Wally Covington burns with an intensity that matches the debate over President Bush's forest initiative, which draws on 30 years' work by the forest ecologist

Arizona Ecologist Puts Stamp On Forest Restoration Debate

FLAGSTAFF, ARIZONA—It's hard to resist comparing forest ecologist Wally Covington to the old-growth ponderosa pines that tower above this bustling mountain town. Both are tall and burly, with rugged skins molded by age and experience. And like the pines, Covington is a lightning rod. But he doesn't burn easily. "I am incredibly confident in what I do—and I have a very thick skin," he says.

Over the last few years, the 55-year-old academic has emerged as perhaps the nation's most visible—and controversial—forest scientist. The folksy, 2-meter-tall woodlands expert has become a scientific Paul Bunyan on the subject of how to prevent forest fires. He is consulted by presidents and lawmakers, courted by the media, and hailed and assailed by environmentalists, loggers, and scientists alike. His research underpins parts of the White House's controversial new "healthy forests" initiative, and President George W. Bush himself might make a pilgrimage to the researcher's plots this week—all this because Covington believes in cutting down some trees in the name of saving forests.

This year's conflagration in the western United States—which scorched 2.5 million hectares of forest—has only heightened interest in Covington's work. He and his colleagues at Northern Arizona University (NAU) here have spent 3 decades studying southwestern ponderosa pine ecosystems. For years, they've warned that vast swaths of woodland have become dangerous tinderboxes: A century of overgrazing, logging, and misguided fire-suppression policies has left many stands unnaturally choked with thickets of young trees and deadwood. To prevent catastrophic fires, Covington argues that massive cutting is needed to restore these forests to their less dense, parklike pasts. The idea is being promoted by the president in his plan, now before Congress.

Some researchers and environmentalists, however, are uncomfortable with Covington's approach to forest restoration. They complain that he has used his political prowess to monopolize resources and worry that government officials might misapply his ponderosa-based ideas to dramatically different types of woodlands. And they charge that loggers have cynically embraced his work to justify a return to damaging practices. "Unfortunately, his science gives political cover to forces that want to increase logging," says Todd Schulke of the Center for Biological Diversity, an environmental advocacy group in Tucson, Arizona.

Still, even critics applaud Covington for bringing the plight of the southwestern forests to national attention. They also confess to liking him. "We disagree, but I really enjoy his company," says Schulke.

"Wally's got strong ideas, and they are not entirely congenial to the timber industry, environmentalists, or policy-makers," says Bruce Babbitt, longtime friend, former Arizona governor, and head of the Department of the Interior under President Bill Clinton. "But people listen because he's passionate, articulate, and credible."

Pointing the way. Wally Covington routinely gives policy-makers, such as Interior Secretary Gale Norton (far right) and Senator Jon Kyl (left of Norton), a firsthand look at his Arizona forest restoration experiments.

CREDIT: GREG BRYAN/ARIZONA DAILY SUN

In Leopold's footsteps

Covington was clearly in his element recently as he loped over downed trees and sized up standing timber. But it was the trees' ecological—not commercial—potential that he was eyeing. Covington has spent his career trying to figure out how to reclaim the glory of declining ponderosa forests. His goal is radical: "I want to see half of all public forests in the Southwest restored to presettlement conditions," he says. Turning the clock back, he argues, is the best way to combat fires—and do everything from protect endangered species to enable the forests to ride out climate change.

His quest for ecological healing goes back to his youth in Oklahoma and west Texas. Covington's dad—a jack-of-all-trades who once worked as a barnstorming pilot—was a devotee of Aldo Leopold, a restoration pioneer who died in 1948. When Covington was 7 his father died, but not before drilling home Leopold's lessons during weekends spent living off the land. "We'd alternate [spending] Sundays in church and outside," he recalls.

Under the guidance of his mother, a schoolteacher, Covington excelled in the classroom and headed off to college to pursue a career in medicine. But a postgraduation summer working among children with cancer exhausted him emotionally, and in 1970 he found himself teaching school in Gallup, New Mexico—and organizing an Earth Day celebration that ultimately got him fired. "Basically, I was a hippie," he says.

