INTRODUCING THE BEETLES

The tamarisk is an exotic shrub that's been spreading across the Arizona landscape since the mid-1800s. Twenty years ago, an insect that devours the leaves of that shrub was brought in to help restore some order. Unfortunately, the tamarisk leaf beetle is more aggressive than expected — and, as a result, even more of the state's ecosystem is at risk.

BY NOAH AUSTIN

HUMAN BEINGS HAVE A KNACK for starting things. But not for stopping them.

That truth is at the center of a story that's entering its endgame along Arizona's waterways. The short version: A century and a half ago, a type of exotic shrub arrived in North America. It quickly spread, populating riparian areas where plants native to this land once thrived. Twenty years ago, an insect that devours the leaves of that shrub was brought to the American Southwest in an attempt to restore order. But now, *that* transplant is spreading fast — and, as a result, more of our region's ecosystem is at risk.

Below the surface, though, the story of the tamarisk and the tamarisk leaf beetle is one of good intentions and unforeseen consequences. Of events set in motion long ago and landscapes changed forever. And of what can happen when we take away Mother Nature's keys and put ourselves behind the wheel.

"It touches on so many issues beyond rivers, plants and species," says Greg Beatty, a Phoenix-based biologist with the U.S. Fish and Wildlife Service. "The way we treat all of this, and our perspectives, is really an important factor. We made choices based on what we wanted to see."

And because of those choices, what we'll see next is anyone's guess.

IN 1938, UNIVERSITY OF MICHIGAN botany professor Elzada Clover and her student Lois Jotter were journeying down the Colorado River as members of an expedition that would make them the first women to traverse the Grand Canyon by boat. Along the way, they spotted a spindly sapling growing on the riverbank. Jotter snapped a photo — the first known visual evidence of tamarisks (genus *Tamarix*) growing in the Canyon.

It's possible, though, that tamarisks had been there for decades. Native to Europe, Asia and Africa, the shrubs — identified by their numerous slender stems, tiny green leaves and small pinkish flowers — came to North America in the mid-1800s. Their tolerance for salinity begat their colloquial name, "salt cedar"; that trait, combined with their deep roots, made them appealing for controlling erosion on beaches and sandbars, while the dense foliage of a mature tamarisk created an effective windbreak.

And so, tamarisks took root in the New World. And then they began to take root wherever they could. By the 1910s, scientists were finding them along Phoenix's stretch of the Salt River. But for the first half of the 20th century, the plants' proliferation drew little concern. As Arizona State University's Matthew K. Chew writes in the *Journal of the History of Biology*, botanists and ecologists of that era "displayed mostly mild interest and curiosity regarding *Tamarix* species," while horticulturists "uniformly recommended tamarisks as drought- and salt-tolerant ornamentals." Even conservationist Aldo Leopold, who generally opposed the introduction of non-native species, planted a tamarisk at his Albuquerque home around 1920.

During World War II, Chew notes, attitudes changed. Citing dubious estimates of tamarisks' water use, federal experts who once had promoted them for erosion control now "declared the plants to be worse than useless," casting them as "machine-like monsters pumping away scarce Western water." What

followed was a 20-year government campaign of cutting, bulldozing and spraying tamarisks — all of it an effort, Chew concludes, to make the plants "a convenient scapegoat for the complex problems encountered by government water managers."

It's easy, in hindsight, to see how that happened. In the West, water is our most precious resource, and the idea of an exotic invader siphoning it away was compelling, particularly in wartime. But the scientific understanding of tamarisks has evolved since then. Beatty, throughout his career, has studied the relationship between the shrubs and the waterways on which they thrive. He noticed that restoration projects that simply removed tamarisks and replaced them with native cottonwoods and willows usually didn't work. "I started to try to understand why the tamarisk occurs," he says, and what he found was that "it didn't take over an area and prevent native vegetation from occurring; it was a plant that was responding to changing conditions on the land."

Water was the critical factor. Decades of damming rivers and diverting water for agriculture and development had left river flows and groundwater elevations far below their historical levels. There simply wasn't enough water for the native plants to flourish as they once did. But tamarisks, thanks to roots that can reach 25 or 30 feet underground, were able to fill the void. "It largely isn't a plant issue — it's a river issue," Beatty says. "[Tamarisks are] a symptom of how the landscape has been changed."

What haven't changed are some enduring tamarisk-related myths, including the claim that each plant consumes an impossible 200 gallons of water per day; in reality, according to the U.S. Geological Survey, a tamarisk uses less water than the average cottonwood or willow. That's not to say tamarisks are model houseguests, though. They form dense thickets along waterways, blocking access for recreation and agriculture. Those thickets burn hot and fast, increasing wildfire severity in areas already more susceptible to fire due to drier conditions. And tamarisks' extensive root systems can lead to narrowing of a river's channel, making floods worse and lengthening the areas they affect.

All things considered, a riparian area lined with native trees, rather than tamarisks, is ideal. But in many places in Arizona and elsewhere, the ideal is no longer within reach.

