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Can We Save the Redwoods by Helping Them Move?

The largest trees on the planet can't easily 'migrate' – but in a warming world, some humans are helping them try to find new homes.

California redwoods on the Boy Scout Tree Trail in Jedediah Smith Redwoods State Park.
Credit...Richard Mosse for The New York Times

By Moises Velasquez-Manoff
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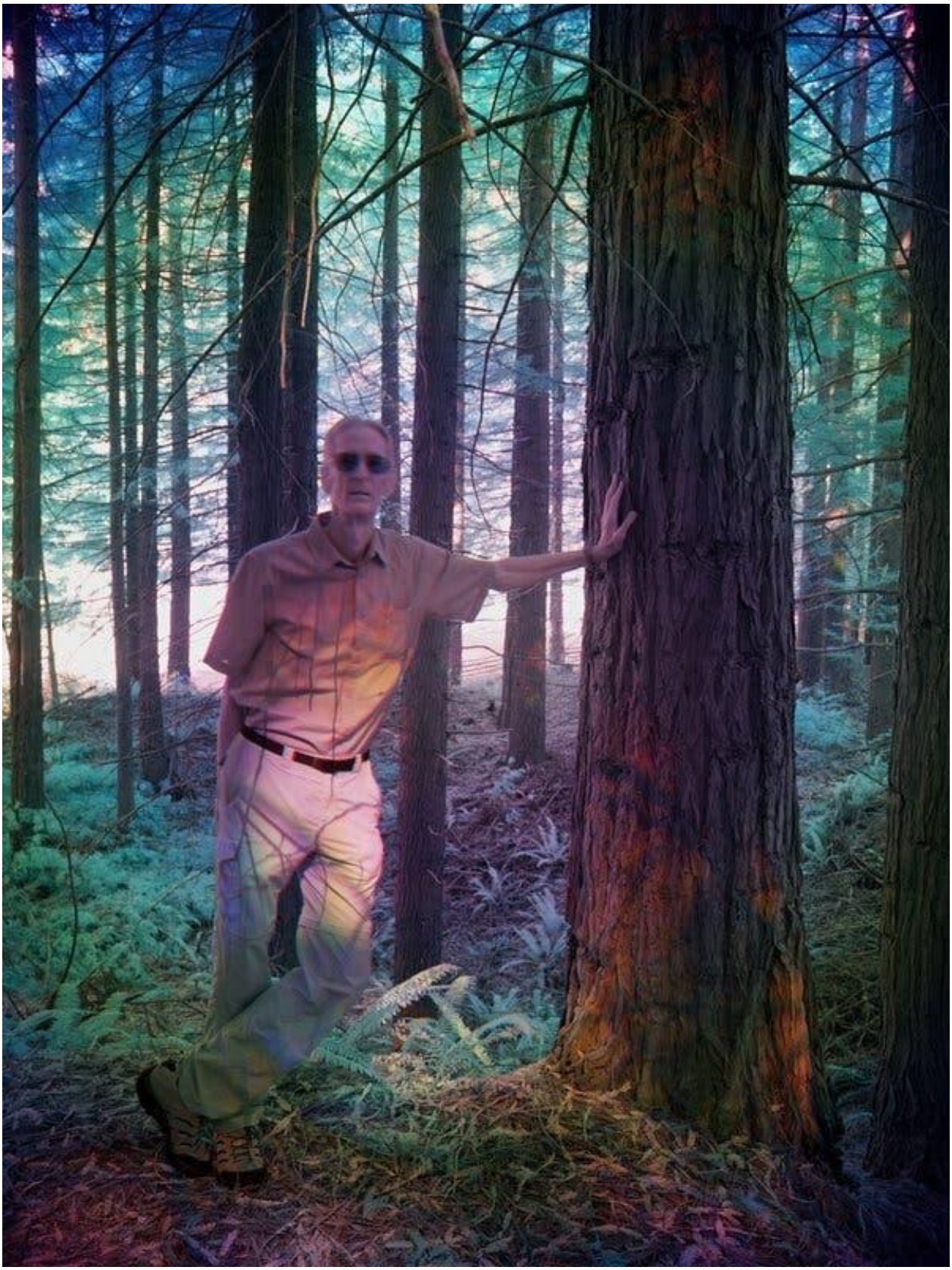
When Philip Stielstra retired from Boeing in 2012, he needed something purposeful to do. He and his wife, Gay, were casual golfers, but Stielstra, an antiwar activist in college who refused to fight in Vietnam — he worked in a post office instead — wanted a pastime with bigger stakes. Before leaving his job, he received an email from the city of Seattle: The Parks and Recreation Department needed "tree ambassadors." Tree canopy cover had receded in the city, and the department was responding by promoting an appreciation for its remaining trees. The volunteer ambassadors would learn about these trees and lead residents on walking tours to marvel at them. Stielstra, despite being a self-described introvert, signed up.