A few years later, inspired by undergraduate ecology courses and graduate work with Jim Gosz at the University of New Mexico in Albuquerque, Covington won a spot in the

graduate forestry program at Yale University, where Leopold had also studied. Working under F. Herbert Borman and Daniel Botkin, Covington completed "one of the most influential studies in the recent history of forest ecology," says Ruth Yanai, an ecologist at the State University of New York College of Environmental Science and Forestry in Syracuse.

Using plots in the Hubbard Brook Experimental Forest in New Hampshire, Covington measured how organic matter in forest soils changed after logging. The result—known as Covington's curve—suggested that logged soils lost 50% of their organic matter, and hence their ecologically important loads of carbon, within 20 years. Even before it was published, the curve was being used by scientists trying to estimate how much carbon logged soils contributed to global atmospheric loads. And although subsequent studies have raised major doubts about the curve's applicability, "it continues to have influence," says Yanai, who is about to publish a paper on the topic.

In 1975, Covington joined NAU and began to examine the nearby Ponderosa forests. The U.S. Forest Service was beginning to experiment with controlled burns to reduce wildfire dangers, and Covington saw a chance to test some of his own ideas. But first—following Leopold's example—he had to set a restoration goal, and that "meant figuring out what the forests looked like before European settlers arrived," he says.

Ever since, he and an array of colleagues—including his wife, NAU forest ecologist Margaret Moore—have pored over historical photographs and records and have mapped old stumps, downed logs, and fire scars on study plots. In a series of 1994 papers, they made the case that many presettlement ponderosa stands were swept regularly by "cool" fires, making them far less dense than today's forests. "There were often several dozen relatively large trees [per hectare]," says Covington, compared with the hundreds of stunted stems often found today.

The data convinced Covington and other scientists that a conflagration was imminent and that immediate thinning was the only way to save the forests. But controlled burns alone wouldn't do the trick, he warned: Early experiments near Flagstaff showed that debris-clogged forests often burned so hot that they scorched the soil and eventually killed the older, larger trees that ecologists wanted to save. Covington's team argued that loggers first needed to thin the forests and rake accumulated needles away from old-growth trees.

At the same time, the team was fine-tuning its "presettlement model" of restoration (*Science*, 28 January 2000, p. 573). The approach begins with mapping the locations of presettlement trees on a target site. Then, loggers clear away younger trees—at times 80% or more—in a bid to recreate the lost landscape.

Into the limelight

Such ideas, however, were little known outside the West until several lethal fires struck in 1994. The resulting outcry prompted Babbitt to seek Covington's help. Soon, Babbitt was touting Covington's work, which he dubbed the Flagstaff plan, as one solution. "I called up Wally and said: 'Ever hear of the Flagstaff plan? Well, now you have and you'd better get ready to answer questions about it.' "

Firefight. Arizona wildfires have sparked debate over how to prevent them.

CREDIT: MARCIO JOSE SANCHEZ/AP

The state's lawmakers, especially Senator Jon Kyl (R–AZ), then went to work in Washington, D.C., earmarking funds to help Covington and working with Babbitt to line up study sites. Soon, Covington had access to a swath of isolated federal land on the slopes of Mount Trumbull in northern Arizona, where he could scale up experiments that involved removing different proportions of trees and implementing various burning timetables. Preliminary tests had suggested that such approaches could lead to less damaging fires and improved biodiversity. And although the outcome of the bigger experiments won't be known for years, the uncertainty hasn't kept Covington's support from growing.

Several years of devastating fires in the West have increased pressure on legislators to act (*Science*, 1 September 2000, p. 1448). In response, Kyl—who serves on the Senate Energy and Natural Resources Committee—has helped funnel more than $10 million to Covington's Ecological Restoration Institute, which promotes science-based forest restoration. Now, a group of Western lawmakers wants to establish duplicate centers in other states.

Covington isn't embarrassed by the earmarked cash. He says that he's won plenty of peer-reviewed grants, too, but that "unconventional research requires unconventional sources of funding." Although some researchers in the region grumble privately that Covington hasn't shared the wealth, others dismiss that argument as sour grapes. "He's had a tremendous catalyzing effect and brought in new resources," says Melissa Savage, a retired forestry professor who now runs the Four Corners Institute in Santa Fe, New Mexico.

