


DETECTIVE DENDRO

# THE DIAGNOSTIC SLEUTH

By Guy Meilleur

# The Case of the Ionized Eyeful

Walnuts, by *Pityophthorus juglandis* and *Geosmithia morbida*. Oaks, by *Pseudo pityophthorus minutissimus* and *Ceratocystis fagacearum*. Dominant trees across the land are being dominated by insects, and the insidious diseases they vector. What in the ecosystem is out of balance—lack of predation on the insects, perhaps. Bats were dying by the millions from a fungal disease in caves, a grant was funded to identify, manage, and monitor suitable trees for alternative chiropteran, "hand-wing" habitat.

Codit and I were working our way across cave country, expanding arboreal habitat for flying mammals. Standing dead snags and hollows in living trees were stabilized by bracing and reduction pruning. Plates of bark became big bat barns, bequeathing berths for beneficial beings. One cave manager asked us about the trees around her home above the cave, so one dry, cold, spring morning, we found our way there.

"Good Morning, Detective! My name is Rebekah Radix," she pulled off her wool hat and greeted us at the driveway. Individual strands of hair stood out, framing her face in a hemi-halo. Even before our hands touched, I got a static shock. Her strands descended as she apologized. "Sorry— I do appreciate your work for our furry friends. Farmers and foresters nearby also enjoy insectivorous associates. I'd like to build bat houses in my big oaks, but one looked so bad that I had it cut down last fall." Her toes curled with tension as she nudged a mustard-colored leaf at her feet.

"First, let's look at your primary woody assets," I started, pulling my eyes back up to the trees. "Codit, you're the cedar specialist; check out that redcedar across the yard. Its deep green glow stands out in this drought-ravaged region." My assistant, diagnostic kit in hand, trotted across the yard, one less distraction from the primary problem.

One former oak was a stump, with no decay evident. A second oak was pale green, and a third was yellow in places. I pulled down a lower branch and entered the anemic-looking foliage with my 10x hand lens.

The magnification took me through the cuticle, through the epidermis, and into the mesophyll. With my thumb on the tough upper surface, my index finger pushed against the slightly softer layer on the bottom.

"Later in the growing season, these leaves will look much worse. You really get into the trees, don't you?" Rebekah approached, hazel eyes flecked with the colors of canary and goldfinch and the arboreal bat called *Lasiurus borealis*. Her voice flowed like water in a brook. "I get really hot every summer, after the leaves fall off."

"L-l-looking is like liquor. It goes to my head," I startled babbling like that imaginary brook, as she drew nearer and grasped the leaf next to mine.

"I know what you mean," she quickly looked me up and down, then smiled with just a hint of shyness. "What exactly is it that we are feeling for?"

Feeling more comfortable in tree territory, my glance was quick as a blink. "Tactile data can be robust," I tackled the topic tritely. "'Touch Trees' is an arborist's motto, but touching may not be enough. Squeezing trees can yield more compelling conclusions." Her eyes flickered and held mine, pulling us closer in time. The space between us shrank to nothing.

"Dendro! Look at this!" Codit, with his unfailingly terrible timing, sauntered over from across the yard. "I never saw anything like it—this redcedar, *Juniperus virginiana*, is growing fast, despite this killer drought. The twig extension from all four quadrants is huge. This drought-resistant species is on a drier part of the yard, but its foliage is soft and lush."

He eyed the two oaks. "As for these poor guys, years of drought seem to have taken their toll. The specific epithet "palustris" indicates an origin in, and preference for, swampy habitats. This is the right tree in the wrong place. Leaf discoloration is often caused by drought, though sucking insects or early autumn coloration due to some other stressor may also be at work. "



JOSEPH O'BRIEN, USDA FOREST SERVICE, BUGWOOD.ORG

Does the detective discern a deficiency in this pin oak (*Quercus palustris*)?

"We'll consider those observations, and other information, over lunch," I promised, setting my pH meter aside on the yielding bed of needles under the redcedar and sounding a buttress root with my rubber mallet. I turned my attention to Rebekah. "Irrigation during dry periods early in the growing season can help keep oak leaves green, and other treatments can address the symptoms we are sensing. As for the mystery of the lush *Juniperus*, there may also be a very direct route, to a very surprising solution."