Through his work for the department, he came to think of the city's trees as like grandparents: always there, always supportive, always gracious and often quite old. But he also came to regard the city as failing to meet its own goal. It claimed to want to increase canopy cover, but as a volunteer, he was planting no trees.

One day, Stielstra's twin brother recommended that he read a book titled "The Man Who Planted Trees," which told the story of David Milarch, a former motorcycle-gang member. Milarch, after experiencing a life-changing epiphany (he said he received messages from divine beings during the delirium of going cold-turkey sober), dedicated himself to preserving the genetics of the world's largest and oldest trees by cloning them. As it happened, Stielstra spent some of his childhood not far from where Milarch propagated his trees, called the Archangel Ancient Tree Archive, in Copemish, Mich. On a visit to the family vacation home in Michigan later that year, Stielstra and his brother stopped by to visit. Large and gruff, Milarch had a knack for speaking directly to people's emotional connections with trees, Stielstra thought. He was a different kind of tree ambassador, one committed to the very type of action — planting trees — that Stielstra wanted to participate in.

A few years later, Stielstra accompanied Milarch on an expedition to the giant sequoia groves of the southern Sierra Nevada in California. There, fitted snugly into a harness attached to a long rope, Stielstra ascended 200 feet into a big, old giant sequoia. The tree and its kindred — each one gnarled and scarred from the fires, storms and droughts it had survived over thousands of years — towered over the other tree species in the forest. Stielstra was shaken by the realization that some of these sequoias were already old when Jesus was born. "Who is in charge here?" he remembers thinking. "Us or them?"



Philip Stielstra with a coastal redwood planted in 1990 on Hama Hama tree farm in Washington.
Credit...Richard Mosse for The New York Times

The expedition, one of many Milarch went on, was motivated in part by what he anticipated would be the effects of climate change. Giant sequoias live only in scattered groves, at mid-elevations, on the southwestern side of the Sierra Nevada. Milarch thought that as the world warmed, the unique conditions in which they thrived — well-drained soil that's neither too hot nor too cold and that is also fed by water from snow melting upslope — would disappear, eventually leading to the trees' extinction.

Some, though not all, experts share these worries. "It's highly likely that many of the giant sequoias in their current groves may not make it for the next century," Park Williams, a climate scientist at the University of California, Los Angeles, who focuses on the Western United States, told me. He notes that the soil is becoming dryer in the southern Sierra Nevada, and snowpack is disappearing earlier in the year, ushering in a longer dry season. "We're already pushing up against the boundaries of what these trees can tolerate," Williams says. Indeed, in 2020, one of the trees Stielstra visited years earlier on his trip, known as the Waterfall Tree, was killed by wildfire, after having survived climatic lashings for millenniums.