Covington's windfall was the product of decades of outreach. Even as a young faculty member, he would regularly invite lawmakers and their local staffers for field trips. "I'd call in the summer, when it was really hot in Phoenix, and invite them up to nice, cool Flagstaff for a tour," he says. "Then I'd campaign the research." He soon was advising governors, then testifying before Congress. This year, the Bush Administration tapped him for advice, and Interior Secretary Gale Norton visited.

But Covington's growing reputation also brought increased scrutiny. Several environmental groups that were initially supportive of his presettlement model, for instance, grew restive after they saw some heavily logged and rutted sites on Mount Trumbull. "It was horrid; there was a real gap between theory and practice," says Sharon Galbreath of the Southwest Forest Alliance in Flagstaff, which subsequently challenged and negotiated alterations to other thinning projects based on Covington's concepts.

Environmentalists worry that Covington's projects are "too aggressive," says Galbreath: "He's trying to restore presettlement forests in one fell swoop." Some environmentalists now derisively refer to extensive thinning projects as "Covington cuts." In their quest to promote what they see as more incremental approaches, they have developed a multipronged critique that challenges nearly everything Covington's team does.

For example, they argue that Covington's method undercounts the number of small presettlement trees on site. And they criticize Covington's zeal for restoration of distant wilderness areas, which they say is expensive and does little to reduce fire threats near human population centers. They are particularly troubled by his unwillingness to preserve all larger trees by prohibiting thinning above a certain size—say, a half-meter in diameter.

The release of the Bush plan has only in-

Out of the Vault, Into the Forest

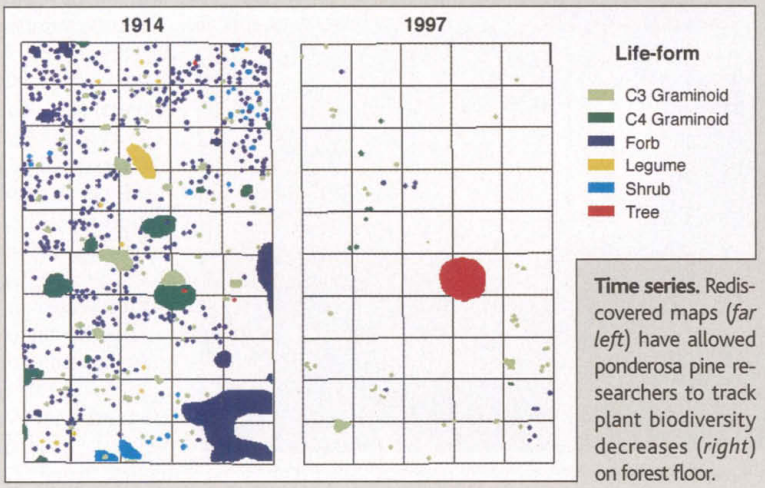
FLAGSTAFF, ARIZONA—Seven years ago, a local historian tipped off forest ecologist Margaret Moore of Northern Arizona University to a cache of dusty maps. They rested in a neglected vault here at the U.S. Forest Service's Fort Valley Experimental Station, set up in 1909 as the government's first research forest. Moore took a peek and marveled at the ecological time capsule that lay before her. In spare black-and-white were drawn the locations of hundreds of saplings, trees, and downed logs in a 160-square-meter patch of forest almost a century ago. The vault contained dozens of such labor-intensive portraits, from 1- to 7-hectare plots spread across the southwestern United States.

The maps were a potential cornucopia of data for Moore and her husband, Wally Covington, who have spent much of the last decade trying to understand the recent evolution of the southwestern ponderosa pine forests (see main text). "That kind of detailed information is incredibly rare," she says. The drawings cried out for a follow-up study to see how the plots had changed.

The collection wasn't perfect, to be sure. Data ledgers were missing, and the cross-hatched rectangles that appeared randomly on some maps were a mystery. Moore didn't even know if the plots, some staked out as long as 94 years ago, could still be found.

