

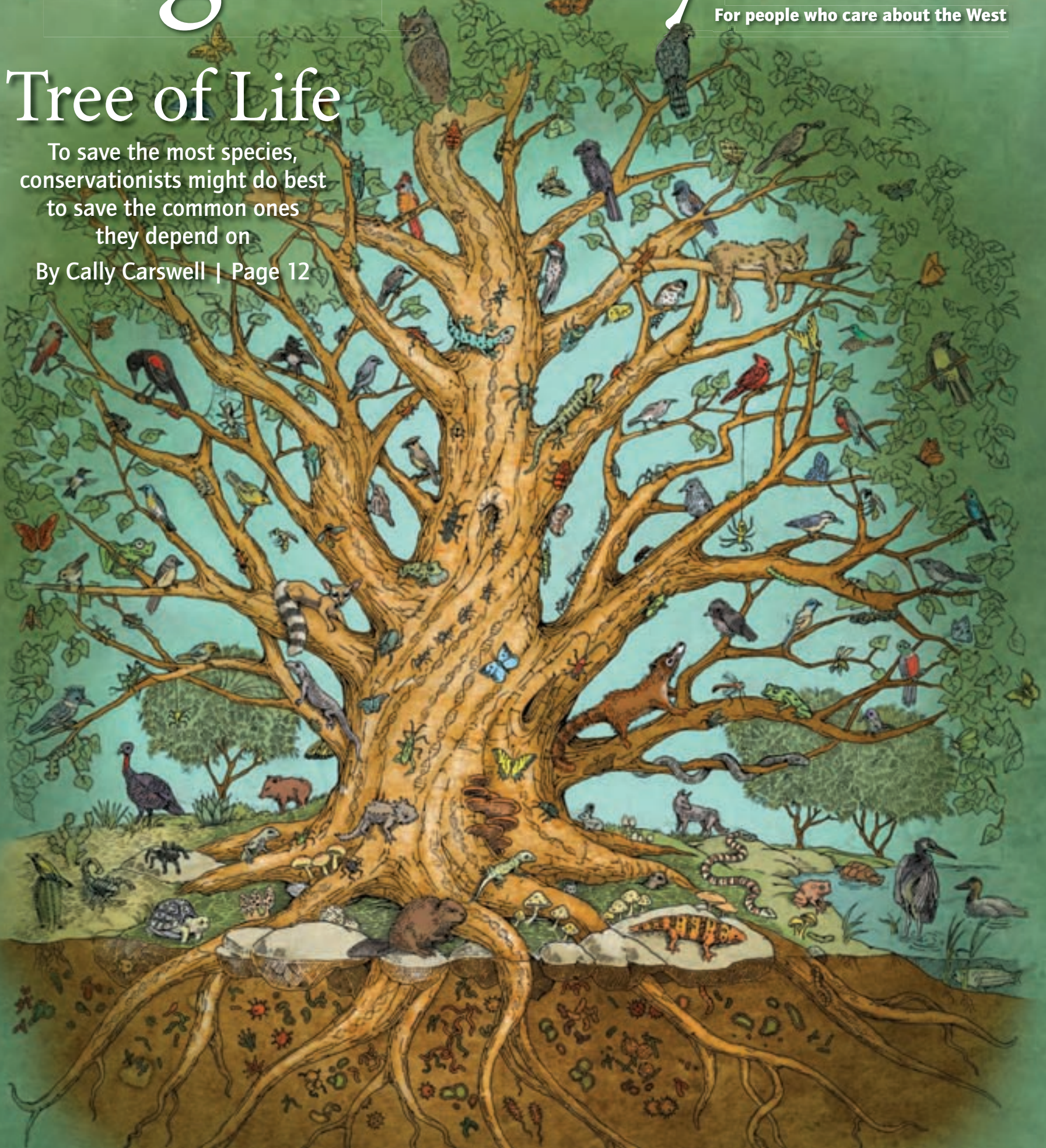
High Country News

For people who care about the West

Tree of Life

To save the most species,
conservationists might do best
to save the common ones
they depend on

By Cally Carswell | Page 12





Piñon pines on a ridge in Sunset Crater Volcano National Monument, where Northern Arizona University scientists are studying genetic diversity in plants. JEREMY WADE SHOCKLEY

FEATURE

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To save the most species, conservationists might do best to save the common ones they depend on. By Cally Carswell

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Editor's note

The precious common

Imagine a white burqa crossed with a beekeeper's suit. At the end of one arm protrudes a pterodactyl-esque puppet head with a long bill, a blazing red pate and cheeks streaked a vivid black. But its golden eyes are flat and unmoving, like those of a specimen in a museum diorama.



If you're a whooping crane chick raised in captivity at the U.S. Geological Survey's Patuxent Wildlife Research Center in Laurel, Maryland, this is the costume worn by the human pretending to be your mom. Because your species numbered around 20 in 1941, scientists carefully selected your biological parents to avoid genetic problems. Once you hatch, your surrogate "crane" teaches you, by example, to eat crane kibble, and to swim in a pool and dash across the grass so that your legbones develop correctly. When you're old enough, she teaches you to follow an ultralight aircraft on your first migratory flight to Florida's Gulf Coast. She shapes you, in essence, to an approximation of wildness, hoping that you will one day mate with another whooper, and build a population that thrives without intervention in the world beyond Patuxent's walls.

Over the past half-century, we've gone to great lengths to conserve rare species, with some success. There are now hundreds of whooping cranes, wolves and grizzlies have reclaimed the Northern Rockies, and certain salmon runs have increased. But today's conservation challenges are infinitely vaster than anyone could have imagined when Congress passed the Endangered Species Act. We are driving Earth's sixth mass extinction, radically changing habitat and the climate to which we are all adapted. Saving every struggling creature now will be impossible, particularly if it requires draconian measures. "Conservationists need new strategies," writes contributing editor Cally Carswell in this issue's cover story. And one of the most viable may involve looking beyond rare species to some of the much more common ones.

Ecologists at Northern Arizona University have built a strong case that genetic diversity within seemingly ordinary cottonwoods and piñon pines determines the biodiversity of the vast community of creatures that live in those trees' canopies and on their bark. That means saving a lot of species at once may be as simple — and as complicated — as ensuring that the handful that form an ecosystem's foundation have the necessary genetic resilience to weather the coming crises. Protecting, and perhaps even directly manipulating, their innate ability to adapt could give everything else a better shot at survival.

That's an unsettling vision of the future — like playing God, as one biologist observes. But it's not all that different from what we already do with whooping cranes, working desperately and with an almost maternal devotion to ensure that this graceful bird, with its nearly 8-foot foot wingspan, inhabits our future as more than just a carefully maintained artifact from a vanishing era.

—Sarah Gilman, contributing editor

On the cover
Original illustration
for High Country News
by Bryce Gladfelter.



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Lesser prairie chicken in Chaves County, New Mexico, a species that could be booted off the endangered species list if changes proposed by congressional Republicans go through.

The role of states in the ESA

This month, the Obama administration proposed increasing the role states play in Endangered Species Act listings, hoping to deter or pre-empt moves from congressional Republicans to overhaul the act and reduce protections for species such as the greater sage grouse and lesser prairie chicken. Under the proposed changes, people wanting to petition the federal government to list a species would first have to send petitions to state agencies that manage that species. The state would then have 30 days to respond with data, such as population counts or comments, which would then be included with the federal petition. Today, petitioners don't need to provide any data, and state input comes later in the process. The proposal also would seek to make the listing process more transparent. **ELIZABETH SHOGREN**

hcne.ws/ESAchanges

Trending

Prison pipeline

A new study finds that Native American students in Utah are disciplined far more harshly than their peers. They're almost eight times more likely to be referred to law enforcement and more than six times more likely to be arrested than white students — a phenomenon known in education circles as the "school-to-prison pipeline." The harshest discipline takes place in schools closest to the state's eight reservations. **KATE SCHIMEL**

You say

LEA TUTTLE: "You're not going to teach anyone anything by punishing them for petty things! All this is doing is hurting them — the cycle continues. These schools are still to this day discriminating against Natives."

W. FRED SANDERS: "There are obviously large social and economic problems resulting from history and the isolation on reservations. Many of these problems are not effectively different from those faced by all rural communities in the West."

hcne.ws/studentsUT and [facebook.com/highcountrynews](https://www.facebook.com/highcountrynews)

\$157,000

The amount Utah-based American Lands Council — whose focus is taking back federal lands for states — collected in membership dues in 2013.

\$134,000

The amount of those dues that came from taxpayer-funded county commissions.

Since 2012, the American Lands Council has raised hundreds of thousands of dollars to advocate and lobby for the transfer of federal lands to states. And much of that money has come from county memberships — that is, taxpayer-funded dues. "ALC comes in and offers counties this incredible-sounding deal: 'We'll get you these lands with minerals and timber and resources,'" Jessica Goad, advocacy director for conservation group Center for Western Priorities, said. "But when you pull back the curtain a bit, (the ALC) is selling an idea that is actually a waste of their time and (their) limited funds."

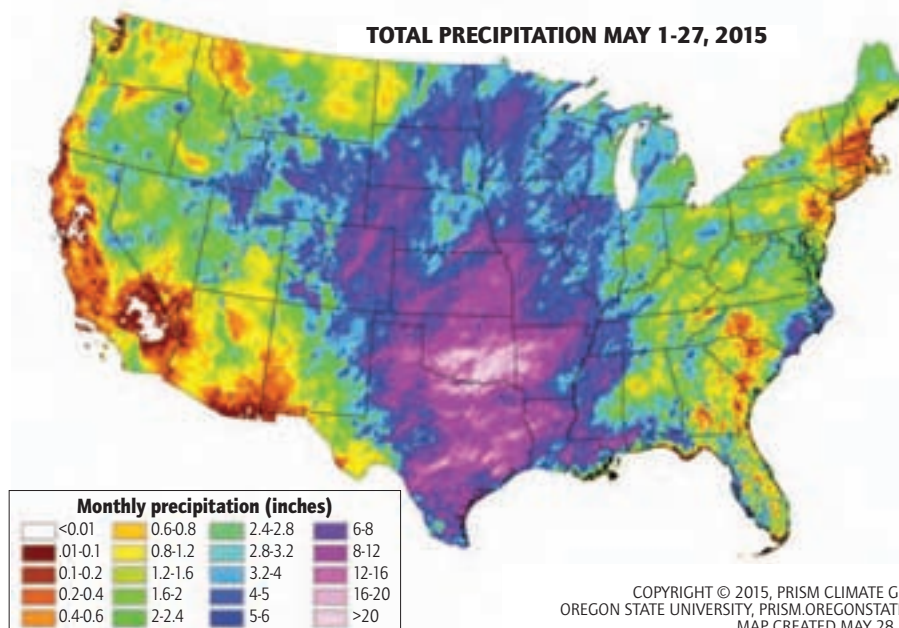
KINDRA MCQUILLAN

hcne.ws/fed-transfer-tax

A little drought relief for the Southwest

A rainy May drenched the Southwest this spring, on the heels of a parched winter. That deluge, depicted in the map below, is helping to keep wildfire risk at normal levels. It's also boosting a meager water supply. But without a substantial winter snowpack,

lingering effects from the longstanding drought in the region won't disappear. For example, Lake Powell and Lake Mead are still facing dismal inflows and reservoir levels on the Rio Grande remain low. **CALLY CARSWELL** hcne.ws/SWrain



Mormon cricket.
MARIAN LYMAN KIRST

GALLERY

Bug life

Former *HCN* intern Marian Lyman Kirst has created an online photography collection, "Bugonthumb," which she calls a "celebration of insects and arachnids, those winged and legged wisps that run the world and rule my mind." Some of our favorites can be found at

hcne.ws/westerninsects

\$950

Amount, in millions, offered to the Lax Kw'alaam First Nation by a Malaysian energy company to put a natural gas export terminal on tribal ancestral lands in Northern British Columbia. The tribe declined because of the possible threat to its salmon fishery, even though it would have meant \$260,000 for each member. **SARAH TORY**

hcne.ws/tribes-energy

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SHALLOW UNDERSTANDING

Reader Brandt Mannchen takes issue with rainwater harvesting as presented in a recent article ("Letters," *HCN*, 5/25/15; "Tucson's rain-catching revolution" *HCN*, 4/27/15). He deplores local Tucson water expert Brent Cluff's belief that "water harvesting could support unlimited growth." I know of Brent Cluff but have never heard of and certainly do not share this opinion. Mannchen's further characterizations of water harvesting and of Tucson's landscaping reveal a shallow understanding of both.