This problem — a species under increasing threat in the place it has long inhabited — isn't limited to giant sequoias. According to the International Union for Conservation of Nature, more than 12,000 species are in similar situations. The question is what, if anything, can be done to prevent a raft of extinctions driven by our remaking of the earth's climate. For Milarch, the answer was clear. He ascribed to something called "assisted migration": moving species to more hospitable areas. Of course, you can't move a massive, 200-foot tree itself, so Milarch learned to grow new trees from samples he had collected in order to plant these genetic copies beyond the tree's current range. Stielstra was taken with this idea (though he would later be unable to find any scientists who agreed with Milarch's claim that the genetics of specific "champion" trees were special). Not only would the species be more likely to survive, he thought, but because the trees suck so much carbon out of the atmosphere, they could also help fight climate change. By the end of the trip, Stielstra resolved to move some of Milarch's trees to Seattle.

Stielstra knew that Milarch would send him coast redwoods, a close relative of the giant sequoia (both species are commonly referred to as "redwoods"). And he knew they could survive Seattle's climate: Three giant sequoias, about 80 feet tall, were growing by the entrance to a freeway that passed through his neighborhood, and there were groves of both coast redwoods and giant sequoias, healthy and majestic, in the Washington Park Arboretum that were planted decades earlier.

Not wanting to cause ecological problems by planting the trees across the Pacific Northwest, Stielstra would eventually contact one of the foremost experts on the coast redwood, a botanist and forest ecologist named Stephen Sillett, at Cal Poly Humboldt, and ask if moving redwoods north was safe. Sillett thought planting redwoods around Seattle was a fantastic idea. ("It's not like it's going to escape and become a nuisance species," Sillett told me, before adding, "it just has so many benefits.") Another factor encouraged Stielstra too: Millions of years ago, redwoods — or their close relatives — grew across the Pacific Northwest. By moving them, Stielstra reasoned, he was helping the magnificent trees regain lost territory.

A dawn redwood in Olympia, Wash. The species was rediscovered in China in the 1940s.

Credit...Richard Mosse for The New York Times

Assisted migration hinges on a deceptively simple-seeming notion: that we can, and should, help solve a problem of our own making; that we should save at-risk plants and animals by moving them to safer places. The concept was first floated in the 1980s, when some conservationists foresaw that as climate shifted, certain species protected by wildlife preserves might not be able to survive over the long-term within their boundaries. Yet the practice didn't really become a topic of scientific debate until two decades later, when a group of self-described citizen scientists decided, like Stielstra and Milarch, to do something to prevent a tree from disappearing from its current range.

Torreya taxifolia is a conifer that grows only in the ravines of the Apalachicola River system, in the Florida Panhandle. The tree, also known as the "stinking cedar," has been harmed by fungal disease since at least the 1960s. The Torreya Guardians, as the group called itself, cited evidence that the tree had been pushed to its current southerly location by the glaciers of the last ice age but was in fact better adapted to more temperate conditions than those of Northern Florida. It was unable to migrate back northward as the glaciers receded, in part, they argued, because a species of giant tortoise that may have helped disperse its seeds had gone extinct. The Guardians didn't go through an official review process to validate their contentions. They considered the tree's circumstances so dire, and officials so slow to act, that beginning in the mid-

2000s, they started moving the tree on their own, planting seeds and young specimens on private lands in North Carolina, Ohio and elsewhere.

Their aggressive approach to conservation featured prominently in numerous scientific articles that followed, discussing the pros and cons of assisted migration. One common theme that has emerged is the need for a framework within which to make decisions about facilitating the migration of plants and animals, not least because the unintended consequences could be irreversible and dire. Any biologist can cite a litany of disasters following the movement of plants and animals from the environments in which they evolved — from the constraints imposed there by competitors, predators and parasites — into new ecosystems. The cane toad, native to Central and South America, was released in Australia in 1935 ostensibly to control agricultural pests; it didn't, reproduced exponentially and became a pest in its own right. The mongoose, brought to Hawaii in 1883 to control rats, instead further decimated native bird populations. Even moving something just a few miles could cause problems. The red squirrel, transported from mainland Canada onto Newfoundland in 1963 to serve as a food source for the island's declining martens, ended up eating so many black-spruce cones — and possibly preying on nests — that a native crossbill that also relies on the tree has been in decline ever since.