"My last questions are about selecting the replacement oak," Rebekah said. "I want to be sure it won't get the same disease. Also, one reference says to give the roots the most volume possible, which makes sense to me. But the directions from the garden center say that the hole should be no deeper than the distance from the flare to the bottom of the root ball, and the sides should be sloped, to train the roots upward. What do you think is the best way?"

The soil probe barely broke the surface of the softest-looking sites in the desired planting location. I shook my aching arms, and saw Codit rub his belly. "The best way for us right now is down the road to lunch, where we'll continue our quest for solutions to these questions. Codit, riddle me this: When is 7 an unlucky number for an oak tree?"

*Can our team figure out these problems?*
*Turn to page 62 for the solution.*

# Arboriculture in Japan: the "miracle pine"

It has been more than a year since the Great East Japan Earthquake (March 2011). The event's undersea motions resulted in a catastrophic tsunami that took the lives of roughly 25,000 individuals and displacing hundreds of thousands more. In Rikuzentakata, Iwate Prefecture, one in twelve residents perished, according to Reuters.

Also in Rikuzentakata, only one pine tree of an estimated forest of sixty to seventy thousand individuals survived the flood. The *Takata Matsubara* was a dense forest that decorated two kilometers of the city's attractive coastline, but soon after the earthquake and its ensuing tsunami last year, only one tree remained. Named the "miracle pine" for being the lone survivor of the stand, and for serving as a symbol of hope amid the nation's reconstruction efforts, this 250-year-old pine tree looks to play a key part in reviving the Rikuzentakata's once beautiful shoreline.

Numerous reports indicate that local forestry institutes have collected and nursed as many as two dozen seedlings from the miracle pine, hoping that as the years pass, they will become resilient enough to be planted as saplings. The seeds successfully germinated this past winter at a facility in Tsukuba, Ibaraki Prefecture, after being chilled for about six months. The original pine cones were harvested back in April 2011, roughly one month following the tsunami.

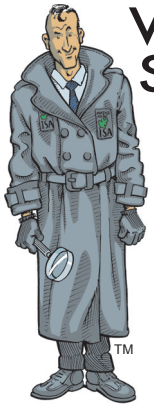
This extensive effort to give birth to a new generation of trees in Rikuzentakata is a priority for several local residents, many of whom are still eager to preserve their memory and fondness for family and home.

For example, another local report highlights the initiative of Takako Niinuma, 74, who donated several seeds she had collected over the years to a nursery in the village of Takizawa. Apparently, Niinuma has altogether collected more than 600 pine cones from the forest—typically to make wreaths, her hobby. Following the devastation of the coastline city, the woman dried out many of her remaining cones and contacted *Takata Matsubara wo Mamoru Kai*, an eleven-year-old association dedicated to the preservation of the Rikuzentakata pine forest, to donate the seeds. According to *The Japan Times*, the association's founder, Seiko Yoshida, perished in the tsunami. Mr. Yoshida was a junior high school friend of Ms. Niinuma.



JACOB EHNMARK; WIKIPEDIA COMMONS

As for the miracle tree itself, standing an estimated 98 feet (30 m) tall, recovery efforts have long since been suspended. Efforts to revive the tree were abandoned in mid-December 2011 following a thorough soil and root analysis of the surrounding site. It was determined that the soil salinity was far too high, and the damage (rotting roots) far too widespread, for the tree to ever regain a sustainable level of good health. **A•N**



# WHAT'S THE SOLUTION?

Codit slurped his milkshake as he closed the soil manual. "So, the number 7 is unlucky for oaks, because a pH reading above 7.0 means the soil is considered alkaline, right? Most oaks like their soil at least five times more acidic, below 6.5, for better uptake of minerals. But how can we tell which mineral is most lacking?"

"By observing symptoms," I slid the leaf toward him. "Deficiencies of calcium or manganese or iron cause similar symptoms, but at different times and on different sites. Manganese deficiency appears first on older leaves, while calcium deficiency occurs only on acid soils, where iron deficiency is unlikely."