Rainwater harvesting is designed to irrigate gardens and landscapes and thus reduce the use of potable sources for these purposes, not to encourage lush lawns. Mannchen admonishes Tucsonans to "Adapt to the desert. Don't fight it." My wife and I live about four miles from downtown Tucson. Yesterday we hopped on our bikes and surveyed our and adjacent neighborhoods. In over five miles of biking, we spotted just one residential lawn. Tucson is truly a desert town.

Mannchen asserts that too much harvesting will rob streams and aquifers of needed recharge. He ignores the article's reference to a study that estimated harvesting reduced water flow by a mere 3 percent. On our property, the total building footprint is roughly 3,500 square feet, compared to the lot size of roughly 11,500 square feet. So if we captured and diverted every drop of rain from our roofs, we would intercept just over 30 percent. Of course, we don't, and in heavy storms, much of the total rainfall still ends up flowing into the street.

*Dale Keyes
Tucson, Arizona*

HIGH-FLYIN' HYPOCRISY

In her May 11 "Writers on the Range," Kathleen Dean Moore laments the view of the North Dakota oilfields at night from her jetliner window at 31,000 feet. And, admittedly, vistas with drilling rigs, pumpjacks and gas flares leave something to be desired, compared with vast sweeps of virgin prairie. The excellent article on Theodore Roosevelt National Park in the last issue explored this topic in depth ("Lost Frontier," *HCN*, 4/27/15).

But what was giving Moore the convenience of the "red-eye to Portland," and what was giving her that Olympian view from on high? What was keeping her from an immediate death plunge into those same oil fields? Why, it was that very same evil Earth-raping petro-



PETER OMMUNDSEN

leum she was railing about. I don't believe a jet engine has yet been invented that can run on organic fair-trade coffee. As we crusade on our high horses, can we at least recognize our frequent hypocrisies?

*Robert Michael
Fort Collins, Colorado*

WETLAND CLARIFICATION

A little clarification is needed to better understand the setting of "The Wetlands Wars" (*HCN*, 5/11/15). The Los Angeles River did not flow continuously through the Ballona Wetlands previous to the calamitous flood of 1825. A flood that had occurred 10 years earlier caused the river to shift westward, away from the hundreds of square miles of tules into which it had previously flown. Such shifting back and forth occurred repeatedly over the millennia, extending back to the end of the last ice age (as well as between ice ages).

There were no wetlands anywhere along what is now the Southern California coast during times when ice covered large portions of the continent. That was simply due to the sea level being hundreds of feet lower. The wetlands were then left high and dry. However, if ever there comes a repeat of the inordinate flood of spring 1825 through the Los Angeles Valley (the eastern flank of downtown Los Angeles), there will be mountains of debris and thousands of bodies floating in the Pacific Ocean. The lowlands of the Los Angeles Basin will have become one of the foremost disasters in the nation's history. The river could shift anywhere gravity and physics allow.

*John Crandell
Sacramento, California*

REMEMBERING 'THE CREEK'

"The Wetland Wars" struck a chord with me. I went to Loyola Marymount University from 1960 to 1963. The campus was above and just to the east of Ballona Creek. In that era, it was known as "the creek." After a long day, I often walked around the area to capture some of the tranquility generated by that urban oasis.

*Stephen McLaughlin
Corvallis, Oregon*

TRADE IMBALANCE

There is something missing from "Trade winds blow through the West" (*HCN*, 5/25/15). There is much talk about poor Rifle and other communities suffering from depressed natural gas production, and the hopes that the Trans-Pacific Partnership will once again increase production and, therefore, jobs in the West. This is undoubtedly true. But what about the obvious fact that, for American consumers, natural gas prices will go up significantly? There has to be a balance here, but ignoring the consumer leaves a vast imbalance.

*Chuck Saxton
Bennett, Colorado*

CITIZEN PSEUDOSCIENCE

Wyoming Sen. Mike Enzi's legislation to mandate use of local, county, state and tribal data in Endangered Species Act decisions ("Sagebrush bureaucracy," *HCN*, 5/11/15) sounds like a reasonable idea, citizen science at its very grassroots. The more information that's included, the better the decision, right? The devil, of course, is in the details.

I have no uncertainty whatsoever — not one iota or shred of doubt — that local, state and corporate "science" in my hometown of Winston-Salem, North Carolina, in the 1960s would have proven beyond question that cigarette smoking was good for you, or, at the very least, a benign influence on your health. Thank goodness we had the relative independence of Surgeon General Dr. Luther Terry and his momentous 1964 report to counteract any pseudoscience cooked up by those motivated not by public health concerns, but by economic and political self-interest. Enzi's bill, the "State, Tribal, and Local Species Transparency and Recovery Act," is, by its very nature, an exercise in fog and obfuscation designed to torque the scientific process. It's transparently obvious.

*David Klinger
Boise, Idaho*

High
Country
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The cost of compromise

New Mexico Sen. Tom Udall championed major chemical control legislation — and took a beating for it

BY ELIZABETH SHOGREN

Sen. Tom Udall prides himself on personally answering constituents' questions. So the Democrat has spent a lot of time recently assuring outraged New Mexicans that his bill to overhaul the nation's chemical safety law was not written by or at the behest of industry, as critics charge. "I can't tell you how many times I've been in one-on-one conversations on the phone answering everybody's questions," Udall said in a recent interview in his Capitol Hill office.

The Toxic Substances Control Act, now awaiting a full Senate vote, might well become the rare piece of major legislation that makes it through one of the least-productive Congresses in history. But along the way, it's opened an unusually ugly rift among Democrats, while creating unexpected alliances among senators who rarely agree.

Being accused of kowtowing to industry is unfamiliar territory for any Udall. Tom Udall, 67, has enjoyed a reputation as an environmental and public-health defender since he entered Congress in 1991, and even before that, as New Mex-

ico attorney general. His father, the late Stewart Udall, built an extraordinary conservation legacy as Interior secretary for John F. Kennedy and Lyndon B. Johnson. He spent his post-government years fighting for nuclear-testing downwinders and uranium miners with lung cancer, and Tom, then a private lawyer, assisted him.

Given his history, the intensity of the recent attacks came as something of a surprise.

"I don't think it's useful to the process of legislating to get personal or to attack someone's character," Udall said. "I care about legislating on chemical safety because it's something that's so important to the people."

After years of pushing a chemical safety bill that attracted zero support from Republicans or industry and never even reached the Senate floor, Udall took a gamble. Following the lead of New Jersey's late Sen. Frank Lautenberg, D, Udall embraced a bipartisan approach to fixing the Toxic Substances Control Act. The 1976 law was supposed to give the Environmental Protection Agency authority to regulate toxic chemicals, but by directing the agency to set the "least burdensome" requirements, it created too high a burden



of proof: The EPA couldn't even regulate a proven carcinogen like asbestos.

Lautenberg died in June 2013, shortly after introducing a bill with one of the chemical industry's biggest supporters, Louisiana Sen. David Vitter, R. Udall, a co-sponsor, took Lautenberg's place. The bill was unpopular among Senate Democrats, because although it gave the EPA new power to regulate chemicals, it broadly limited states' authority. Udall still thought it was better than current law and believed he could make it stronger, such as by requiring the EPA to consider health and safety but not costs when setting standards for chemicals, and to protect vulnerable populations like infants,

Please see Compromise, page 6

New Mexico Sen. Tom Udall, D, shakes hands with Oklahoma Sen. James Inhofe, R, at a news conference on the Chemical Safety Improvement Act in May.

TOM WILLIAMS/CQ ROLL CALL/AP

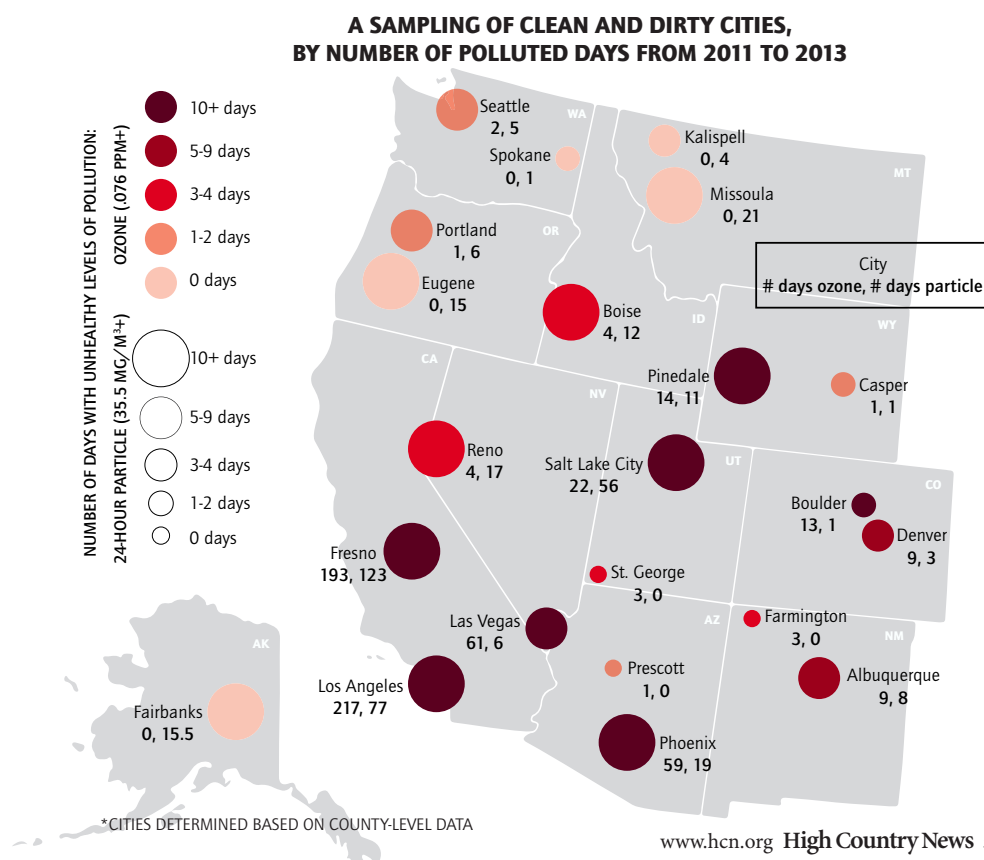
Snapshot

Clean or dirty?