These cases underscore the reality that other plants and animals are already living where you might want to introduce something in order to save it. Adding another life form could upset the ecological balance on which the native organisms rely. For these and other reasons, Anthony Ricciardi, an ecologist at McGill University in Montreal who studies invasive species and is an outspoken skeptic of assisted migration, compares the approach to playing ecological roulette. It's impossible to predict the outcome of moving plants and animals around, he says. "I would treat assisted migration as a tool of last resort," he told me in an email. "And it should be recognized as a technofix, rather than a sustainable conservation strategy."

Even so, in the roughly 15 years since the scientific debate over assisted migration first emerged among academics, what's notable today is how, naysayers notwithstanding, it's already being put into practice. Beginning in 2016, researchers from the University of Western Australia started releasing a captive-bred swamp tortoise into seasonal wetlands about 200 miles south of its natural range; it is thought that this makes it the first animal species ever relocated to protect it from climate change. Many of the animal's native wetlands were fragmented and shrinking, and conservationists feared that global warming would finish the tortoise off. "It's going to literally blink out in a few years if we don't do it," Nicola Mitchell, an associate professor at the university and the effort's lead scientist, told me.

For trees, the conversation has shifted from "should we do it?" to "how can we do it best?" The U.S. Forest Service, among other agencies, has experiments underway around the country to study what trees will grow most vigorously in today's rapidly shifting climate. Some of these trees are southern varieties of species that already grow in an area. But in a few other plots, the Forest Service has planted species, like the relatively drought-tolerant ponderosa pine, that don't yet inhabit that region of the country. By moving these trees into the area, the agency is essentially testing which, if any, of today's nonnative trees have the best chance of thriving there in the future.

Critics argue that “nature” should be left to produce its own adaptations. The counterargument is that humanity’s global impact has become so all-encompassing that “nature,” in the sense of untouched wilderness, no longer exists (if it ever did) and that inaction could mean the disappearance of life-forms or the collapse of ecosystems. Jessica Hellmann, executive director of the University of Minnesota’s Institute on the Environment and an early thought leader on what she prefers to call “managed relocation,” likens the practice to chemotherapy. “You don’t say, ‘Oh, is chemotherapy a good idea?’ No, it’s a terrible idea,” she says. “It’s only a good idea if you’re confronted with some other terrible thing,” like cancer. Similarly, she says, assisted migration is appropriate when contrasted with the other possibility: extinction if no one intervenes.

A fallen coast redwood in Jedediah Smith Redwoods State Park in California.
Credit...Richard Mosse for The New York Times

By 2019, what began as a quixotic quest to plant a few hundred redwoods in the Seattle area was becoming an organized effort, a nonprofit group that Stielstra named PropagationNation. He says its mission is to "paint the Pacific Northwest red" — here he pauses for dramatic effect — "wood." Two other tree enthusiasts joined forces with Stielstra: Bob Barnes, a semiretired landscape architect, and David Pearsall, a longtime tree farmer. Pearsall, who thought the fast-growing coast redwood was the ideal lumber tree of the future in the Pacific Northwest, brought tree-growing know-how. Barnes, who had connections throughout the area from his years in landscape design there, introduced Stielstra to dozens of communities in the Puget Sound area that wanted redwoods.

After his return from that seminal California trip, Stielstra needed to figure out who might take the 350 coast redwoods that Milarch was sending. He wanted the saplings to be cared for and to be seen by the public — and he didn't want to deal with bureaucracies like the National Park Service — so he focused on city parks departments. They would also, he figured, be more open to planting nonnative trees.

