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COVER STORY

Devastated Page All

The World's Largest Known Organism Is In Utah-And It's Dying

By Matthew D. LaPlante & Paul Christiansen

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FISH LAKE NATIONAL FOREST—There was a boy named Gary here, in 1984. He carved his name into the bark of an aspen tree, and, next to that, the name of his lover, Lori.

Then, hedging his bets against beavers and beetles, fires and foresters, he did it again. And again. And again.

The letters he cut into these chalky-white trunks long ago blackened into thick, rough scars. Some have cankered, oozing with coffee-colored sap. At least one of the trunks that carried Gary's marks has fallen, split and splintered right above his name.

Love being what it is, it's possible these carvings have outlasted Gary and Lori's romance. Aspens being what they are, it is very likely they will outlast Gary and Lori, too.

But in the long run—and it is a very long run—all of these marks will fall away. The bark will peel. The trunks will fall. Time will do what time does to all things.

Even to this ancient aspen forest.

It cannot be known for certain—not by any tool or trick of today's science, at least—but this unified colony of aspen trees might be the oldest living thing on the planet.

It is also the most massive known organism in the world.

Clones—as singularly genetic, interconnected aspen woods are called—spread below ground, crawling just beneath the surface of the terrain through a unified root system, stretching out

for water, reaching up for sunshine. As they do, they grow. Sometimes they grow to be an acre; occasionally, they get as large as two.

Over time, an entire colony can migrate from one place to another as it seeks better soil and exposure to the sky. Sometimes, in the midst of this long, slow journey, a part of the clone can become separated from the master colony by a landslide, fire or human intrusion. But, like conjoined twins split by a surgeon's knife, the parts remain genetically identical to the whole.

It's possible that's what happened to this clone—a highway runs right through the center of this colony. If so, the separated twins would still likely be the first-and second-largest organisms in the world—that's just how big this behemoth is.

Nestled alongside Coots Slough, near the southwest corner of Fish Lake in Utah's Sevier County, this aspen clone spans more than 430,000 square meters—more than four times the size of New York's Yankee Stadium.

And deep in this hundred-acre wood is a mystery that scientists are now rushing to solve.

What is killing this great and ancient thing? And can it be stopped?

STATE TREE

There will certainly be more important things for the Utah State Legislature to consider when its members return to Capitol Hill in early 2014. But among the first pieces of legislation the body is likely to debate is a proposal to adopt the quaking aspen as Utah's state tree.

Since 1933, Utah's tree has been the blue spruce—the *Colorado* blue spruce, to be precise. And each year, when they learn this, the students in Angie Blomquist's fourth-grade class at Monroe Elementary School laugh at the absurdity.

This year, the class decided to do something about it. And as it happened, a member of the Sevier County Board of Commissioners named Gordon Topham had also been thinking it was time for a change in the state tree.

With a little political pull and a bit of good timing—the Rocky Mountain Jamboree was coming up in nearby Richfield—Topham arranged for Blomquist's students to make their case to Gov. Gary Herbert, who would be addressing attendees at the festival for ATV enthusiasts.

Pulling leaf-shaped pieces of paper from a potted tree, the children recited facts about aspen.

"Did you know," one of Blomquist's students read, "that the largest living organism in the entire world lives right here in the state of Utah?"

The children's pitch won the governor's support for legislation drafted by then-Rep. Spencer Cox, R-Fairview, recently named as Herbert's lieutenant governor. It will be sponsored in the Senate by Ralph Okerlund, R-Monroe, whose district includes Fish Lake—and whose granddaughter's name is Aspen.

If the effort succeeds, some scientists hope, it might open more resources for protecting the Fish Lake aspen colony.

And if that happens, it will have been a long time coming.

It was a University of Michigan forest ecologist named Burton Barnes who first suggested that the Fish Lake clone might be a single, unified organism. Using aerial photos and comparing the patterns of its leaves and bark, Barnes drew a 107-acre perimeter around the colony on a map and published his report in a Canadian scientific journal in 1976.

In findings that were mostly lost to obscurity, Barnes had laid the foundation for claiming the discovery of the world's largest organism.

But superlatives aren't often scientifically helpful. By definition, they're outliers. And Barnes appears to have been reluctant to make a big deal of his big forest.

"Many ideas and comments were written about the large clone and other candidates, but I was not inclined to make a contribution at that time," he writes in an e-mail. "That's still my view today."

He had nonetheless drawn the attention of other researchers—including some who would come to see that preserving these woods might help ensure the longevity of many others.