A Western air quality map

What's the air like outside your window? Fresh and breezy? Or stale and smoggy? If you live out West, it might be dirtier than you think. For years, the American Lung Association's annual *State of the Air* report has ranked Western cities as among the country's most polluted. The aridity, dust and wildfire smoke can create a haze made worse by agriculture and coal-fired power plants, and the dirty air settles in urban areas between mountain ranges. In this year's report, which covers 2011 through 2013, cities in California's Central Valley filled out the top five for both particle pollution — caused by wind-blown dust, coal plant emissions and even mold — and ozone, created by reactions between sunlight and compounds produced primarily by burning fossil fuels. Cities throughout the West saw some of the dirtiest days ever reported. On the other hand, many Western cities, even in dry California, saw their average air quality improve, and several ranked among the nation's cleanest. Check out where the cleanest air is, and where you might end up short of breath.

KATE SCHIMEL





A Wyoming DEQ-Air Quality Division monitoring station used to study ozone formation in the Upper Green River Basin. BLM

THE LATEST

Backstory

For years, the smog over Sublette County, Wyoming, has symbolized the impacts of the West's oil and gas boom. It's caused in large part by the thousands of natural gas wells and their accompanying infrastructure, but pipeline leaks, dirty pump engines and a thousand other sources have proven difficult for regulators to tackle ("Oil and gas drilling clouds the West's air," *HCN*, 10/31/05). **By 2008, ozone levels in the area had outstripped federally mandated limits.**

Followup

Although ozone pollution has been declining since 2008's peak, Wyoming decided to take stronger action to prevent future spikes. On May 19, the state's Environmental Quality Council approved a new rule requiring operators to retrofit their equipment and follow tight guidelines on any new construction. Just two other oil- and gas-producing states have similar regulations: Colorado and California. But **environmental groups say the rule doesn't go far enough; it applies only to the Upper Green River Basin,** and they say it should apply to the entire state.

KATE SCHIMEL

Compromise *continued from page 5*

the elderly and chemical workers.

Many people, Udall said, told him they worried about the chemicals in everything from sippy cups to sofas. But ever since the EPA lost a 1991 court case, it's failed to regulate any of the tens of thousands of chemicals already in commerce.

Meanwhile, however, the chemical industry was rethinking its long opposition to regulation. Fears about flame retardants and compounds in plastics like bisphenol A, better known as BPA, had eroded public confidence. A few states, including California and Oregon, had begun regulating chemicals, and the industry began to think that dealing with a single federal law would be easier than coping with a patchwork of state regulations.

Udall saw this as an opportunity. But many public health and environmental activists thought he was compromising too much — betraying his principles by giving the industry what it wanted.

California Sen. Barbara Boxer, D, told reporters in March: "To be 100 percent candid and direct, their bill has been generated by the chemical industry itself." Computer coding, Boxer said, proved the bill originated at the American Chemical Council.

Udall denies this. He said he and Vit-

ter first wrote a draft and then asked for comment from industry groups and environmental and public health advocates, along with fellow senators, including Boxer. "I think it was an unwarranted, completely false accusation," he said.

But national media, including *The New York Times*, questioned the donations Udall had received from the American Chemical Council, as well as a campaign ad the group sponsored. Those attacks got some traction, but Udall said he isn't worried about his reputation. "They have to be true to mean anything to me. And none of them are true."

Udall appeared undaunted, and behind the scenes, he pushed Vitter and industry to accept a number of changes. The bill the senators introduced in March was significantly stronger than the 2013 Lautenberg-Vitter bill. For instance, it introduced new fees for chemical companies and increased the number of chemicals the EPA would be required to evaluate.

But the attacks continued. Boxer convened a press conference April 21 where public health advocates trashed the bill. Deirdre Imus, co-founder of the Imus Cattle Ranch for Kids with Cancer, in New Mexico, called it an "irresponsible prescription for disaster."

One substantive explanation for the Boxer-Udall discord is that New Mexico, a

poor state, has no plans to regulate chemicals. So California has much more to lose if states' authority to regulate toxic substances is pre-empted.

The criticism started to ebb only after April 28, when four Democrats joined all 11 Republicans on the Senate Environment and Public Works Committee to approve the bill. By then, it had moved closer toward Democrats' goals, significantly reducing restrictions on states. It was the first time in two decades that the committee passed major environmental legislation with a bipartisan vote.

Rhode Island Sen. Sheldon White House, D, one of the Senate's most ardent environmentalists, marveled that he and senators on the opposite end of the political spectrum supported the same bill. He credited Udall with "a signal legislative accomplishment."

Boxer, however, said that though the original Vitter-Udall bill "was slain," the new legislation "is still not a really good bill."

Despite the beating he took, Udall could end up looking like an environmental statesman. His bill has at least 40 co-sponsors, and chances of a Senate vote on it look good. If chemical safety reform ends up becoming law, Udall said: "I think it will be shown that all of us who worked on it did the right thing." □

Last-ditch effort

Colorado cautiously embraces irrigation water leasing to keep farms alive

BY JOSHUA ZAFFOS

John Schweizer has spent most of his life raising corn, alfalfa and other crops and about 200 cattle in Otero County, along southeastern Colorado's Lower Arkansas River. It's never been easy, but the last 15 years have been particularly tough on the nearly 81-year-old Schweizer and his neighbors. Their corner of the state is drier now than it was during the Dust Bowl. Meanwhile, growing Front Range cities are buying out farms and shifting their irrigation water to residential use — a process called "buy and dry."

Cities have siphoned more than 100,000 acre-feet of ag water — enough for about 200,000 Colorado homes — from the Arkansas River Basin alone since the 1970s. In neighboring Crowley County, farming has vanished, school-class sizes are half what they were 50 years ago, and tumbleweeds from dried-up fields pile up along fences and block roads. "That's what they're stuck with, because there's no more

water," Schweizer says. "It's gone forever."

Schweizer is president of the 35-mile-long Catlin Canal, which irrigates about 18,000 acres of farms. He's hoping that the trial run of something called the Arkansas Valley Super Ditch will save the basin's remaining communities and farms. The initiative is not actually a big ditch, but rather a scheme that allows six of the valley's irrigation canals to pool their water rights and temporarily lease them to cities. Starting in March, five Catlin irrigators "leased" a total of 500 acre-feet of water, which would normally supply their fields, to nearby Fowler and the cities of Fountain and Security, 80 miles away. Under the agreement, communities can use the farm water to supply homes and recharge wells for up to three years out of every decade. During those years, the irrigators will have to fallow, or rest, some fields, yet will still be able to earn money from the water itself and farm the rest of their land.

Supporters believe the Super Ditch could eventually enable farms and cities to

share up to 10,000 acre-feet of water. "We look at leasing water just like raising a crop," says Schweizer, who is avoiding any potential conflict of interest by keeping his own farm out of the pilot. "It is a source of income, and anybody who's doing that can have the water next year if they want to farm with it. And they are still in the valley, so the community stays viable."

Statewide, cities have acquired at least 191,000 acre-feet of agricultural water, eliminating farming and ranching on millions of acres. Water managers estimate Colorado could lose up to 700,000 more acres by 2050. Like Schweizer, officials consider water leasing, also called lease-fallowing or rotational fallowing, a promising way to slow that loss while satisfying urban thirst, particularly since alternatives like new dams and other big water-development projects face regulatory hurdles and environmentalist opposition. Colorado's draft water plan suggests the state could meet up to 50,000 acre-feet of its future water needs — and avoid more buy-and-dry — through such water-sharing deals.

But it wasn't easy to get anyone to commit to even a trial run of the Super Ditch. Farmers worry that leasing is just the first step toward selling out, and cities are leery of year-by-year arrangements. With the pilot finally in motion, supporters hope it will build enough trust to attract more



participants and inspire similar efforts elsewhere. Farmers and cities are watching, says Schweizer, “without a doubt.”

Other Western states already tap into lease-fallowing. California has had a major long-term program since 2004, designed to meet urban needs without drying up farms in the Palo Verde and Imperial valleys, while Arizona began its own pilot project in 2014. The combination of drought and urban growth in the early 2000s spurred on Colorado’s discussions. In 2004 and 2005, the city of Aurora, facing severe shortages, was able to lease water from farmers along the High Line Canal, another Arkansas Valley ditch. In 2007, the Legislature created a \$4 million grant program to study and support leasing and other ways to avoid buy-and-dry, leading to the establishment of the Super Ditch Company in 2008.

Previous Super Ditch pilot projects, however, failed to launch. Cities, rural power providers and some farmers and ranchers formally complained in Colorado water court that the project could “injure,” or deplete, their own water rights and supplies, or take more water than allowed. Irrigators have also gotten “cold feet,” says Jay Winner, general manager of the Lower Arkansas Valley Water Conservancy District, which backs the project. In several years, project farmers feared they wouldn’t have enough water to both lease and raise crops, due to drought.

Agricultural water users also worry that temporary transfers will diminish their legal water rights. Under state law, an irrigator who wants to lease water typically has to legally repurpose his water rights in water court to enable municipal or industrial use. Theoretically, a water court could then re-measure and reduce those rights — although that isn’t the intent.

Some farmers believe that the deals

threaten agriculture, rather than protect it, says MaryLou Smith, policy specialist at Colorado State University’s Colorado Water Institute. But Smith says that if they don’t become more common, “agricultural water will be bought up and converted to urban use. (Farmers) are going to get run over.”

Cities have also balked at leasing, saying it’s easier and cheaper to just acquire farmers’ water rights and build a “firm” supply than to invest in water that may or may not be available, depending on snowpack and farmers’ needs. Some urban water providers argue that having access to water only in relatively wet years, when farmers are more willing to share, isn’t that useful, because urban supplies are also plentiful then.

State lawmakers have eased some worries with a number of new laws, though. One 2013 bill, backed by Lower Arkansas water managers and others, clarified the rules for long-term water leases, helping to keep irrigators out of water court. Another allowed the Colorado Water Conservation Board to authorize up to 10 pilot projects, giving the state an oversight role. The measures helped finally launch the Super Ditch this spring.