Stielstra eventually found homes for this and subsequent shipments in nearly 200 communities around the Seattle region. Olympia took several dozen, planting them in city parks because, as Charles Rambo, the operations and maintenance manager for the Olympia Parks Department, explains, native trees like the big-leaf maple and even the ubiquitous Douglas fir are increasingly succumbing to ever more severe dry spells. (Recently, fir trees in more than a million acres of the Pacific Northwest died off, a record-breaking occurrence sometimes called "firmageddon.") "The consensus seems to be that assisted migration is needed," Rambo says, not just to help southerly trees like redwoods persist as their native ranges become hotter and drier but also to reinforce the beleaguered forests of Washington and Oregon.

Eugene, Ore., received more than 2,000 sequoias from Archangel. "In an urban setting, or peri-urban setting, they strike me as ideal," Scott Altenhoff, an urban forester with the Oregon Department of Forestry, told me. "They are drought tolerant. They are extremely low maintenance." And, he adds, they are "well behaved," unlikely to invade people's backyards or nearby wild lands, as more aggressive introduced plants have.

For the Jamestown S'Klallam, a Native tribe on the North Olympic Peninsula northwest of Seattle, redwoods seemed the perfect stand-in for a culturally important tree, the western red cedar. Native Americans in the area call the rot-resistant cedar the tree of life and once used it to make everything from canoes to baskets. But it, too, was being killed off by drought. The coast redwood, also famously decay-resistant, could be used in habitat restoration. "When I got started with the tribe 20 years ago, it would have been unthinkable to move plant species out of their normal range," Hilton Turnbull, a restoration ecologist who works with the tribe, told me. "But everything has changed."

Today, Stielstra needs more trees than Milarch can provide and is procuring redwood seedlings in bulk from nurseries, which he then gives away or sells at low cost. More and more, he stresses redwoods' ability to store carbon. Because they grow so large and their wood is so resistant to decay, old-growth coast-redwood forests, he has learned, stored

the largest amounts of carbon of any ecosystem in the world, even more than the Amazonian rainforest. And thanks to the meandering contours of Puget Sound, Washington has, like California, a vast amount of coastline — in theory, prime habitat for coast redwoods. Stielstra no longer aims to plant a few groves here and there. He wants to plant forests.

A giant sequoia growing outside a residence in a suburb of Seattle. Credit...Richard Mosse for The New York Times

There are only a handful of redwood species in the world today, and two are native to California: the giant sequoias in the Sierra Nevada that so impressed Stielstra and the coast redwoods. While almost all the old-growth coast redwoods were cut down, the trees continue to grow in about 75 percent of their original range, a narrow strip of coastal land that runs more than 450 miles from Big Sur to just north of the Oregon border. This persistence highlights both the success of 11th-hour conservation efforts and the remarkable nature of the tree itself. The shoots from stumps of felled coast redwoods are each capable of becoming a full-size tree. This regenerative capacity is so robust, in fact, that in some cases it forced early American farmers in California to abandon land they hoped to cultivate, because redwoods wouldn't stop reclaiming recently cleared fields.

Such resilience highlights a seeming contradiction: The coast redwood and its cousin the giant sequoia are, respectively, the tallest and largest trees on the planet, and they are among the longest-lived. Why, then, are they found only in small slices of the world, as if

they are too delicate and finnicky to grow anywhere else? A likely answer, experts told me, is that today's redwood groves are the remnants of forests that covered vast swaths of the Northern Hemisphere millions of years ago. Judging by the fossil record, redwood varieties once grew in Europe, East Asia and across upper North America. Some scientists think that starting about 56 million years ago, as the world gradually cooled and dried after an extremely warm period, the optimal habitat for coast redwood shrank. Similar climatic trends may have pushed the giant sequoia westward from the continent's interior. As the Sierra Nevada began to rise, they created a rain shadow, a dry area, to their east. According to one theory, the trees, which at that point grew as far east as Idaho, migrated toward the sea, seeking moisture.