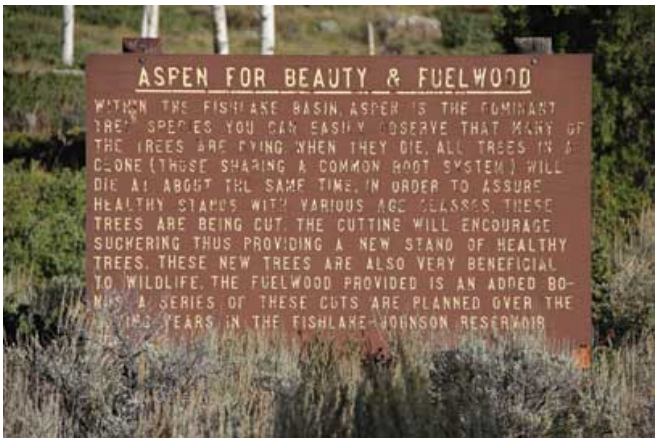
BEAUTY FOR FIREWOOD

The ages of most trees, even the very old, are relatively easy to determine. And just about everyone knows how to do it.

It starts with a clean cut across the waist, like arborist seppuku. Once the rings are exposed, the counting begins. With some scientific caveats, each ring represents a year.

Special augers, called increment borers, are used to extract long, cylindrical core samples by researchers who don't want to cut down the trees they're aging. That doesn't always work out, though. In 1964, a University of North Carolina graduate student named Donald Currey broke two expensive borers trying to age a Great Basin Bristlecone Pine near Wheeler Peak, just south of Highway 50 near the Utah-Nevada border.

It was only after U.S. Forest Service officials helped Currey cut down the tree and started counting the rings that anyone realized that they'd killed what was then thought to be the oldest tree in the world. "Prometheus" was nearly 5,000 years old, meaning it had come into being right around the founding of Troy.



Currey would go on to become a popular and influential teacher and researcher in the geography department at the University of Utah, but he carried the ignominy of what he had done all the way to his death in 2004.

“Many tree-hugger types have attacked Currey for felling the tree,” obituary writer and former student Bob Sewell eulogized in an online memorial to his teacher, “but they should remember that no one knew its age. It could have just as easily been cut to pieces by some camper wanting to make a fire.”

At least two other subsequently discovered bristlecone pines—perhaps as old and possibly older than Prometheus—are purportedly alive and well in California’s White and Inyo Mountains; their exact locations are a rather closely guarded secret.

The irony is that Prometheus was not well known until it was destroyed. And the hidden pines — including one named Methuselah, for the figure from Hebrew scriptures who is said to have lived longer than anyone else in history—are largely unprotected from those who might do them harm every bit as carelessly as Sewell suggests.

By contrast, just a few hundred miles to the east of the place where Prometheus long stood guard—and, it might be worth noting, at remarkably similar latitude—the Fish Lake clone stands, wide open, for anyone to come and see. And this comes with its own set of challenges.

Visitors can camp here. They can start fires here. And there was a time not so long ago when campers were cutting down parts of this aspen clone for firewood.

That’s what Michael Grant saw when he made his first pilgrimage to this place.

“There were campgrounds and cabins and firewood-cutting areas inside the clone,” says Grant, a professor of ecology and evolutionary biology at the University of Colorado in Boulder. “It wasn’t marked. No one was doing anything to highlight it. There was nothing to signify that it was an important natural wonder.”

That’s because it wasn’t. Not in the way that most people think, at least. Not in the way that just about everyone who ever went to science camp learned to age trees.

Cut down any of this aspen clone’s stems—what researchers often call the trees’ trunks—and the rings inside might indicate that it first broke through the surface of the soil 100 years ago. Even the most senior stems in this clone were born after Utah’s Mormon pioneers arrived in the mid-19th century. Like the hair on a person’s head, new ones emerge as older ones die, but the forest remains.

And this, Grant says, made the Fish Lake aspen clone rather uninteresting to many people—so much so that, rather than being aghast and contrite, as many were when Currey chopped down Prometheus, forest service officials were actually facilitating the fall of this clone.

Though chipped and peeling, an old forest service sign alongside Highway 25, which cuts a northeasterly line across the colony's center, still trumpets "ASPEN FOR BEAUTY & FUELWOOD."

Grant also recalled that the clone's stark stems had become a gallery of arborglyphs. The carvings, concentrated around campsites, were mostly names and initials. But there were also hearts and peace signs, scriptural citations and swastikas, happy faces and crude pornographic sketches. Each carving invited insects and disease.

Soon, Grant came to see the clone's broad anonymity as a threat to its safety.

Even today, many of the autumnal visitors to this hallowed place are awestruck by the changing leaves—a fire in the trembling canopy—unwitting as to just how long it has been burning.

And in 1992, Grant came upon a way to change that.