Undaunted, Moore and the historian—Susan Olberding—searched for one plot that appeared to be just steps from the vault. "I bet it didn't take us 10 minutes to locate it," recalls Moore. The treasure trove grew as Moore and her colleagues hunted down original corner stakes and even metal tree-marking tags, rusted but still readable. Then the ledgers turned up, providing meaning to the mysterious rectangles. They were 4.5-square-meter microplots that had also been carefully surveyed—down to grass stem and twig locations. Beginning in 1909, Forest Service scientists G. A. Pearson and T. S. Woolsey had established the more than 100 plots of various sizes as part of long-term monitoring studies. Some had been revisited periodically up to the 1950s.

Discovering the microplots was enough for Moore to get started. She and her colleagues have already looked at eight of the microplots near Flagstaff, and they have found that the thickening ponderosa forests appear to have reduced the number and kinds of plants on the forest floor. A $310,000, 4-year grant from the U.S. Department of Agriculture will now allow them to remap about 40 of the bigger plots in New Mexico and Arizona. Moore expects to document measurable changes and build computer simulations to depict the past, present, and future of the forests. "It would be great," she says, "if researchers 100 years from now could revisit these plots, too." **–D.M.**



Time series. Rediscovered maps (*far left*) have allowed ponderosa pine researchers to track plant biodiversity decreases (*right*) on forest floor.

CREDIT: M. MOORE AND J. BAKKER/NORTHERN ARIZONA UNIVERSITY

creased their fears that Covington's ideas will be misapplied. The fire-related portion of the plan calls for increasing thinning in all threatened forests—including stands far from inhabited areas—and paying for it by allowing loggers to cut bigger, more valuable trees. It would also ease environmental regulations to avoid legal delays. Critics say that would promote too much cutting in the wrong places, and they argue that Covington hasn't done enough to challenge the plan. "He hasn't made it clear that his approach is experimental and focused on ponderosa forests; we're not ready to run with it across the Southwest," says Bryan Bird of the Forest Conservation Council in Santa Fe.

Such criticism, Covington says, is the inevitable consequence of trying to spur action and running the largest ponderosa restoration experiments in the nation. It's true, he says, that he declined to sign a recent letter from dozens of prominent academics opposing the plan, because he disagreed with parts of their argument. But he bridles at suggestions that he's bitten his tongue in order to promote a "one size fits all" approach. In testimony and interviews, for instance, he's criticized the plan for failing to differentiate between forest types that withstand cool fires and those that need to burn fiercely to reproduce. His own experiments, he notes, test more than two dozen tailored restoration recipes. And he argues that the plan gives too much attention to "salvage logging"—cutting already burned trees—which has questionable value for restoration.

Overall, the plan's sometimes vague and confusing language "is pretty much what you'd expect from people who aren't well trained in logic," he says. He also notes that the White House ignored chunks of his advice, including having the National Academy of Sciences develop guidelines on thinning and restoration. (He now hopes to have his institute assemble such a study.)

But like many other forestry scientists, he is weary of the debate over tree-size caps, saying the science doesn't support any particular size limit. Similarly, he says that although it makes economic sense to start thinning near inhabited areas, many of the natural resources most at risk—from endangered species to water supplies—often lie deep within a forest. And he expresses some sympathy for the Administration's controversial proposal to streamline environmental regulations. Some of his own experiments have been held hostage by "environmental obstructionists," he says. In testimony earlier this month, he encouraged Congress to consider rules that would allow the public to help craft multistage experiments but then leave land managers free to practice "adaptive management"—feeding lessons learned into the next stage of the process. "We shouldn't have to revisit every detail," he says.

At the same time, Covington joins forces with some of his environmental foes in questioning the government's commitment to restoration. He rejects the notion that the agencies are still dominated by "timber beasts" dedicated to logging: "These are post–Earth Day foresters," he says. But he concedes that they "still aren't very good at learning from the past." One solution, he suggests, is to earmark 5% of the potential $1 billion or so that might be spent on thinning over the next few years for studies designed to test—and then replicate—a wider range of approaches.

Before designing those studies, Covington suggests that researchers think about how Aldo Leopold would tackle the challenge. "If you were a time traveler from the future, what would you ask us to do right now so that future forests would be healthy?" he asks. Immediate action is essential, he emphasizes. Otherwise, scientists might find themselves fiddling around for answers while Rome burns.

–DAVID MALAKOFF