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Global Warming/Activism

Guardian Angels

As climate change threatens a transformation of almost biblical proportions of our plant communities, advocates of "assisted migration" rush to rescue an at-risk species. But just how far can these citizen activists responsibly go?

By Janet Marinelli/Photography by Ken Gehle/Illustration by David Allen Sibley

"We have to come up with names for these trees!" Connie

Barlow declared as we trooped up the slope of the Corneille Bryan Native Garden in Lake Janaluska, North Carolina, carting 10 little conifers. The potted seedlings were about knee high, with sharply pointed needles and a classic Christmas tree

shape. They looked ordinary enough, but they were about to stir up the biggest controversy in contemporary conservation science.

A petite and resolute woman in a tan-and-black dress, Keens, and a baseball cap, Barlow reeled off the names of a motley collection of botanists and conservation heroes: John Muir, Asa Gray, Aldo Leopold, Edward Abbey. "We need a lady here!" she proclaimed. Rachel Carson, Julia Butterfly Hill, and Wangari Matthai were added to the list.

Lee Barnes, a horticulturalist who wrote his doctoral dissertation in part on the conifer, lugged buckets of lime and other soil amendments up the narrow ravine, where a spectacular assortment of southern Appalachian wildflowers were blooming on either side of a trickling stream. Jack Johnston, a soft-spoken, 6-foot-4-inch-tall emergency room nurse who grows an astonishing number of rare Appalachian plants at his home in the northern Georgia mountains, began digging and transplanting the tiny trees. Pitching in was recently retired microbiologist Russell Regnery, who with his wife, Helen, is helping 35 acres of once-cut forest at about 4,000 feet near Highlands, North Carolina, in his words, "restore itself." Clutching a clipboard and a camera, Barlow documented the locations of the transplants. On metal labels attached to the seedlings, her husband, Michael Dowd, an ordained Christian minister and author of *Thank God for Evolution*, wrote the names of the trees. After each one was planted, Dowd and Barlow sang a short song welcoming the species back to its ancestral home.

For the past few years the citizen activists, part of a loosely organized group who call themselves the Torreya Guardians, had been laying the groundwork to move the storied tree, believed by some to be the gopher wood Noah used to build his ark, to cooler climes. Known more commonly today as the Florida torrey, the conifer is poised on the brink of extinction in its tiny native habitat, the sharp-sloped ravines called steepheads along a short stretch of Florida's Apalachicola River and its headwaters just across the Georgia border. Decimated by a combination of causes, including overcutting and disease, *Torreya taxifolia*, as the species is technically called, no longer lives above ground long enough to reproduce in the wild. Only the occasional struggling sapling remains, sprouting from old roots. Some of the Torreya Guardians believe that climate change is hastening the species' demise, and they are determined not to wait for its Panhandle habitat to become warmer and drier, completing its slide to extinction.

On a perfect summer day in late July the small band of modern-day Noahs defied the rules of the conservation science establishment, moving a total of 31 seedlings some 400 miles north of the Florida torrey's current natural range to two sites in the North Carolina mountains. By introducing a species to a new environment, well outside of its native habitat, they did precisely what conservation biologists urge us not to do at a time when invasive nonnative plants and animals pose one of the gravest threats to natural areas. Their action has intensified the debate over using "assisted migration" as a tool for saving species unable to keep pace with rapidly changing conditions on their own. It has also sparked a new controversy about how far citizen activists should go on their own to help imperiled

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citizen activists should go on their own to help imperiled species.

Climate change has already forced plants and animals to move toward the poles and up mountaintops. A study published last year in the science journal *Nature* predicts the climate will shift rapidly, about a third of a mile per year, on average, in the 21st century. The velocity of change will vary by location, depending on such factors as latitude and topography. It will be fastest—about three-quarters of a mile per year—over flat areas like marshes, mangrove swamps, and deserts, but it could be as much as six miles per year in the most extreme scenarios.

