climate change pits notions of what constitutes native ecosystems against the realities of forest function. "You're trying to keep forests as forests in the future, where you have some viable population," Woodall says. "It might not be the tree species you want; it's just the species that can adapt to that climate," he says.

The consequences of migration playing out without our intervention may be dramatic, with significant ecosystem decline affecting entire regions as foundation species become poorly adapted to the new climate. "Nature will do it, but it's going to happen in nature's time frame, and that isn't going to be acceptable to people," Rehfeldt says. ●

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