Despite their narrow ranges, the species themselves are not in immediate danger of going extinct in the literal sense. Partly that's because they have already been planted elsewhere. New Zealand is home to forests of coast redwood. Some of the tallest trees in continental Europe are redwoods, both giant sequoias and coast, planted in the 19th century. Such relocations highlight something that's often glossed over in the debate over assisted migration. People have for centuries been relocating trees around the globe for reasons unrelated to climate change. According to several scientists I spoke with, the question is not whether redwoods are in danger of disappearing but how climate change might alter the native communities they shape and are, in turn, shaped by — and whether portions of the iconic redwood forests might look very different in the future.

Coast redwoods are well adapted to fires of moderate intensity — their thick bark protects them from the flames — but in recent years, fires have become more intense, especially around the southern groves in Big Sur. Stephen Sillett expects the southern redwood forests to become increasingly stunted. He speculates that, at some point in the future, the tree's prime habitat in far Northern California, the place where they grow largest, which is characterized by cool nights and abundant moisture, could shift north. But that change doesn't have to mean a death knell. Millions of years ago the trees lived much further north than where they do now. "They were pushed out of the north by glaciation," Sillett says. "Humans can definitely help them move back."

For giant sequoia, the picture is slightly grimmer, if far from hopeless. Historically the trees were less often logged than the coast redwood; their brittle wood tended to shatter when felled, reducing its commercial appeal. About 70 percent of the original old-growth sequoia groves are thought to remain. But in the past decade or so, one disaster after another has befallen them. In the 2010s, the most intense droughts on record caused a loss of foliage. Then came the wildfires. The tree is exquisitely adapted to fire: In fact, it needs fire to complete its reproductive cycle; green cones can stay on higher branches for decades, until fire dries them and coaxes them to open. But the intensity of recent wildfires along the southern Sierra overwhelmed many old sequoias. Nathan Stephenson, a forest ecologist with the U.S. Geological Survey who has studied the trees for decades and who lives about 30 miles away from one grove that caught fire, recalls burned sequoia needles raining down on his deck in 2020. That's when he understood that, for the first time in his experience, the fire had reached the trees' crowns. Between 13 and 19 percent of the world's sequoias were lost in recent fires. "They've been there thousands of years," Stephenson says, "and they just sort of burned up in the blink of an eye."

In the face of this and other threats, like beetle infestations, many people are taking steps to protect the trees. The nonprofit organization Save the Redwoods League, for example, is replanting sequoias. Anthony Ambrose, the executive director of the Ancient Forest Society, another nonprofit, collects cones for seed banking. There's also renewed emphasis on fighting fire with fire. It has escaped no one's notice that groves recently subject to prescribed burns, in which the underbrush and detritus that acts as kindling has been deliberately burned off, did not suffer the same catastrophic losses as untreated groves.

Among land managers, the reactions to efforts like Stielstra's run from exasperation to carefully qualified endorsement. "I don't think private people moving sequoias to Washington is a bad thing," Christy Brigham, the chief of resource management and science at Sequoia and Kings Canyon National Parks, told me. But she and others argue that conservation efforts should focus on better management of the land where they already grow. "We need to not give up on sequoias where they are now," she says.

Redwoods may be a perfect candidate for assisted migration. They are relatively slow to colonize new territory and, thanks to their size, very conspicuous. And they aren't likely to spread like, say, the kudzu vine, which, since its introduction from Japan in the 19th century, has overgrown large tracts of forest in the American South. But even in a case in which the organism in question seems relatively benign, a bigger question always lurks in the background of any proposed assisted migration: How do we decide which plants and animals deserve to be saved?

Redwoods are perhaps the most charismatic tree species in the world. Even the biologists and ecologists I spoke to tended to speak in awe-tinged terms when explaining to me what the trees mean to them, how these ancient behemoths make them feel insignificant in the best way, displacing their worries with a sense of peace and wonder. But what about humbler life-forms that don't readily inspire the same emotions — insects, fungi, worms, rodents — that may nonetheless be no less important in their ecosystems?