But other projects are still running into opposition — including from some Super Ditch supporters. In northern Colorado, the Colorado Corn Growers Association, Aurora Water and Ducks Unlimited tried to develop a “flex market,” where farmers could have their water rights amended to allow them to be used for other purposes. Then they could auction them off in years when they weren’t planning to use them, and cities, industry or conservation groups could bid for the flows. But the Lower Arkansas Conservancy and others helped defeat a bill that would have authorized the market this spring. Winner says the setup looked like an illegal “spec-

ulation” scheme that could allow water to be auctioned off for non-agricultural uses every year — thus actually accelerating buy-and-dry and water diversions from one river system to another.

Andy Jones, a Johnstown, Colorado, water attorney who was involved with the legislation, responds that the flex market is a “narrow, intentional exception” to the state’s anti-speculation rule. But the opposition hasn’t surprised him, considering the water plundering that’s occurred in the Lower Arkansas. “I think the novelty is a concern to them,” Jones says, “but I don’t think it’s justified in the sense that we’re really all on the same page, trying to create incentives for water to stay in agriculture.”

Other approaches to water sharing for agriculture — and the environment — are having more luck. This spring, the nonprofit Colorado Water Trust and state Water Conservation Board established the state’s first permanent split-season water right, another legal water-sharing option. It allows water from a ranch, recently purchased by the Western Rivers Conservancy to prevent subdivision, to be used for irrigation during the early summer. After that, it will be returned to a once-dry stretch of the Little Cimarron River the rest of the year to benefit fish and improve water quality. “This project shows the environment can have a place, and it’s not a zero-sum game where you take water from one use and it never goes back again,” says Colorado Water Trust attorney Zach Smith.

And following the flex-market setback, a new working group in northern Colorado is discussing a sort of land-and-water bank, where farmers ready to call it quits could sell their resources. The “bank” would then broker conservation easements and land sales, allowing only a limited portion of water to be sold to cities. The rest would go back to farms. “It has gotten people excited,” MaryLou Smith says.

The long-awaited Super Ditch pilot project and other efforts are hopeful signs. But as demand grows and water supplies dwindle, preserving farms in Colorado and much of the West will require more than gradual, piecemeal progress. The clock is ticking: This spring, just as Catlin Canal irrigators finally began sending off Super Ditch flows, a developer announced plans to buy 14,600 farmland acres and connected water rights from the nearby Fort Lyon Canal for \$53 million, the latest massive selloff to rock southeastern Colorado.

“Once it’s sold, it will never, ever come back,” says Schweizer. “We’ve had plenty of opportunities to throw our hands up and say, ‘To hell with it,’ but if I’d have done that, I wouldn’t have been farming for the last 50 years either. If what you think you’re doing is the right thing to do, then you work for it.” □

Arkansas Valley Super Ditch President John Schweizer stands near an irrigation canal on his farm near Rocky Ford, Colorado. He believes a unified approach to selling water through leases is the only way to stop cities from buying and drying the valley’s farms.

BRYAN KELSEN/
THE PUEBLO CHIEFTAIN



This story is part of an ongoing series that looks at the people and ideas helping the West better understand and use its water.

THE LATEST

Backstory

At least 89 workers died in the Interior West's oil and gas fields between 2000 and 2006 ("Fatalities in the energy fields," *HCN*, 4/2/07). In jobs that require long shifts working with heavy equipment and toxic materials, often with little training or supervision, the hazards are numerous — and critics say industry sometimes neglects safety in its rush to produce. "(The oil and gas industry) treats employees like a commodity," AFL-CIO representative Kim Floyd told *HCN* in 2007.

Followup

The Centers for Disease Control is taking a closer look at fatalities involving hydrocarbon inhalation. **A new CDC report says that between 2010 and 2014, nine oil and gas workers likely died from inhaling toxic gases, rather than of "natural causes," as reported.** "The industry is trying to make improvements. We're moving in the right direction," Kenny Jordan, executive director of the Association of Energy Service Companies, says. Still, recent research shows the industry's death rate remains six to seven times higher than the national average for all jobs.

KINDRA MCQUILLAN

Oil worker in New Mexico. BRIAN LEDDY



Bull trout migrating to spawn in a tributary of the Metolius River. DAVID HERASIMTSCHUK/FRESHWATERS ILLUSTRATED

Clackamas comeback

A bull trout reintroduction in Oregon proves what's possible

BY BEN GOLDFARB

On a damp October morning, a troop of wader-clad scientists plunged into Pinhead Creek, an icy Oregon stream around 60 miles southeast of Portland, to search for fish nests. Finding those nests, called redds, was no easy task: The same labyrinth of moss-bound logs that makes Pinhead prime fish habitat also makes it a hellacious obstacle course for humans. The crew spent that morning straddling downed cedars, crawling through alder, and getting slapped by the glossy palms of rhododendrons. "Both my feet are soaked," declared one surveyor, whose boots had sprung leaks. He sounded more cheerful than the situation seemed to warrant.

The struggle, though, only made the discovery of the day's first redd more rewarding. Chris Allen, a fisheries biologist with the U.S. Fish and Wildlife Service, traced its outline in the streambed with a wading pole, like a conductor guiding an orchestra. "Here's the pit," Allen said — where the fish had scooped out a soccer ball-sized depression to deposit its eggs — "and here's the mound," where it had heaped the displaced gravel.

I nodded uncertainly. Without narration, the redd would have been invisible. "It's not an obvious one," Allen said. "But

this is about the right size for a bull trout."

For the band of researchers canvassing Pinhead Creek, a slim tributary of the Clackamas River, every redd was an auspicious sign. Since 2011, Allen and his colleagues have relocated 1,758 bull trout into the Clackamas watershed, an ambitious — and, in some quarters, controversial — attempt to re-establish this threatened predator to part of its former range. The redd surveys have become an autumn rite, a vital measure of whether the finicky fish are spawning — and whether this landmark program can inspire bull trout reintroduction in other Western rivers.

A lot, then, was riding on this four-foot-wide patch of pale gravel tucked against a fast riffle. Allen shrugged. "They don't lay them in textbook places like salmon," he said. "Bull trout are weird that way."

Like many salmonids, *Salvelinus confluentus* had a rough 20th century. Once abundant from the mountains of Montana to the rivers of the Pacific Coast, bull trout were classified as threatened in 1998. The Clackamas, an 80-mile tributary of the Willamette, was a microcosm of the fish's plight: The river's bull trout were hammered by decades of overfishing, dam-building, and sediment runoff from logging and road-building. In the 1990s, biologists realized the fish hadn't been

seen in the river since 1963. Surveys confirmed that bull trout were gone.

That could have been the story's end: Just another local extinction, on a planet where such tragedies are depressingly common. By the mid-2000s, however, the West had entered an era of rewilding. Wolves were again prowling Yellowstone, black-footed ferrets were scarfing down prairie dogs in Wyoming, California condors were swooping over Big Sur. The Clack's wounds had healed: Fish passage through its dams was improved, and overfishing had been curtailed. In 2007, biologists at the Fish and Wildlife Service, the Forest Service and the Oregon Department of Fish and Wildlife decided the Clackamas was ready for bull trout again.

Others, however, were less enthusiastic about this apex predator's comeback. When Allen and his colleagues proposed reintroduction, the National Marine Fisheries Service worried that bull trout would devour enough young salmon and steelhead to damage the Clackamas' endangered stocks. Anglers — who in some watersheds once received bounties for every bull trout they killed — also balked. "At first I was dead against it," said Bob Toman, a local fishing guide. "It's still kind of scary to me."

To alleviate concerns, the Fish and Wildlife Service agreed to label the reintroduced fish as a "non-essential experimental" population, a designation that allowed for more flexible management and shielded anglers who accidentally harmed bull trout from prosecution. The agency also designed a series of controls, many borrowed from wolf management, that al-

HCN correspondent Ben Goldfarb (@ben_a_goldfarb) writes from Seattle.

lowed for the removal of individual bull trout, or even the termination of the project, if salmon and steelhead suffered. At last, with the Fisheries Service's cautious blessing, the reintroduction could begin.

On June 30, 2011, before a cheering crowd, Allen wrestled a gleaming adult bull trout from a blue cooler and into the Clackamas River. The moment was a personal triumph for the scientists involved, one that more than justified years of preparing permits and impact statements. Said Allen, sounding a smidge emotional: "It was the kind of professional highlight that happens only rarely in your career."

The hard work, however, was just beginning: The agencies had vowed to establish a spawning population of 300 to 500 bull trout by 2030. That presented a challenge for Patrick Barry, the Oregon Fish and Wildlife biologist (now with the Forest Service) who was tasked with capturing juvenile, sub-adult and adult fish via nets and traps from the Metolius River, home of Oregon's healthiest remaining population. For all their voraciousness, bull trout are delicate: They require frigid water, and the Metolius is three hours from the Clack. Picture technicians in a truckbed on a 90 degree day, frantically adding blocks of ice to a warming transport tank, praying their fish don't go belly-up. "Boy, we made a lot of ice," Barry said.

Barry and his crew gradually got better at keeping bull trout alive, and the fish flourished upon release. Radio-tracking suggests that most of the 68 relocated adults and 204 sub-adults have survived and stayed put in their new environs. Even better, bull trout haven't generally lurked near the dams, where juvenile salmon would be easy prey. Indeed, salmon and steelhead runs have ticked upward since reintroduction began. Though that's probably a credit to improved dam passage, it also buoys scientists' hope that bull trout may tilt the Clackamas' scales in favor of chinook, coho and steelhead. After all, bull trout don't exclusively eat young salmon: They also feast on mid-level predators, like cutthroat trout and sculpin.

"Without a big boy on the playground, those other fish have been left unchecked," said Barry. "The Clackamas was already a relatively healthy system, but now it's a complete system."

If bull trout indeed stabilize the Clackamas' food web, it could motivate similar projects elsewhere — and not a moment too soon. Bull trout reintroductions have thus far been few and far between: Besides the Clack, the only significant effort occurred in Oregon's Middle Fork Willamette River, where biologists have managed to establish a small population of 20 to 30 spawning adults — encouraging progress, but not yet gangbusters success. Meanwhile, *S. confluentus*' proclivity for cold water makes it a poster species for the



Researcher Kristen Harris with the Oregon Department of Fish and Wildlife collects juvenile bull trout in the Metolius River to translocate to the Clackamas River, above. Patrick Barry with the Oregon Department of Fish and Wildlife releases juvenile bull trout into a headwater tributary of the Clackamas, left.

DAVID HERASIMTSCHUK/
FRESHWATERS ILLUSTRATED

perils of climate change. As temperatures rise, warns Marci Koski, biologist at Fish and Wildlife's Columbia River Fisheries Program, pockets of warm water may create thermal barriers throughout river basins, leaving some fish stranded. "We need to protect habitat that links populations at risk of being isolated," Koski told me. "Otherwise, reintroductions and translocations may become more commonly used tools."

Though the agencies will stop adding bull trout to the Clackamas after 2016, October's redd survey suggests that the new population stands good long-term

odds. By afternoon's end, we'd counted 10 certain nests; another team saw five more upriver. (Altogether, Allen and his crew found 35 redds in 2014, almost triple the previous year's tally.) Improbably, the survey's least-trained member — me — spotted the only actual bull trout: a dark torpedo that hugged the bank as it cruised downriver.