Writing in the journal *Nature* that year, a team of Canadian and American researchers bragged that they had found the world's largest singularly genetic organism—a 38-acre fungus growing on the roots of trees in Michigan's Upper Peninsula. Not to be outdone, the U.S. Forest Service and the Washington State Department of Natural Resources countered with their own discovery—a 1,500-acre fungus south of Mount Adams in the Evergreen State, weighing in at an estimated 825,000 pounds.

But bettering them all in *Discover Magazine* the following year, Grant laid out the case for Utah's enormous aspen clone.

With more than 47,000 individual stems and an interconnected root system that is even more expansive, the Fish Lake clone weighs an estimated 13 million pounds, Grant wrote. That's roughly equivalent in weight to 35 blue whales—and some three times the weight of California's largest sequoias, which are conventionally thought to be the world's largest trees.

And reasoning, as many conservationists have, that humans have a harder time destroying things that have been anthropomorphized, Grant gave the clone a name.

He and his colleagues called it "Pando"—Latin for "I spread."

"It was simple. It was easy to say," Grant says. "It had nice phonemes. It fit the situation reasonably well. I'm sure there were a lot of other things that would work, but that's what we went with."

The name stuck.

A wave of media attention followed—most of the gee-whiz-isn't-that-something sort that accompanies the biggest, oldest, shortest or smallest of anything.

But some of it caught Grant by surprise. "One journalist wanted to know if Pando was a danger to the human populations here," he says. "I don't know what they were thinking—we certainly weren't suggesting it was taking over the world."

THE REAL METHUSELAH

The ultimate impact of Pando's publicity was uneven. The recreational firewood cutting stopped—officially, at least—but all these years later, there's still very little that distinguishes Pando from neighboring aspen clones. Camping continues. So, too, does the wanton defacement of its sensitive bark. Among the initials carved into the trunks are plenty marked '11, '12 and '13.

It's possible the dearth of public understanding and lack of political protection are related to the rather late-coming scientific surety as to Pando's superlative qualities. For while Barnes' 1970s estimate of Pando's size certainly convinced Grant, there were plenty of questions left unanswered.

It wasn't until just a few years ago that Utah State University conservation geneticist and molecular ecologist Karen Mock began genetically testing aspens. She collected hundreds of leaves from Pando and sent dried leaf samples to USU and the National Forest Genetics Lab in Placerville, Calif. for testing.

Mock was dubious of Pando's purported reach, but to her surprise, the analysis confirmed a border area for one singularly genetic clone that almost exactly matched the one Barnes had drawn on a map more than 30 years earlier. Mock and her collaborators reported their findings in a 2008 article titled "Pando Lives," published in the journal *Western North American Naturalist*.

Barnes' prescience, when it came to Pando's size, lent new credence to another of his theories about the colony—that its large area might be indicative of a very ancient past. Based on the distinct appearance of the clone's leaves and similar-looking fossils, Barnes also concluded it could be as much as 800,000 years old—an estimate that would put Pando's birth alongside some of the earliest humans.

More recent estimates have been derived from looking at the rate at which aspen clones spread their seeds. Declining fertility, researchers have found, can be connected to age. Still others have reasoned that the maximum known growth rate of aspen clones can be divided into a clone's total size to give a minimum possible age.

Popular opinion has coalesced around 80,000 years. It is, at best, an educated guess. But if it is true, Pando is 16 times older than the oldest known bristlecone pines of California and Nevada.

Generation by generation, human DNA has changed significantly in that time. But if Barnes, Grant and Mock are correct about Pando's genetic uniformity—and there is little reason to believe they are not—the heritable material that is the basis for everything that is Pando has not changed at all. The code that was written when Pando was created—the very record of that time and place as expressed in an aspen genome—remains as it ever was.

But now, finally, it might be coming to an end.

"WHERE DO WE EVEN START?"

It wasn't long after Pando's great size became a matter of genetic certitude that researchers began to notice something striking about the clone.

Pando didn't appear to be impacted by the same sort of abrupt die-off, often called Sudden Aspen Decline, that had been observed in other colonies, but it was dying nonetheless.

Mature aspen trunks last 100 years—200 at the very outer limits—before falling away as new growth takes over. In a healthy clone, the cycle is perfectly balanced, with equal numbers of juvenile, adolescent, adult and senior stems.

But when Utah State University wildland resources researcher Paul Rogers took a walk through Pando in 2010, he was alarmed at what appeared to be an almost complete lack of the younger generations.

"There are no juveniles, no adolescents and very few adults, but there are plenty of seniors, and, of course, they're either dying or will be soon," says Rogers, who directs the Western Aspen Alliance, which coordinates and facilitates research. "Something's been disrupted. There really hasn't been any new growth for three, four, five decades."