Hellmann, of the University of Minnesota, describes this as a value problem. The decision to save one species but not another is inevitably informed by how we feel about the organism in question. Moreover, even if the will existed to save the thousands of species threatened by climate change by moving them all, is such large-scale translocation really possible? "The bigger problem with assisted migration is that it's not up to the task," Hellmann says. "It's a tool in the toolbox, but I see it as a fairly small hammer."

Yet the concept of assisted migration, even if no panacea, at least acknowledges the increasing fluidity of the world. In doing so, it breaks with traditional approaches to conservation that assume more static landscapes. This is no small shift in mind-set. The Endangered Species Act, for decades a cornerstone of efforts to preserve species, tries to save and, if necessary, reintroduce species to their historic habitats. But what if animals or plants can no longer survive where they used to live? Consider a large-footed rodent called the Bramble Cay melomys. It used to inhabit a small island off Northeastern

Stielstra measures his favorite tree behind a coast redwood sapling in Laurelhurst Park in Seattle. Credit...Richard Mosse for The New York Times

Australia. The animal disappeared around 2009 as rising seas swamped its home, and it's now considered the first mammal to fall victim to climate change. But imagine if conservationists had a captive population — where would they introduce it now? Who would accept another type of rodent in their backyard?

Stielstra doesn't pay much mind to these larger conundrums. He just wants to get redwoods in the ground. One warm day in July, I accompanied him and Barnes on a drive through the dense, fir-dominated forests around Hood Canal, a fjord connected to Puget Sound, to visit various redwoods, some of them planted by PropagationNation. As we drove, Stielstra confessed that he felt the "proverbial Mack truck" of age bearing down on him — he would be 77 in November. Several of his colleagues at PropagationNation had recently taken sick. "We're a bunch of old farts," he said. "Time is not on my side." Within the next few years, he told me, he wanted the organization to have enough momentum to enable him to pull back.

Nearly 10,000 trees have passed through PropagationNation so far. From the first batch of 350, about 25 percent have died. Either they hadn't been watered enough in the years after they were planted or they were too exposed to wind and sun (redwoods like to start under the protection of other trees). But Stielstra and Barnes have been learning what conditions are most conducive to redwood health in the Pacific Northwest; Stielstra calculates the current survival rate of the trees they plant is around 90 percent. And their ambitions have grown: They now aim to plant at least one million redwoods yearly by 2027.

And while they had mostly trafficked in coast redwoods, in some ways the potential was greater for the giant sequoia, a tree more tolerant of cold and dry conditions. Unlike the coast redwood, giant sequoias could theoretically, they thought, grow on the drier eastern side of the Cascade Mountains. A lingering question, though, is whether they could propagate by themselves in Washington. The experts I asked knew of no instances in which the giant sequoia had naturally produced offspring anywhere beyond its native groves in the Sierra Nevada.

Stielstra, however, knew of a place in Washington where the coast redwood appeared to be reproducing without human help. It was on the grounds of the Seabeck Conference Center, a bucolic retreat on the eastern shore of Hood Canal. There, we traipsed through thick woods where a previous director had, simply because he liked the tree, planted dozens of coast redwoods in the 1980s. It took some effort to find the slender redwood saplings in the gloom. Barnes and Stielstra couldn't be certain they weren't just offshoots from a "mother" tree's roots or even that they weren't trees originally planted decades ago that had simply failed to grow. "We need a scientist to confirm," Barnes said.

The air was moist and cool, suffused with the briny scent of the sea. "This is a tree paradise," Stielstra said. Barnes concurred: "This is a gold mine." The delicate saplings gave no hint of the massive trees they could become. They seemed to be waiting under the dense canopy of maple, hemlock and fir for some disturbance, an opening, that would give them the chance to shoot up and dominate the forest in turn.

California redwoods on the Boy Scout Tree Trail in Jedediah Smith Redwoods State Park.
Credit...Richard Mosse for The New York Times

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