I paid the bill and we headed for the pickup truck.

"And as you know, it is too early for sucking insects or drought or seasonal changes to cause any discoloration."

"Okay, got it," Codit nodded as he cranked the engine. "Plus, I figured out that it's too early for sucking insects or drought or seasonal changes to cause any discoloration. Duh!"

I finished writing specifications, and drew long curling doodles up and down the side of the clipboard as Codit drove back, and eased into the driveway. Rebekah met us on the dusty stubble that once was her lawn. "So have you found the answers to my trees' persistent questions? And what were we feeling for when we squeezed the leaves?"

"There are two types of photosynthetic cells in the mesophyll, the middle layers of the leaf," I began. "Most food production takes place in elongated, 'palisade' cells. These firm cylinders nestle amongst more elastic, 'spongy' cells. In the snug, moist, moving interfaces, carbon dioxide enters with photosynthesis, and oxygen releases during respiration. In and out, in and out."

Rebekah's eyes smoldered. It was hard for me to get back on track. "The leaves felt thin and dry and hot. "Those cylinders were not nestling because they lacked chlorophyll, and no wonder—my pH meter registered an average of 7.2. Limestone is the parent material, as we know from the limestone cave nearby, so high alkalinity is no surprise."

"Chlorosis—abnormal yellowing—due to iron deficiency is a common problem of pin oak. They need ferrous iron, with two electrons lacking in the outer shell and carrying a +2 charge. Alkaline soils release another electron, so the molecule carries a +3 charge, more ionized, so to speak. This ferric iron is static, unavailable to pin oak roots. Burr oaks, *Quercus macrocarpa*, tolerate alkaline soil. Swamp oak, *Quercus bicolor*, has been reported tolerant, but. . ."

"But, better forget the *bicolor* then—this place is the opposite of a swamp," Codit impetuously warned.

"A swamp by any other name might smell the same, but even scientific names can mislead," I cautioned in reply. "*Quercus palustris*, this pin oak, may have evolved in wet areas, but it does not need wet feet. Like American elm and willow oak, it does well in urban areas because it tolerates low soil oxygen levels. Please take the shovel and wheelbarrow and harvest some feeder roots from the other side of that stump."

I turned to Rebekah. "For your mildly affected tree, chlorosis can be treated by watering chelated ferrous iron into holes that can be blown or punched under the drip line, and in adjacent rooting areas. Even though the tree is dead, the roots that Codit is harvesting should contain propagules of ectomychorrhizal microbes. Attached to roots, ectomycorrhizae chelates iron for plants by producing siderophores, Greek for "iron carriers." Soil modification and fertilization, specified early in the growing season according to ANSI A300 Part 2 standard clause, should green the tree up by autumn."

"I will have that done to this oak, as soon my arborist can schedule it," Rebekah said. "Now, what can we do with the sicker oak?"

"The same, plus biannual systemic applications might help bring this one back. Some careful restoration pruning will also be needed. I'll write up some specifications for you, based on the industry's pruning standards." Codit returned with the wheelbarrow and I eyeballed the roots with the hand lens. "These seem alive with microbes—great! Now, let's walk down the hill and see the source of the redcedar's vitality, and its instruction to us on proper planting methods."

Rebekah led us into the cave, where we navigated a dry route along an underground stream. My helmet light swung around as we turned a corner, illuminating an eerie but amazing sight. Two roots descended through the top of the cave, and formed buttresses above the level of the water. Codit's jaw dropped. I sloshed my way to the roots, peeled back some bark with my thumbnail, and took a whiff. "Yup, that's redcedar—branches and roots and moth-repelling potpourri, it all has that same smell.

This phenomenon demonstrates that roots grow wherever their needs—primarily oxygen and water—are met. Trees old and new need large pores for water and small pores for air. Trunk flares stay visible at grade, so the soil beneath the stem should be firm. The outer soil should be prepared deep and wide. These roots grew 40 feet down! Sloping the sides of a hole might set trees up to fail—especially species that tend to form taproots or sinker roots. Pin and other "red" oak roots naturally grow downward, forming



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root systems that are shaped like hearts."