There's little debate in favor of this being a healthy state for aspen—"no more than a human community comprised of all senior citizens would be," Rogers says.

It is possible, of course, that Pando has reached the end of its incredible life and is simply dying of very old age. By this line of reasoning, it is mere coincidence that humans have arrived just in time to witness its demise.

Rogers, though, reasons there is a more direct cause.

"The evidence certainly suggests that something has changed in the recent history of this plant," he says. "And clearly, the biggest change in the recent past is us."

And if that is true, Rogers says, "it's incumbent on us, if we think we're the ones who screwed things up, to do what we can to right it."

That ambition, though, poses a profound challenge: No one is yet certain what it is that has so grievously wounded this enormous, ancient being.

After examining the clone a few years back, forest pathologist John Guyon sat down to list the potential causes of its demise in a letter to colleagues at the U.S. Forest Service. Like a

geriatrician chronicling the symptoms of a long-suffering patient, Guyon noted Pando was suffering from boring insects, bark beetles, canker infections, bark rot, leaf diseases, root decay and fungal attacks.

That's likely just the beginning, Guyon says.

Aspen, he noted, thrive in the midst of disturbance. Cut down a clone's stems, and a healthy aspen root system will send up many more in replacement. Allow a fire to rage through a colony, and new suckers will often follow the path of the flames.

"And the dominant disturbance across most of the Western landscape," Guyon says, "is fire."

Or, at least, it long has been. In recent decades, with homes and cabins scattered across one of the state's favorite recreation areas—including some dwellings situated within the clone's boundaries—state fire managers have not been prone to sit idle.

That is not a phenomenon limited to Pando. "You have a bunch of aspen forests throughout the West where there have not been anywhere near as many fires as there used to be," Guyon says.

Climate change has likely played a role as well—and if it hasn't yet it almost certainly will, according to a joint research effort from the U.S. and Canadian forest services. In an elegant study that plotted changes in climate against forest health, the collaborators demonstrated that regions that have been impacted by the most drastic aspen die-offs were closely aligned with areas that have experienced hotter temperatures and drier winters in recent years.

The implication, the scientists concluded, is that aspen woods might be more precariously balanced than many believe—and small changes in climate in coming years could result in even more drastic die-offs.

In September, following an afternoon hike through Pando's western stretches in an unsuccessful search for any new growth, Rogers stopped on a hillside overlooking one of the most brutally devastated stretches of the Pando clone, where recently fallen trunks far outnumber those that remain upright.

He raised his hands in exasperation.

"Given everything we know about everything that's going wrong, where do we even start?" he asked.

NEW GROWTH

At least for now, the answer to Rogers' question is right down the hill. That's where the U.S. Forest Service has erected a fence around dozens of acres of Pando's eastern woodlands.

The fence—a $50,000 testament to Grant's vision that making Pando famous might secure the funding needed to help save it—comes in response to yet another theory about what is killing the clone.

"The individual aspen stems—not the clone, the trees above the ground—they don't live forever," says Jim Long, a professor of forest ecology at USU. But if "you cut those big guys down with a chain saw or let a fire burn through there, you'll get those new suckers sprouting and the clone is perpetuated. Unless, when that happens, herbivores stop it."

Young aspen leaves are a favorite snack of the elk and mule deer that graze in this region, and the fence is intended to help protect whatever young stems breach the surface.

This has been tried, on a smaller scale, in the past. But falling trunks from the dying clone breached the fence and, within days, years of work were ruined.

"It was like a salad-bar buffet," Rogers says.

Aside from hunters, Utah's 60,000 wild elk and 350,000 deer have little to fear. Their chief natural predator, the once-statewide population of gray wolves, has been hunted nearly to extinction.

"Without carnivores, there's nothing out there to keep them moving," Rogers says. "There's

really nothing at all to keep them from bedding down in an area and just eating for a week or a month."

Better monitored, this time around, the fence might give young stems a shot. But while that might buy Pando some time, it's not a scalable option for other aspen clones.

And ultimately, given the perfect storm of pressures Pando faces, no single action can guarantee the clone's future.

But on the day after standing over Pando's dying southwest corner, Rogers was inside the month-old fence, marveling at growth he hadn't seen in these parts for years.

"Here's one," he says, running his fingers over the leaves of a shin-high stem before darting to another, which looked as though it might have just broken out of the ground. "And here's another ... and another."

In those moments, he was not a scientist. Not a conservationist in mourning over this beautiful forest. Not a man trying to turn back time.

He was a boy at play in a hundred-acre wood. And that's the sort of thing that lives forever.

Matthew D. LaPlante is a professor in the Department of Journalism and Communication at Utah State University, where Paul Christiansen is an undergraduate student studying journalistic writing.

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