"I have absolutely no doubt that reproduction is happening," Allen said, satisfied, as he stepped out of his dripping waders. "There are juvenile bull trout swimming around down there. It's just a matter of catching them." □

WEB EXTRA

See more photos of the bull trout reintroduction at hcn.org.

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Thank you, Research Fund contributors, for joining us on a wild ride

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A dory runs Hermit Rapid in the Grand Canyon.
JOHN BLAUSTEIN

THE HIDDEN CANYON: A RIVER JOURNEY
John Blaustein and Edward Abbey
160 pages, softcover:
\$29.95.
Cameron & Company, 2015.

In the late 1970s, wilderness advocate Edward Abbey and longtime river guide John Blaustein floated 277 miles of the Colorado River through the Grand Canyon in small wooden dories. At the time, the Grand Canyon was best known from the rims, far above; few had braved its wild depths. First published in 1977, *The Hidden Canyon: A River Journey* documented the two men's passage through Blaustein's photographs and Abbey's witty and lyrical journal entries, presenting a radical new view of the American treasure.

This latest edition includes dozens of additional photographs from Blaustein's subsequent trips through the Canyon. From majestic geological vistas to fleeting glimpses of wildlife, these timeless and stunning color images catch moments that touch the heart of every river-wanderer.

WEB EXTRA See more of rafting and landscape photos in the Grand Canyon at www.hcn.org.

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Ch-Ch-Changes

As of May 26, associate editor **Brian Calvert** takes over as managing editor of *High Country News*. **Jodi Peterson**, who did the job for five years, has decided to focus on writing and editing, so she'll become our second senior editor, joining **Jonathan Thompson** but remaining here in Paonia, Colorado. As for Brian, what can we say but (*cue the ominous background music*): "Your next stop is ... the *Twilight Zone*!" Congratulations (we think) to both Brian and Jodi.

HURRAY FOR EVERYONE! *HCN* contributor **Ana Maria Spagna** has just released a handbook for the post-oil world called *100 Skills You'll Need for the End of the World (As We Know It)*. She describes it as "slightly tongue-in-cheek, but earnest, too, a quirky shift in thinking about what makes us human, what might help us survive." Her suggestions include "canning" and "bartering," but also "daydreaming," "laughing" and "staying home." For details, see anamariaspagna.com.

Nick Neely, former *HCN* intern (winter 2010), recently received a Food and Farming journalism fellowship from the UC Berkeley Graduate School of Journalism. Nick plans to write about the way "excess hatchery salmon and steelhead in Oregon are delivered to food banks or thrown back into streams as carcasses to enrich the ecosystem." He first hatched this story idea while at *HCN*, he says.

And finally, our own website, **hcn.org**, received first place for "General Website Excellence" in the Society of Professional Journalists' Top of the Rockies annual contest. We competed against other publications from

four Western states, with readerships of 30,000-79,000, for "content, interactivity, design, navigation, multimedia and community tools." Good job, *HCN*! (If we do say so ourselves.)

A MAN AND HIS DOG
At well over 6 feet tall and wearing a T-shirt decorated with wolves, **Dale Hawker** stopped in to renew his longtime subscription. Dale, who runs a sawmill in Troy, Montana, population (maybe) 800, also makes lamps and tables, but is proudest of his dog, Timber, a 170-pound mix of Alaskan malamute and wolf, with fur as thick as dreadlocks. A lot of wolf-dog mixes have, um, emotional "issues," but Dale assured us that his dog was just shy, though you wouldn't want to "mess with his food" by attempting to take away a bone, for example, nor should you "come near him with scissors." Dale added that his dog possesses remarkable discernment: "If he doesn't want to let somebody out of their car, it's because he shouldn't. He's a good judge of people." We'll take your word for it, Dale. But what about delivery people? "No problem!" said Dale. The UPS guy "always starts out flinging dog biscuits." Dale was in our area to attend the 75th birthday party of his stepdad, **Tom Huerkamp**, a former *HCN* board member.

CORRECTIONS
Our May 11 cover story, "The Wetland Wars," said that Roy van de Hoek girdled eucalyptus while still a Bureau of Land Management employee; he actually did that two years after leaving that job.

—Paul Larmer and
Betsy Marston for the staff



Dale Hawker shows off his wolf pride with a wolf-adorned T-shirt.
BROOKE WARREN





TREE OF LIFE

*To save the most species, conservationists might do best
to save the common ones they depend on*

FEATURE BY CALLY CARSWELL

Back when he was in his 30s, Tom Whitham would have been leery of the meddlesome approach to conservation that he is laying the foundation for today. Whitham came out West in 1973 to pursue a doctorate in biology at the University of Utah. He had just finished a tour as an Army photographer at a hospital in Hawaii filled with soldiers injured in Vietnam, a difficult experience that had one positive result: He encountered buzzing, singing and tangled rainforests, and became enchanted with wild places, which were rare in his native Iowa. He decided to move to the American West because, he says, “we hadn’t plowed it under yet.”

He imagined it as an untamed frontier. Though not naive about the human tendency to damage the environment, he thought the West was still too big and sparsely populated to be threatened in any existential sense. One good way to protect or heal the environment, he believed, was to leave it alone. Given time and space, nature could often fix itself.

Today, Whitham is a meticulous and accomplished ecologist based at Northern Arizona University in Flagstaff. He wears round glasses, a gray goatee and, when outdoors, an oiled leather cowboy hat. His love of nature hasn’t wavered. At last count, his home garden boasted 120 species of native conifers, poplars, shrubs and grasses. In the field, he always carries a camera, and even at sites he’s studied for decades, he still finds things worth photographing. But he thinks the frontier is dead. He is no longer optimistic about nature healing itself. The challenges — a climate in disorder, a looming sixth extinction, and people, always more people, always seduced by short-term gain — have grown too big, too fast. “We live everywhere and we’re affecting everything,” Whitham says. “My senior colleagues, some of them use the ‘f-word.’ Some of them think we can’t do anything.”

Whitham, however, prefers not to dwell on the negative. “We don’t need another study to tell us how bad things are,” he says. Lots of damaged landscapes need help right now, and that need will only increase as global tempera-

tures rise and warp the local conditions to which organisms are adapted. What we need to know is: *How* do we take action to sustain plants and animals through the turmoil ahead?

Whitham believes the answers lie in an unexpected place: The DNA of species so common we usually take them for granted. As Whitham and his colleagues have researched the Southwest’s cottonwoods and piñon pines, they’ve introduced groundbreaking new ideas about how these trees’ genetic traits influence the community of surrounding organisms, and even shape entire ecosystems. If their discoveries hold true in kelp beds, coral reefs, tropical forests and desert shrublands — and so far, they have — they may transform our understanding of how everything in the web of life is connected.

That could make today’s restoration efforts more successful, and even help managers take the kind of radical leaps that conservationists increasingly say are necessary to prevent extinctions: Moving species to more favorable habitats, for example, without making things worse in the process. But for now, the most revolutionary idea to emerge from Whitham’s work is perhaps the simplest: Saving a large number of species has everything to do with saving the few they all depend on.

WHITHAM GREW UP IN THE TINY TOWN OF AGENCY, IOWA, with an oak and hickory forest nearby. His father, Lloyd, ran a wholesale nursery, selling big trees to banks, which paid good money for the image of stability that they imparted. Lloyd also bred new varieties for landscaping, including a frost-resistant yew that could survive a couple hundred miles farther north than other varieties. A green thumb ran in the family: Whitham studied nursery management and plant pathology in college. And though he decided not to take over the family business, his interest in trees — an inheritance, of sorts — inspired his future research.

A little way north of Salt Lake City, where the University of Utah is located, flows the Weber River. It originates high in the Uinta Mountains and gurgles through small farming and mining towns before draining into the Great Salt Lake. Whitham wandered the Weber’s banks, which were lined with sun-speckled cottonwood galleries. The trees were familiar, though in Iowa the cottonwood was considered “kind of a lowly tree,” he remembers. “It produces a lot of debris, it’s not really long-lived. If you plant one next to your house, the wind could blow it over.”

In the Southwest, however, the tree is special. Cottonwoods are one of the few big deciduous trees that grow wild in the

Cottonwoods at the Northern Arizona University greenhouse, where seedlings with different genetic signatures are grown for field trials at experimental gardens under varying conditions. JEREMY WADE SHOCKLEY



Tom Whitham plants cottonwood seedlings for an experiment at Cibola National Wildlife Refuge in Arizona. COURTESY ARIZONA BOARD OF REGENTS

region, and, together with willows, they anchor native riverside habitat. Cottonwood galleries are home to insects, birds and animals, and the trees themselves are beautiful — flushing a brilliant, glittering gold every fall. Though not endangered, they are vastly depleted, thanks to overgrazing by cattle, overzealous cutting, and the damming and diversion of wild rivers, whose seasonal ebbs and flows are critical for cottonwood reproduction.

Whitham began to look closely at the Weber River's two resident species — Fremont and narrowleaf cottonwoods — searching for interesting patterns. A milky, soft-bodied aphid caught his eye. The bug attacks the trees each spring, forming a hollow gall just below the leaf, where it feeds, reproduces and hides from predators. Whitham noticed that one cottonwood might attract millions, while another tree of the same species, only feet away, had none.

There were two possible explanations: There could have been something different about the trees' environment, with one spot slightly drier or warmer, creating some change that the aphid preferred, perhaps in leaf shape or size. Or something in the trees' DNA could have conferred natural pest resistance on some trees. "The trees were so close together, it almost had to be genetic," Whitham says. "But I was still kind of surprised to see it in nature, because it was so striking. I always expected it to be more subtle."

He took cuttings from 81 cottonwoods and planted them all in a "common garden." A few acres in size, it would ensure consistent growing conditions, removing the possibility that any differences that emerged were caused by soils, temperature or water supply. Sure enough, aphids swarmed clones of the same trees they attacked in the natural forests. The insects were responding to the trees' genes.

Whitham noticed other things, too: The aphids attracted other bugs that didn't visit the resistant trees, and those bugs drew an unusual number of hungry birds. He began to wonder if a tree's genetics might not only determine the presence of one measly aphid, but indirectly, the panoply of creatures that frequented its canopy.

For the next two decades, he and a formidable group of collaborators intensively studied that first garden and others, planted with diverse genetic variants, or genotypes, with each tree DNA fingerprinted. They saw the influence of the trees' genes almost everywhere they looked. Birds of various species preferred to nest in genotypes with particular branch and canopy architectures, for example, while spiders favored one with thickets of dead branches and dense foliage. Beavers selected a "sweet" genotype, with low tannin levels. Lichen attached to the trunks of a genotype with rough, topographically complex bark. On a stretch of the Weber where Fremont and narrowleaf cottonwoods naturally

hybridized, the two species supported two distinct insect communities, while the hybrids hosted elements of both.