"When we look at restoration, I think we should probably do a lot more in figuring out what will work where," says Ben Bloodworth, the program coordinator for RiversEdge West. Formerly called the Tamarisk Coalition, the group works to restore riversides across the Southwest by, among other things, replacing tamarisks and other invasive plants with native species. "If you have a spot that's historically been a beautiful cottonwood gallery with a willow understory, is the water table there now to support that?" Bloodworth asks. "We spend a lot of time, money and effort on more of a cultural restoration than an environmental one. People want to get back to what they remember, or what they envision it 'should' be. There are a lot of places, especially in the water-hungry West, where that's just not possible anymore."

Bloodworth adds that the key is finding places where restoration can have a positive, lasting impact. But now, there's another variable in this equation, and it doesn't care which places it affects.

It just wants to eat.

THE TAMARISK LEAF BEETLE (genus *Diorhabda*) is tiny — about as long as a ladybug, but with a thinner body that's green or straw-colored. To us, it's barely noticeable; to a tamarisk, it's an assassin. It's perfectly suited for the plant's small leaves, which are the only thing the beetle eats. It and its larvae extract the nutrients, rendering the leaves dry and brown. When it happens repeatedly over a period of months or years, this process, known as defoliation, weakens the plant — and, in some cases, kills it.

The beetles, like the tamarisks, aren't native to North America. But in 2001, the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) won approval to introduce the beetles in the U.S. as a biocontrol agent. Over the next several years, the agency did so in Texas and six Western states, including all five of Arizona's neighbors. Arizona itself wasn't included — in part because while the tamarisks had been adapting to our environment, an endangered species had been adapting to them.

That species is the Southwestern willow flycatcher (*Empidonax traillii extimus*), which typically nests in willows in dense riparian areas. As those areas became endangered themselves, biologists noticed that some bird species, including the flycatchers, were nesting in tamarisks when willows weren't available. "[Tamarisks are] very dense, and some species need that cover for nesting — there's less predation and less cowbird parasitism," says Matthew Johnson, an avian ecologist at Northern Arizona University's Colorado Plateau Research Station. "It also keeps the temperature lower and the relative humidity higher."

A biological assessment conducted before the beetles were released noted that the release sites were at least 100 miles from areas where flycatchers were known to nest in tamarisks. And it suggested that the beetles would not spread more than 2 to 4 miles per year — meaning that, at worst, it would

PRECEDING PANEL: Tamarisk leaf beetles feed on the leaves of a tamarisk near the Eastern Arizona city of Safford. This area's tamarisk stands are some of the oldest and densest in the United States.
BRUCE D. TAUBERT

RIGHT: In many parts of the Southwest, tamarisks have occupied areas where native trees, such as cottonwoods and willows, no longer have adequate water to thrive. Here, the shrubs have proliferated on the Salt River below Saguaro Lake.
BRUCE D. TAUBERT

be 25 years before they threatened the birds' newfound habitat. A subsequent APHIS proposal added that the agency was employing "unprecedented safeguards and precautions" to protect the flycatchers in the "very improbable" event that the insects needed to be controlled.

But the beetles proved to be more than willing to hit the road. Bloodworth says they easily travel 20 to 30 miles in a year; if conditions are right, it's more like 40 to 50 miles. From their origin points in Utah, the beetles quickly colonized the Virgin River, a key flycatcher nesting area on the Arizona Strip. By 2011, they'd reached Lake Mead, and a year later, they'd traveled down the Colorado River to the lower end of Lake Mohave. By 2016, they were defoliating tamarisks on both sides of Lake Havasu and at the mouth of the Bill Williams River.

During this time, the beetles became well established across the Colorado Plateau, which includes most of Arizona's northern half. Then they started showing up farther south. In 2019, they appeared along the Verde River; last year, another population, one that originated from releases in Texas and New Mexico, was found in Eastern Arizona's Graham and Greenlee counties, in the upper Gila River watershed. And this past summer, large swarms of beetles descended on the Safford area, farther down the Gila. Bloodworth expects them to become established along that river and in the Phoenix area in the next two or three years — and within five years, he says, they'll be on every Arizona waterway where tamarisks grow.

That means the Southwestern willow flycatcher could soon face a reckoning. Tice Supplee, director of bird conservation at Audubon Southwest, says it isn't yet known how the beetles' spread will affect flycatchers and other bird species in the long term. But she notes that large, dense tamarisk stands that extend past the floodway and into drier areas aren't good for the birds. "A tamarisk in the absence of water is not good habitat," she says. "It has to be in proximity to surface water." In that sense, a reduction in tamarisk numbers could be positive.

But a defoliated tamarisk isn't good habitat, either, and nature's timing works against the flycatchers in that regard. "The beetle defoliates tamarisks right during the nesting period," Johnson says. And if the plant can't provide cover to alleviate high temperatures, the birds will abandon the nest and the eggs won't hatch.