Rooted in place, the vast majority of plants have not evolved for rapid locomotion, and their seeds typically disperse a few hundred yards at most. "Some weedy species will probably be able to adapt in place to climate change—that's why they're weeds. But other plants probably will not," says Kay Havens, director of plant science and conservation at the Chicago Botanic Garden. During past episodes of climate change, many plants were able to keep up, but the speed today is unprecedented in the fossil record. Without human help, countless species may not be able to migrate fast enough, and others will be stopped dead in their tracks by housing subdivisions, shopping malls, and sprawling industrial complexes.

Severe droughts, increasing wildfires, fierce storms, and rising seas are among the better-known consequences of the global climate changes under way. But few people are aware that once-familiar landscapes are already in flux and are likely to change drastically in the decades to come. Plants and the animals that depend on them, all moving at their own pace, will find themselves with implausible companions in novel ecologies. In a hundred years California's Central Valley, for example, could be the preferred habitat for cacti and succulents now found in Arizona. Along the coast, California's iconic redwoods could still be hanging on because adult trees are so long-lived. But they will be a forest of the living dead, unable to reproduce.

"This is a sad time to be a plant ecologist," says Steven Handel, professor of ecology and evolution at Rutgers University. "When I go into the woods now, I'm crestfallen. The forests have already changed. They've been overrun by invasive species. The woods are not healthy. The eastern forests I was trained to study are probably gone for the rest of my lifetime—and I expect to be working for a long time. No one knows if the strange new communities that are replacing them will function in a sustainable way."

Conservationists are being forced to reexamine even the most basic assumptions. "How do we define 'native'?" asks Gwen Stauffer, former director of the New England Wild Flower Society, as plants from the south move northward into the region. "What is a natural community?" And "how do we decide which plants deserve protection?"

The Florida *torreyia* would seem to be a prime candidate for protection. Not long ago it was one of the most abundant trees in the humid, dark, and otherworldly forests that clutch the steep ravines along the upper Apalachicola River. In a vast biotic convergence, species from the Gulf and Atlantic coastal plains merge here, while subtropical plants from farther south

plants merge here, while subtropical plants from farther south mingle with northern denizens driven to the Florida Panhandle over eons by glaciers. Dainty maidenhair ferns and white doll's eyes luxuriate in the dense shade cast by a dazzling diversity of other trees and shrubs—oak-leaf hydrangea, sparkleberry, leatherwood, Sebastian bush, overtopped by massive southern magnolias, muscular American beeches, and tall, straight hickories, to name but a few. The ancient conifer, however, no longer casts its evergreen veil over the Apalachicola's steepheads.

In the late 19th century local inhabitants used the torreyia to make fence posts and shingles. Its wood also fueled the riverboats that plied the Apalachicola. By the mid-20th century most of the large torreyas were gone. During the 1950s the remaining trees were attacked by several fungal diseases and suffered a catastrophic dieback. Whether recent climate change has contributed to the Florida torreyia's decline has been largely a matter of speculation, based on events of the Pleistocene, some 15,000 years ago. It is widely believed that the conifer is a cool-climate species that once grew in the Appalachians, was pushed southward to the Florida Panhandle during the ice ages, and was unable to reclaim its original northern habitats when the last of the Pleistocene glaciers retreated. Current studies indicate that warming of 1.8 to 3.6 degrees Fahrenheit would be devastating to the moist, temperate forests of the Florida Panhandle. In fact, the area is likely to experience warming of this magnitude by mid-century, according to data compiled by The Nature Conservancy, the University of Washington, and the University of Southern Mississippi.

"Careful—they bite!" quips Ron Determann as he shows off a torreyia branch full of its signature prickly needles and the rounded, bluish-green cones that have become exceedingly rare. The future of the Florida torreyia now lies in the capable hands of horticulturists like this unassuming man with a mop of blond hair, director of the Atlanta Botanical Garden's spectacular conservatory complex. He is one of a mere handful of people who have managed to coax the plant, which no longer lives long enough to bear seed in the wild, to produce them in cultivation. Determann has been so successful that the largest population of Florida torreyas now resides not along the upper Apalachicola but at the Atlanta Botanical Garden—more than 1,000 specimens that live mostly in various propagation beds and a potted orchard.