The researchers dug into the soil and analyzed leaf litter in streams. Eventually, they demonstrated that a single group of genes influenced not only the community, but the invisible ecological processes that helped sustain it. Tannin-poor and tannin-rich leaves decomposed at different rates, causing variability in soil fertility. The two leaf types similarly affected the nutrient cycle in streams, and with it the bacteria and bugs at the bottom of the food chain. Genotypes even differed significantly in their ability to sequester carbon in their roots.

Based on the researchers' hundreds of studies, it appeared that genetic diversity within cottonwood species influenced the composition and function of the entire riparian system — accounting for between 39 and 78 percent of the total biodiversity in the researchers' cottonwood gardens. Parallel research in aspen, eucalyptus and piñon pine forests suggests that “foundation species” — that is, the dominant, habitat-forming plant on the landscape — do the same in other ecosystems.

Genetic diversity — the raw material of evolution — had long been seen as important, but scientists and conservationists primarily considered it when trying to protect rare and endangered species. Without it, small populations are especially vulnerable to extinction. In the event of a disease outbreak, for instance, genetic diversity acts as an insurance policy: The more diversity there is, the better the odds some individuals will carry genes that confer some resistance. But for common species, beyond recognizing genetic diversity's importance in keeping them healthy and abundant, nobody paid it much mind. Now, there was new incentive to care.

“Almost everyone thinks a species is a species is a species,” says Jessica Hellmann, a biologist at the University of Notre Dame who specializes in the ecological impacts of climate change. “Tom has shown that there are differences between cottonwoods that matter. The identity of an organism influences every other member of its community.” That means that maintaining genetic variation in a foundation species is “going to be critical for the associated community's biodiversity and ecosystem function,” adds Gery Allan, a plant geneticist and a member of Whitham's research group at NAU. “We know it's all tied together.”

It's necessary, then, not only to understand how a foundation species' genes influence the whole community of living things around it, but also to parse out what traits hidden in its DNA might ensure its persistence, even as its world shifts. After all, species that are common today might not be so common decades from now. Some models predict that within this century, torturously hot, dry spells could kill off or significantly



beat back some of the Southwest's most familiar tree species.

In the region's piñon woodlands, the crippling 2002 drought offered a grim preview, with 57 percent of the mature piñon in northern Arizona perishing. But there was a sliver of hope in the die-off, and it taught scientists a new version of the lesson they'd learned among cottonwoods: When it comes to who lives and dies, a tree is not a tree is not a tree.

ON A WARM SEPTEMBER MORNING, Whitham and Kitty Gehring, an NAU colleague who studies soil microbes, take me to see a special stand of piñon trees, a foundation species that, at this site, supports roughly 1,000 species of birds, rodents, bugs, bacteria and fungi. The stand is about 30 minutes from Flagstaff, in Sunset Crater Volcano National Monument. The volcano erupted nearly 1,000 years ago, smothering an 800-square-mile area in lava, ash and cinder. Life rose from the rubble, but its existence still feels improbable. The sandy “soil” the trees live in has all come from somewhere else, an accumulation of dust deposited by the wind. There's just a thin layer of it, no more than one or two inches thick, sandwiched between layers of jet-black basalt pebbles that radiate the day's building heat. Growing here must be sort of like trying to eke out a living on a hot tar roof.

Right around the time Whitham planted his first cottonwood garden, he came to this place with a group of graduate students. They immediately noticed that the piñon grew in two distinct shapes. One resembles a classic tree, with a canopy, a trunk and admirably upright posture. The other has a form reminiscent of a fat, laughing Buddha, reclining

lazily on one elbow, looking perhaps a little drunk, its branches sprawled across the cinder.

Research pegged the difference to the Buddha trees' genetic susceptibility to a moth that attacked each year's new shoots. The moths acted like hedge-clipper-wielding suburbanites, cutting the trees down to shrubs. Not only did the trees grow painfully slowly, there was also the matter of the sex change: Piñon produce female, seed-bearing cones in their crowns and male pollen-dusted cones down their sides, but the moths chewed only the crowns, eliminating most of the trees' lady bits. “You look at them and go, ‘Poor things,’” says Gehring.

Gehring also found what appeared to be a subtler disadvantage. The moth-munched trees had much less — and different types — of a helpful kind of fungi than the resistant trees. Called *mycorrhiza*, these fungi form little hairs around the trees' roots and, in exchange for a supply of sugar, deliver nutrients from the soil. Experiments showed that the trees' genes determined which kind they ended up with. Because moths were attacking the shrubby trees, they couldn't afford to give their fungi much sugar. Thus, Gehring assumed, the fungi would be “cheap and not very good.” She dubbed them “Wal-Mart mycorrhiza.”

“These resistant trees seemed so superior,” Whitham recalls, “that I would have bet that they would have taken over the piñon world.”

But he would have lost that bet. After the 2002 drought, nearly 70 percent of the “superior” trees perished, while less than 30 percent of their moth-attacked neighbors did. Gehring suspects the fungi made the difference. She's discovered that the susceptible trees' fungi stay



Environmental Genetics and Genomics Lab Director Gery Allan studies plant genetics at the molecular level. Above, a hole punch is used to extract samples of cottonwood leaf for DNA sequencing.

JEREMY WADE SHOCKLEY



Kitty Gehring at Sunset Crater Volcano National Monument near Flagstaff, Arizona, where she studies moth-resistant piñon pines that look healthy (right) and those that are more susceptible to hungry moths (far right) — and are more resistant to other environmental stresses. Below, a piñon rises from the volcanic soil.

JEREMY WADE SHOCKLEY



active and abundant when it's dry, while others die or go dormant, perhaps depriving trees of critical nutrients. "Maybe it's cheap," she says of the Wal-Mart mycorrhiza, "but it's really good."

It was an encouraging sign: The piñons had vulnerabilities, sure, but also wells of resilience. The dramatically higher survival rate of one genetic variant suggested that drought-hardiness was embedded in its DNA. "If you find populations like this one," Gehring explains, "and if they reproduce or if you breed them intentionally, then you may not have a species that goes extinct in Arizona in 2080. It could survive."

But for Whitham, the scale of the die-off also underscored the urgent need for action: Since trees live for hundreds, even thousands, of years, they have to be adapted to a wide range of environmental conditions. "If you see mortality in these really long-lived species, that suggests something fundamental is changing," Whitham says. Climate change was no longer a distant threat: "It's occurring right now."

THIS SPRING, the journal *Science* published a study that predicts one in six species globally will go extinct if carbon emissions continue climbing on their current trajectory. Some scientists say that estimate is low; the number "may well be two to three times higher," one told *The New York Times*. Neither estimate accounts for the species that will die out in parts, but not all, of their range, thanks to local variations that pound some areas with much more extreme climatic changes.

The scale of the crisis seems well beyond the scope of laws like the Endangered Species Act. As the national climate change policy advisor for the U.S. Fish and Wildlife Service, Mark Shaffer, wrote in a recent editorial in the journal *Conservation Biology*: "Tending to one species at a time in the face of thousands in need promises a long journey to closure." Protected areas are one way to safeguard lots of species at once, but our current collection wasn't designed to withstand a turbulent climate. Joshua Tree National Park, for instance, may become unsuitable habitat for Joshua trees. And without protected corridors between these islands of preserved habitat, creatures may not be able to move or connect to other populations as their environments change.

So conservationists need new strategies. Shaffer's editorial introduced a group of papers focused on a novel approach dubbed "conserving nature's stage." It suggests ensuring that a wide array of geophysical features are protected — soils, topography, geology — "as 'stages,'" Shaffer writes, "for the evolving cast of players sure to be on the move in an era of climate change." Another option is "assisted migration," where people pluck species or populations out of habitats they're no longer suited to, and plop



them down in more hospitable ones. Yet another is the idea of preserving genetic diversity within foundation species.

With any of this, there are practical problems. In a lot of places, we don't yet know what the foundation species are, nor can — or should — we relocate every struggling species. We don't know whether it would even work. And there are risks. A transplanted species could become invasive in a new environment, crowding out others that were doing fine before humans intervened. "The idea of assisted migration comes up all the time," says Notre Dame's Hellmann, a leading thinker on the approach. "But the leap from starting to think about it to actually implementing it is a big one. We probably have five, 10, 15 years we can spend thinking about it," before it becomes much more common for species to blink out in parts of their range. "We don't have much more time than that."

Scientists are thus rushing to understand whether species can move quickly enough to friendlier climes on their own, or adapt quickly enough to stay where they are. And for critical species that are already dying at alarming rates — such as corals — scientists are at the same time trying to devise ways to help them adapt.

"Corals are foundation species, just like trees," says Ruth Gates, a marine biologist at the University of Hawaii.

Scientists are only beginning to study how genetic variation among corals might affect all of the algae, fungi, plants and fish associated with them. What they already know, however, is that — just like Whitham and Gehring's piñon — some corals within the same species withstand stress better than others.

"When you go on a reef that is in a stress event, usually from high temperatures, you'll see some are completely colored, and the one next door will be bleached," which often leads to death, Gates explains. She and a collaborator in Australia, Madeleine van Oppen, are now working to understand the survivors' biology in order to develop stock able to endure and adapt to future climate conditions, an approach they've dubbed "assisted evolution."

"We need to see if we can manipulate the system using selective breeding," Gates says. "Or create environmental treadmills, giving them experiences that will turn on certain genes." It appears, for example, that stress flips on genes in some coral that help them survive bleaching events, and that once those genes are "on," they stay on and can be passed on to offspring. That's an exciting prospect, Gates says, because "these changes happen in the same timeframe that these radical environmental changes are occurring."

If Gates and her collaborator can develop resilient stock that can be successfully planted in the wild in Hawaii and Australia, they will then hurry to see whether their methodology can be applied to a wide array of coral species around the world. "We'd have to make this a viable restoration strategy," she says. "We're all in the race against time."

IT WAS WITH THE GOAL of winning that race that Whitham refocused his research around enabling conservationists and land managers to figure out how to keep critical species like piñon and cottonwood, along with a little, or maybe a lot, of the insects, birds, microbes and mammals they support.

Today, he and a laundry list of collaborators — including the Bureau of Land Management, the U.S. Forest Service, The Nature Conservancy, the Flagstaff Arboretum and the Arizona Game and Fish Department — are creating a climate-focused network of 10 common gardens in Arizona, plus a number of satellite sites around the region, called the Southwest Experimental Garden Array. The 10 core gardens will span elevations from 5,000 to 9,000 feet above sea level — a gradient that can be used to mimic the effects of climate change — and feature a range of soil and habitat types, from desert scrublands to aspen and mixed conifer forests.

Coral bleaching in Kaneohe Bay, Hawaii, last October. As in the Arizona piñon and cottonwood trees, researchers have found genetic variation among corals that leave some healthy in the face of stress (brown in the photograph) and others bleached white and more likely to die.