The beetles' effects won't be the same everywhere. Waterways such as the upper Verde River and Southern Arizona's San Pedro River are largely unregulated, with a higher groundwater level; there, tamarisks grow in harmony with native trees. If the beetles reduce the tamarisk population in those areas, "there are opportunities for native vegetation to grow," Beatty says. In contrast, think of the Colorado River and much of the Gila River, where flooding is prevented and groundwater is far from the surface. "There isn't much opportunity for native trees," Beatty says. "When the beetles affect locations like that, we're going to lose vegetation and habitat."

That's the situation in the Safford area, and Bloodworth notes that some of the country's oldest and densest tamarisk stands are found there. "It's a huge monoculture," he says, and as a result of the insects' feast this year, "we're expecting very large beetle populations."

And very large beetle populations, he adds, tend to travel a very long way.

BELOW: Along the Gila River upstream from Safford, defoliation by tamarisk leaf beetles has turned tamarisk leaves dry and brown. Over time, this process could dramatically reduce tamarisk populations.
BRUCE D. TAUBERT

OPPOSITE PAGE: How the beetles' spread will affect the endangered Southwestern willow flycatcher, one of the species that use tamarisks for habitat when native trees are not available, remains to be seen.
U.S. FISH AND WILDLIFE SERVICE

HERE'S WHAT WE KNOW: Tamarisk leaf beetles won't eat themselves into oblivion. Once they become established everywhere tamarisks exist in North America, they'll eventually reach an equilibrium with their sole food source. While the insects will reduce tamarisk populations — perhaps by 75 to 85 percent in some areas — they won't eliminate them. And although dry, defoliated tamarisks may pose an even higher wildfire risk for a short time, green tamarisks are more flammable than dead, bare branches, so observers expect the beetles to be a long-term benefit when it comes to fires.

That's the good news. But what will happen to Arizona's riparian areas when many of the tamarisks there now are gone? That will depend on the choices we make — and most of those choices will come down to water. In biodiverse areas where there's enough of it, cottonwoods and willows will take the tamarisks' place. But on heavily regulated waterways with little groundwater, they won't — unless we allocate more water for restoration.

And in those places, that's a tall order. "On the Gila, all the water goes to agriculture — cotton farmers upstream, alfalfa farmers downstream," Johnson says. "Those guys are already fighting [for water rights]. They're not about to release water for restoration efforts. … If they took out all the dams, we'd have no problem at all. But that's not gonna happen." And a hands-off approach doesn't seem workable, either. "You've got to have something to come in and take over behind tamarisks," Johnson says. Otherwise, invasive weeds such as kochia, another Eurasian import, will take over, and those plants don't provide adequate habitat for birds and other wildlife.

The goal, experts say, should be rivers that strike a balance between a plant that's here to stay and the plants that have been here all along — perhaps, as Johnson suggests, a mix of 70 percent native plants and 30 percent tamarisks. "That's a reasonable goal," Supplee says. "My optimistic side hopes that the beetle will contribute to that." Audubon Southwest has supported efforts to restore river courses and plant native trees, along with encouraging transactions that lead to rights holders keeping more of their water in the river. "These systems are dynamic, and without water, trying to have habitat that's beneficial for the flycatchers and other birds is kind of a lost cause," Supplee says.

When it comes to the flycatchers, Bloodworth says, it might

be beneficial to think small. "As long as the surface water and the hydrology are there, you don't need that much space for this bird to do well," he says. "Rather than thinking about having to save 100 acres, figure out how you can protect a few acres of patches as small as a tenth of an acre in one place and another tenth of an acre 100 feet away." Creating a string of small nesting territories, he says, could greatly reduce the cost of protecting this imperiled species.

That thinking is in line with the targeted approach to tamarisks that Bloodworth believes is the region's best way forward. "When you're working in environmental restoration, it's hard for people to accept that having this invasive species — one you've worked against forever — might be OK in certain situations," he says. "There are some areas where, if tamarisks are removed, nothing else will grow there. It's just going to be a desert."

Beatty notes that the arid Southwest is a difficult place for plants to grow, and that the beetles' arrival is "an additional stressor to a system that already is dynamic." And it's difficult, he adds, to know how to deal with that, given that public opinion on the beetles — and the tamarisks, for that matter — is so polarized. "Because the effects aren't the same everywhere," he says. "You could have somebody on one piece of dirt who thinks the beetle is great, and someplace else, where the effects are not going to be good, people might think it's horrible."

In a way, though, that's fitting. Because the tamarisk, the tamarisk leaf beetle and the Southwestern willow flycatcher are supporting characters in this story, which really is about Earth's most ambitious species — and the effects of the decisions we've made. "We definitely learned that moving things around the planet can have unexpected results, good or bad," Bloodworth says. "No matter how much research and testing you're doing — and they did years and years of it [on the beetles] — when you're dealing with moving species to a different continent, it's just really hard to predict how that will go."

Beatty takes an even broader view. "There are all sorts of conditions out there that you can layer on top of each other and start to reach some conclusions about lessons learned," he says. "To try and boil it down, though: We've changed the world through the way we've altered our landscape."

In many places, tamarisk leaf beetles now are a part of that landscape. In others, they soon will be.

And we have ourselves to thank for that. AH