As part of the Center for Plant Conservation, the Atlanta Botanical Garden works with other conservation groups and government agencies to save imperiled plants like the torreyia. "The idea is to create a backup system," says Jenny Cruse-Sanders, the Garden's director of conservation and research. If they can propagate enough plants to distribute to sites around the country, they can ensure that if a storm, disease, or other catastrophe were to wipe out Atlanta's torreyas, others would still be available for conservation work. For years their efforts have had one overriding purpose—to increase the likelihood the Florida torreyia will be able to survive in its current range. Assisted migration has not been part of the plan.

Until quite recently, botanic gardens and other conservation

groups were responding to climate change with more robust versions of their customary tactics, such as collecting seeds of threatened plants for use in future reintroduction efforts. They have been expanding their seed banks to include samples from a wide variety of populations to preserve species' genetic diversity and collecting the seeds of even common species for future restorations. They have also been moving more vigorously to preserve land and create so-called migration corridors because large, continuous tracts are most likely to enable plants and animals to successfully rearrange themselves. And they have been redoubling their efforts to control invasive species.

Just a couple of years ago most scientists considered assisted migration, also called "managed relocation," all but inconceivable. Now guidelines and best practices are being thrashed out in prestigious scientific journals. One of the leaders of a working group of biologists, ethicists, and legal scholars who published a decision-making framework last year, University of Notre Dame biologist Jessica Hellmann notes that assisted migration is a huge leap for her and her colleagues. "Many of us became biologists because we love wild places and want to preserve them," she says. "Traditionally, we have studied what the world is like. Moving things for climate change is a totally different ballgame. Now the question is what the world *should be* like and what we *want it to be* like. That feels like a big line we're crossing."

For Connie Barlow, moving the Florida *torreya* north is about restoring the species to its former home. Her book, *The Ghosts of Evolution*, paints a new picture of the ecological catastrophe that occurred at the end of the last ice age when North America's mammoths and other megafauna went extinct and left some native plants without their natural seed dispersers. She believes that indefinitely maintaining the Florida *torreya* in a network of potted orchards, as botanic gardens are doing in what seems like an increasingly quixotic quest to prevent the species from dying out in its current habitat, may stave off outright extinction. But at the same time it raises ethical issues for those who believe that species should have a chance to survive outside of cultivation. "Potted is the botanical equivalent of caged," she says. "I'm interested in preserving not just a species but its wildness."

In 2005, as part of a "no-budget, self-organizing, completely volunteer and paperwork-free recovery plan" for the Florida *torreya*, Barlow recruited Lee Barnes to launch a grassroots seed-distribution project. Taking seeds or plants from the wild and moving them across state lines without a permit would have been illegal, so the *Torreya* Guardians began by distributing seeds donated by a public garden in North Carolina, where a grove of Florida *torreyas* planted 70 years ago has been thriving and reproducing. The seedlings the Guardians planted were also from cultivated stock obtained from one of the handful of commercial sources that have been propagating and selling *torreya* plants for years.

The *Torreya* Guardians have no board, no bylaws, no physical location. The closest thing to a set of operating principles is their online statement that they "do not speak or take action as a group," although subsets of those involved are encouraged to post ideas and undertake initiatives. They have been called con-

post ideas and undertake initiatives. They have been called ecovigilantes. "We don't need more bureaucracy," Barlow responds. "Somebody needs to be doing this."

"I applaud the passion and commitment," says the Atlanta Botanical Garden's Jenny Cruse-Sanders. But she points out a number of technical problems with the approach. First is the fact that the 31 potted seedlings may be genetically different from plants in the wild because they were propagated from trees at the commercial nursery that have long been in cultivation and may have adapted to the easy life in the artificial setting, including regular watering and a lack of competition from other plants and animals. She adds that the plants potentially could even be carriers of the fungal diseases that currently plague the species in its Panhandle habitat, spreading the pathogens northward with unknown ecological consequences.