Rebekah grasped my hand gratefully. "We will break up the soil and amend it, with more of what roots need. We will also follow your other specifications, and expect a miracle."

"Iron is catalyzed when it is less ionized. More chlorophyll's made, which means more shade, and sweetness in the air. We could check their progress during our bat survey later this summer, some day at sunset," I hinted as I stepped into the pickup. "The electricity might be more active than static. Miracles could happen."

"My trees will respond to your kind attentions. Healthy trees, and associates, will make summer evenings very pleasurable, indeed. Until then, take care!" Rebekah leaned forward and closed the door, slowly. I sensed the click.

Codit started to laugh as we drove away. "Hey Dendro, I don't want to come down with chlorosis, so should I use deionized water to make tea from now on?"

**Additional Reading**

Hauer, R.J., and J.O. Dawson. 1996. Growth and iron sequestering of pin oak *(quercus palustris)* seedlings inoculated with soil containing ectomycorrhizal. *Journal of Arboriculture* 22(3):122–130.

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# Death of "the Senator"

## Florida's Oldest Documented Bald Cypress Tree Succumbs to Fire

A long-smoldering lightning strike is thought to have caused the fire that consumed "the Senator," the tallest, single-trunked bald cypress (*Taxodium distichum*) tree in the United States and the tallest tree east of the Mississippi River.

Located in Big Tree Park in Longview, Seminole County, Florida, the Senator was estimated to be 3,400–3,600 years old, based upon a core sample taken by the American Forestry Association in 1946. It was named in honor of Florida State Senator Moses Overstreet, who in 1927 donated the land on which the tree stood for the purpose of creating a public park. The tree served as a local landmark for centuries: first, as a way marker for Seminoles and other indigenous peoples of the region, and then for newcomers, including traders and loggers. During the New Deal programs of the 1930s, the Civilian Conservation Corps constructed a long boardwalk to lead park visitors to the tree, a popular tourist attraction in the decades before Disney World; until that time, people who wanted to get up close to the Senator would have to leap from log to log across the swamps.

This ancient, monumental bald cypress had encountered other natural disasters in its long life and survived them all—some events lost to history, and some occurring in the recent past—including a hurricane in 1925 that sheared off approximately 45 feet (13.7 m) from its top. Before the hurricane, the Senator had soared to 165 feet (50.3 m) in height, but at the time of its death the tree rose to "only" 118 feet (36 m), with a diameter of nearly 18 feet (5.5 m). The great majority of the trunk was solid and strong, but its top 20 feet (6.1 m) were hollow—a factor that may have caused the Senator's unfortunate demise.

Early on the morning of Monday, January 16, 2012, a person walking in Big Tree Park noticed a fire burning at the top of the Senator and reported it. Firefighters responded to the call and arrived on the scene just before six o'clock, running more than 800 feet (243.8 m) of water hoses through the densely wooded park in order to reach the flames. According to Seminole County Fire Rescue staff, a 20-foot section of the tree fell to the ground at 7:45 am, and within another 30 minutes, even more of the tree had collapsed. After considerable effort to keep the blaze from spreading to adjacent trees—including "Lady Liberty," now the oldest and largest bald cypress in the park, which measures 89 feet (27.1 m) tall and 10 feet (3 m) in diameter—the Senator was lost, with only a jagged 30-foot (9.1 m) shard of wood rising from the charred, split stump.

Investigators have ruled out arson, noting evidence that shows the fire burned hottest at the top of the tree and not near the ground. While the official cause of the fire remains undetermined, it is thought that lightning struck the Senator at least one week earlier, and that flames slowly grew from that initial spark in the hollow portion of the trunk, which created a chimney effect.

Longview residents who remember visiting the Senator throughout their lives mourn its loss, as do its longtime caretakers, the staff of the Seminole County Leisure Services Department. **A•N**



ANTHONY SCOTTY; WIKIPEDIA COMMONS

The Senator only a handful of years ago. An adult male stands fifteen feet in front of the tree's base.