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Northern Arizona University graduate student Hillary Cooper, above, and her study of drought-resistant grasses, such as native grama grass and Arizona fescue, at the Flagstaff Arboretum, part of the Southwest Experimental Garden Array. Michael Ingraldi, right, of the Arizona Game and Fish Department at the Chevelon State Wildlife Area, where invasive tamarisk and other exotics thrive in the riparian area. JEREMY WADE SHOCKLEY



They'll be big enough to support multiple studies, and offer ready-to-go infrastructure — fencing, data management, irrigation systems that can be controlled from afar — to encourage as many researchers as possible to use them.

The methodology is not so different from that of field trials to develop new seed varieties in corn country. But where agricultural experiments might focus on increasing the harvest from each acre, here the metrics of success involve biodiversity and long-term survival.

"The huge power of genetics is that you can take a species like piñon or cottonwood and look at the variation over their whole range," Whitham says. "You can find areas where they're adapted to much more severe conditions that reflect what another area will become in the next 50 years." And you can quantify how much environmental change different genotypes and populations can tolerate. "Genetic differences," Whitham explains,

"are the difference between life and death in a given environment."

One of the gardens in the new experimental array will sit on the bank of a Little Colorado River tributary called Chevelon Creek, just south of Winslow, Arizona, on Arizona Game and Fish Department land. The day after visiting Sunset Crater, Whitham and I meet Michael Ingraldi on the creek, where similar work is already underway in an established garden. Ingraldi, youthful-looking at 50, inquisitive, a constant jokester, is a research biologist with the state agency. Both men, it turns out, have species of flies named after them, gifts of a kind from the friends who first identified them. Whitham's namesake eats poop, Ingraldi's sucks blood.

Ingraldi is in charge of removing tamarisk from some 55 acres around the creek and restoring its native cottonwoods and willows. Sounds routine enough, but it's no small task. Though the

tamarisks at the garden's edge are now thick enough to hide a meth lab — which they have, in fact, been known to do — they are probably on their way out. In 2001, federal officials introduced a beetle to the West to kill the riparian invader, and it is making its way into Arizona. Ingraldi must ensure that native vegetation becomes established in its wake rather than tumbleweeds, which now grow so big here they look ready to collapse under their own weight.

Plus, trees planted for restoration projects often die. "People say it's because of salty soils," Ingraldi explains, or because the water table has dropped too low. Climate change doesn't help, he adds. "That's why we're partnering with these guys. We want it to work." After all, they're on the hook. Once his agency replants the area, it must maintain it in perpetuity. Moreover, this restoration work will be a demonstration project for a larger vision: To restore the cottonwoods and willows that have been lost in much of the 27,000-square-mile Little Colorado River watershed. "This is going to be the jewel of the Little Colorado," Ingraldi says. "Hopefully."

Until now, restorations like this have typically been done with cuttings from local trees, on the theory that they are the most likely to thrive, or with plants of unknown provenance bought from a nursery. But "this place is probably going to get drier," Ingraldi explains. "And if it gets drier and warmer, you would assume cottonwoods and willows from a drier climate would do better here. Well, is that true?"

To find out, researchers have planted local cottonwood and willow genotypes in the garden, along with genotypes from lower and higher elevations, and more southern and northern climes. They track their growth and survival rates, and how different combinations of willow and cottonwood fare together, among other things. As Whitham explains it to Ingraldi, citing data collected at other sites: "If you tell me, 'I want a tree that supports the greatest diversity,' I can guarantee you that we can select trees that maximize biodiversity. If you want to maximize growth, we can do that."

That might sound like a potentially dangerous level of meddling. But Dan Simberloff, an invasive species expert at the University of Tennessee and a sharp critic of assisted migration, says there's little risk in moving cottonwood and willow genotypes around across relatively short distances, and to already highly disturbed sites, within their native range. There's not a lot to mess up on the tamarisk-lined banks of Chevelon Creek, as Whitham puts it, but there is a lot of opportunity to learn "the tools of a new trade."

His confidence that this kind of restoration can work comes in part from a proof of concept project on the Weber River 13 years ago. Simply planting strategically selected cottonwoods has helped shift a site that was completely consumed

by invasive weeds to one composed of nearly 40 percent native plants, and with some 700 species of bugs living in the trees alone. The lesson of this project: If you build it, they *may* come.

Things were a bit different on the Weber, though: Creatures didn't have to go far to colonize the restoration site; they had intact habitat nearby. If managers plant genotypes from a hundred miles away, or in places without cottonwoods and willows nearby, it's unclear how much of the life they supported in one place would follow them. Kevin Grady, a restoration ecologist at NAU, is just beginning to tackle these additional layers of complexity in large research sites on the Little Colorado River, transferring understory grasses and even microbial communities with trees.

Already, it seems likely that economically expedient one-and-done plantings won't last indefinitely. Climate models predict that the Chevelon Creek site could warm by 6 degrees Celsius this century, but new results from the garden show that cottonwoods adapted to those higher temperatures don't thrive here now. They leaf out too early and set their buds too late, often getting nipped by frost, and they are more vulnerable to pathogens; some have died. Conversely, data from a garden to the south show that the trees that do well here now won't thrive under radically warmer conditions. That means that land managers may have to consider planting new genotypes incrementally.

"The genetics stuff is getting sort of science-fictiony," Ingraldi observes after a while. Whitham nods. The pie-in-the-sky goal, he explains, would be to have the genome of everything sequenced and functionally parsed apart — the natives, the invasives, the soil microbes. "Then we could say, 'This is the gene in the tree that's interacting with the gene in the willow interacting with the gene in the tamarisk, and if you take this gene away it's going to have these effects, negative or beneficial.'"

Ingraldi works it over in his mind: "Once you understand these interactions, you're saying then, we can play God, in a way. If I want this, just tweak this gene here, or move this from the system, and you'll get it."

"That's true," Whitham says. "And I think it's actually possible" — eventually. That kind of precise understanding of the genetic basis of everything, as another NAU biologist touring the site with us quips, is "Tom's Death Star."

AFTER INGRALDI DEPARTS for a tango lesson in Flagstaff, Whitham and I sit on a cooler a few hundred yards from the creek, waiting for a group of grad students scrambling to collect their last data of a research project. Cottony clouds on the horizon begin to blush purple and pink.

Whitham pulls out a graph, determined to make sure I understand it. It's based on data from a garden in Yuma, planted with Fremont cottonwoods from

across the species' Southwestern range. It plots their reproductive success against the temperature shift they've experienced going from their native environment to their new home.

"So let's say we're down at this low-elevation garden, and it increases 4 degrees," he explains, moving his finger four steps down the graph. "According to our research, you can't find a cottonwood that would tolerate a 4 degree increase down here. This would predict, well, they're dead." The only way to maintain cottonwoods at that hot, dry edge, then, might be to genetically engineer them, like a soybean. Unlike the near-term efforts to shuffle cottonwoods and willows around, "that is a controversial thing to do," Whitham acknowledges. "But then, I have a choice. Would I rather have a genetically engineered one, or none at all?"

Whitham doesn't want to make that choice. But the climate is already changing faster than many scientists expected, and our emissions remain on a trajectory that promises extreme future warming. If nothing big changes — and soon — that's bad news for a lot of life on earth. It makes Whitham think that the day could very well arrive when we have to make many such decisions. It will be imperative, he believes, to have good science to inform them. Saving species may "require moving things around, and upsetting the natural order of things," he says. "But we made this problem. Now we've got to do our best to fix it." □



Cally Carswell (@callycarswell), an HCN contributing editor, writes from Santa Fe, New Mexico.