Like most scientists, Cruse-Sanders bristles at the prospect of citizen activists taking the fate of rare and vulnerable species into their own hands. Instead, she says, they should be working under the supervision of botanic gardens and government agencies, which are approaching assisted migration cautiously and methodically to make sure that they do not inadvertently harm imperiled plants in a rush to save them.

Undaunted, Barlow, armed with a website and an email list, has managed to advance a new conservation paradigm. The website she launched, www.torreyaguardians.org, has provided a forum for both citizens and scientists interested in debating the efficacy and ethics of assisted migration for critically imperiled species like the Florida torrey. In fact, many of the guidelines now being discussed in various scientific forums originated on this website.

Before too long scientists will be doing their own managed relocations. Currently, there is no officially sanctioned plan to relocate the Florida torrey, although by searching in the wild the Atlanta Botanical Garden and its partner organizations have

doubled the number of known genetically distinct individuals. These will be protected in cultivation, at least for now, and the search continues. Kay Havens and her colleagues at the Chicago Botanic Garden are beginning to test the feasibility of assisted migration for the dune thistle. This imperiled wildflower with puffy cream or pink summer blossoms and leaves covered with woolly white hairs has been driven by development and drought from much of its habitat along the western Great Lakes. In recent years they have been collecting seeds from different parts of the dune thistle's range to preserve as much of the species' genetic diversity as possible. In laboratory experiments they are now using growth chambers and special germination tables to test the dune thistle's response to different conditions—and by extension to help determine the best places to relocate it in the wild. "We're not quite ready to move it yet," says Havens. "We're at least five years away from making a decision about that."

The small group of Torrey Guardians continued on from Lake Janaluska to private land in nearby Waynesville, the next stop on the Florida torrey's extraordinary journey. There, on a

stop on the Florida torreya's extraordinary journey. There, on a little bluff at about 3,800 feet, down a trail and across a ravine, 21 seedlings were nestled among sourwood, striped maple, and sassafras, amid struggling stump sprouts of once towering American chestnut trees ravaged by blight, and hemlocks succumbing to hemlock woolly adelgid, a fuzzy, aphidlike insect from Asia that is the latest scourge of the eastern forests.

As climate change intensifies, humans inevitably will become the movers of last resort for a growing number of plants and animals. In fact, the transformation of almost biblical proportions we have unleashed on the world will be so staggeringly complicated and costly that public funds and scientific manpower will likely be stretched to the limits just managing species that play major ecological roles. There is already speculation that the fate of so-called non-keystone species may be left to citizen groups like the Torrey Guardians. Barlow has launched a new website, www.plantguardians.org, to encourage these and other efforts.

In the meantime, it's impossible not to root for the little trees planted far from the steephead forests that for millennia have been their home. According to Lee Barnes, who periodically checks on their progress, Chauncy Beadle, Asa Gray, and Hardy Croom were gnawed on by voles and did not survive their first winter. A fourth, Thomas Jefferson, shows signs of severe decline and may also have perished. Barnes remains optimistic about most of the remaining plants, and hopes to add seedlings from different cultivated sources to increase the plantings' genetic diversity.

While scientists debate the wisdom of assisted migration, there is poetic justice in the fact that the Florida torrey, the reputed gopher wood of Noah's Ark, has come to symbolize our struggle to do right by this jumbled new world we have created. Boston

University ecologist Richard Primack concedes that assisted migration of the Florida torrey and other imperiled plants risks unleashing invasive species. "But these endangered species have such a specialized niche, have such difficulty growing," he says, "that the chance of them becoming invasive is infinitesimally small." Primack says there is a much more serious danger: "that our efforts to move them will fail."

*Janet Marinelli has written widely about imperiled plants and landscapes, and about the often heroic efforts of the scientists and citizens working to save them. Her latest book, *The Climate Conscious Gardener*, is about how to design and maintain a home landscape that helps prevent global climate change.*

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