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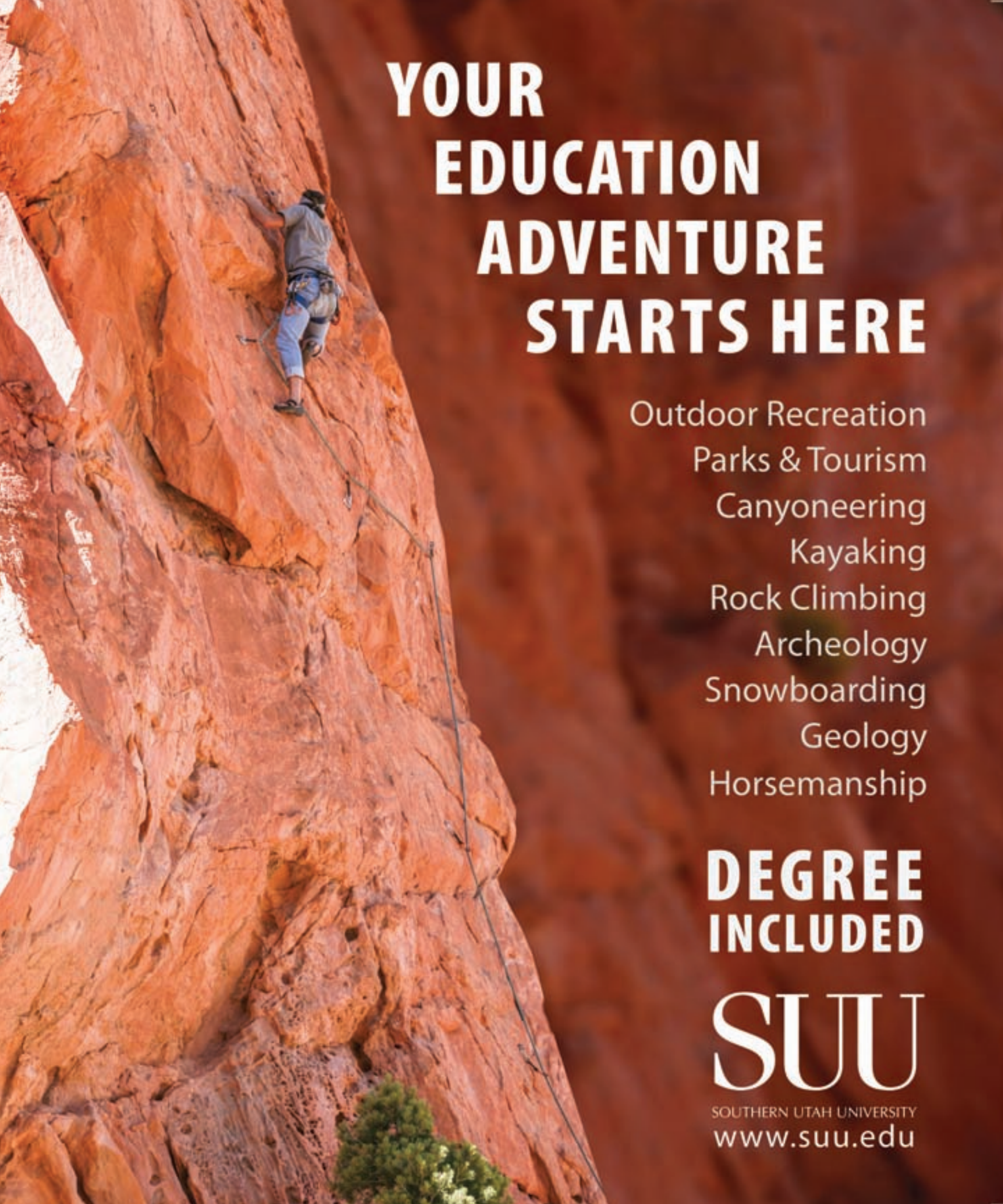
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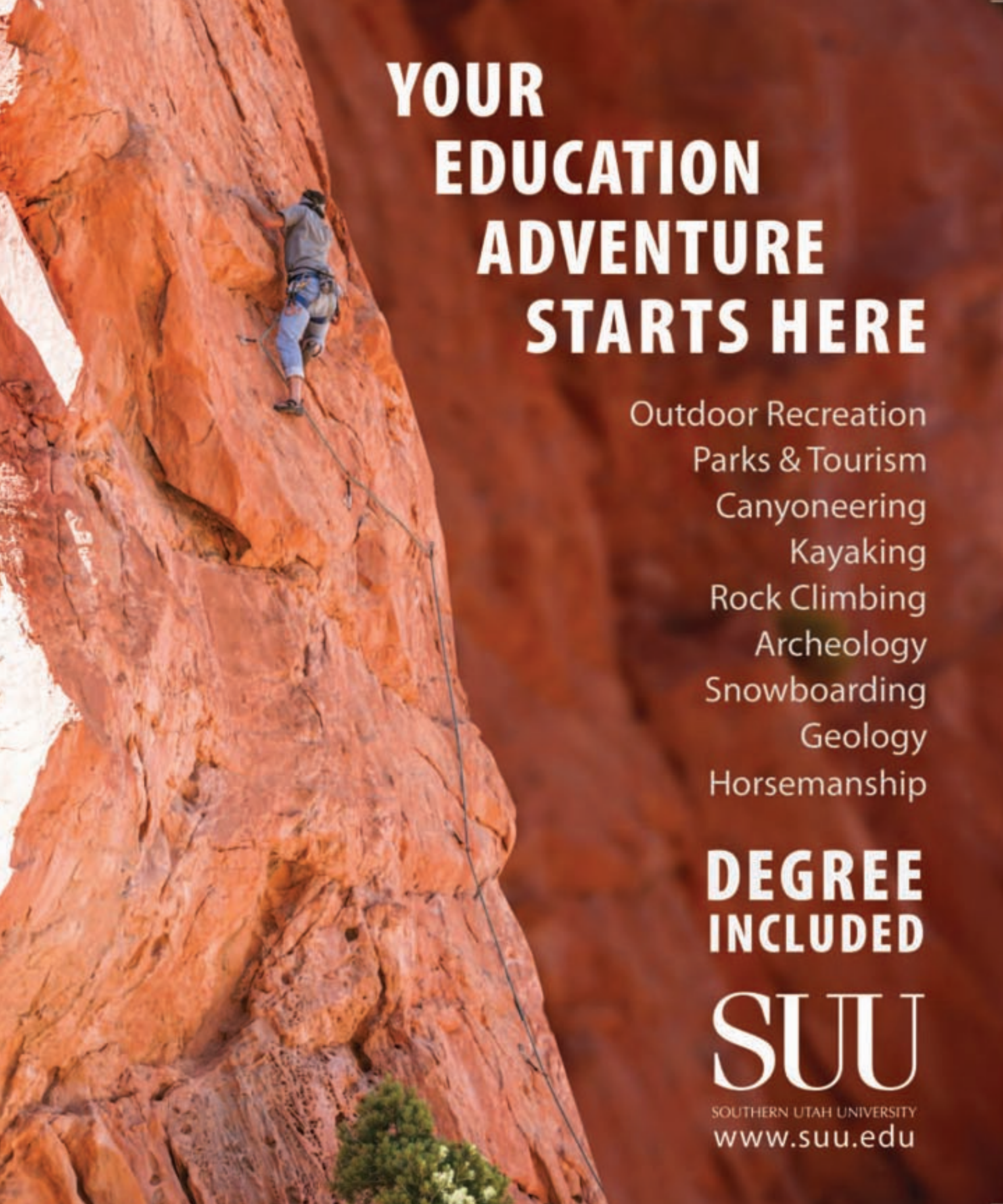
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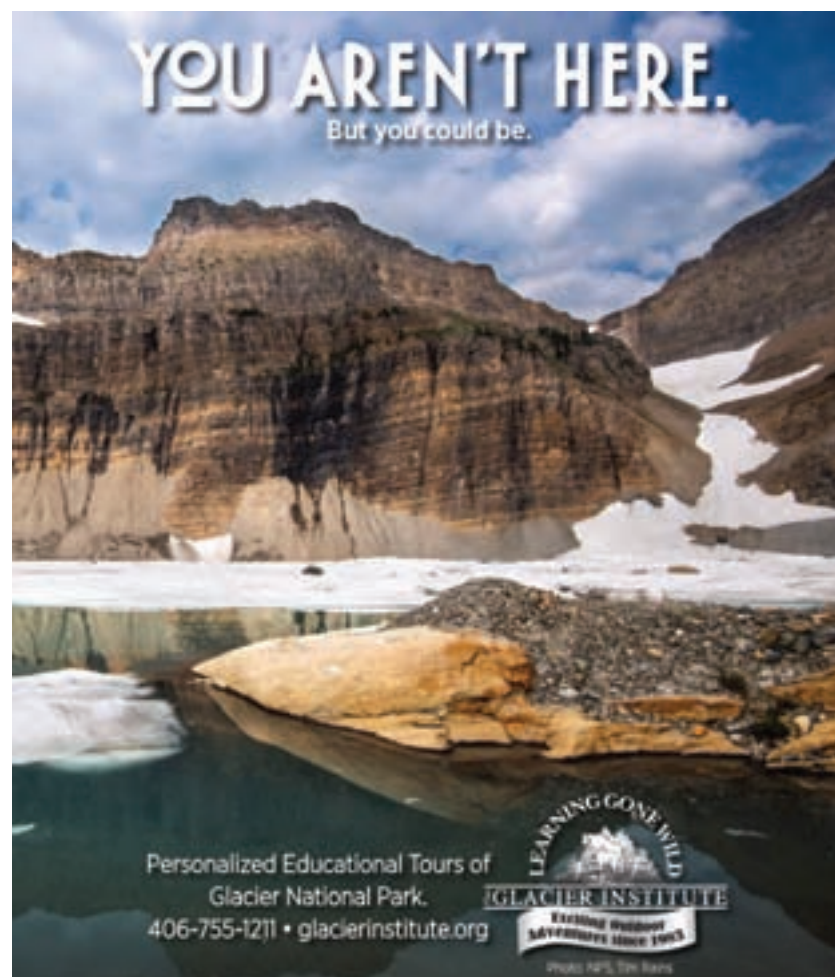
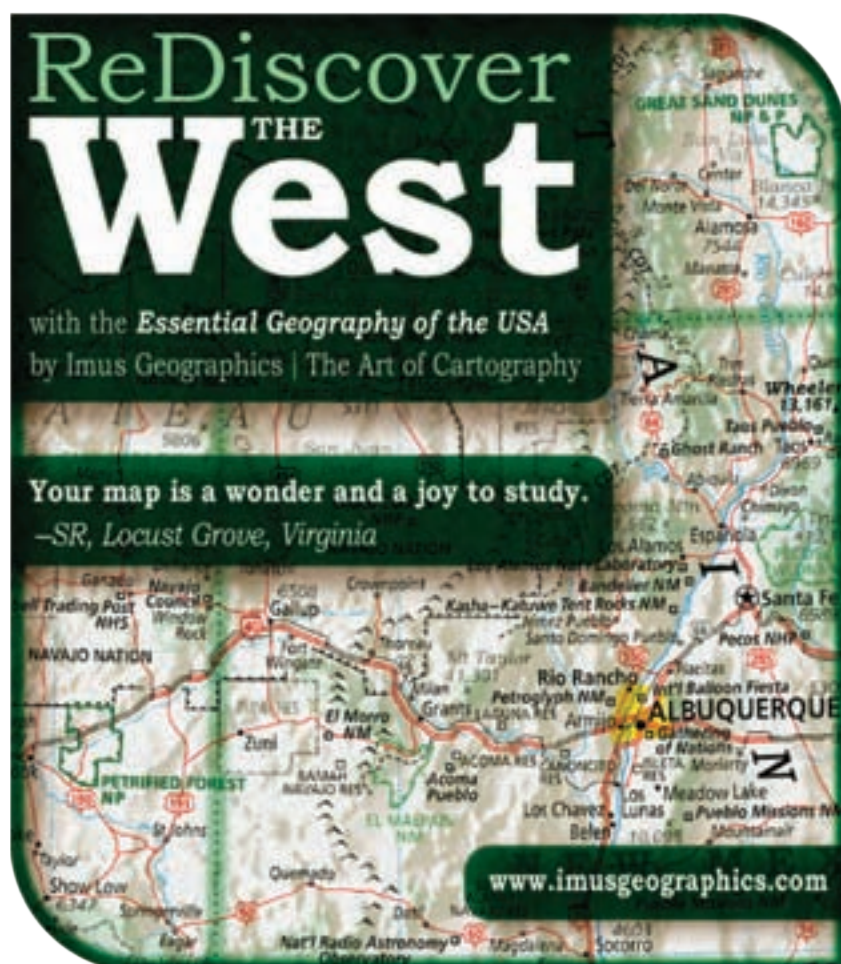
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Citizen scientists observe tundra life in Glacier National Park. Citizen science like this could be outlawed under a new Wyoming law.

COURTESY GLACIER NATIONAL PARK

Wyoming acts to discourage citizen scientists



OPINION BY
SHARMAN APT
RUSSELL

I am a longtime and enthusiastic citizen scientist. As part of various citizen-science projects, I've banded birds, chased tiger beetles, counted frogs, monitored archaeological sites, and documented the lifecycles of plants in my backyard. So I am particularly interested in Wyoming's new Data Trespass Bill, passed by legislators this March. While some say the bill simply toughens existing no-trespassing laws, others charge that it will criminalize citizen science.

Specifically, the bill says that anyone who "enters onto open land for the purpose of collecting resource data" without the landowner's permission can be fined and imprisoned for up to a year. More specifically, the term "collect" is defined as acquiring or preserving any information, including photographs, "which is submitted or intended to be submitted to any agency of the state or federal government."

But what is "open land?" Is it public as well as private land? If I am hiking on state land and discover an illegal toxic dump, and if I then photograph that dump and give a copy of the image to an "agency of the state," could I be charged under this law? Maybe. What if I am observing birds for the Audubon Christmas Bird Count, and Audubon passes on that information for a government report on climate change? Will I be fined \$1,000 for seeing and describing a red-breasted nuthatch? Maybe.

The law is vague, badly worded and probably unconstitutional. Ultimately, the courts will decide. But what does seem clear is that Wyoming legislators are scared of data — of facts. Environmentalists in Wyoming believe the bill is a response to the recent discovery by an environmental group of high levels of *E. coli* bacteria in the riparian areas of public land leased by ranchers. A group of Wyoming ranchers is now suing that group, the Western Watersheds Project, for allegedly taking water samples from

their private land without permission. Western Watersheds says it took samples only from public land and public access roads.

I don't know all the details. But as the environmental group says, the bigger issue should be the bacteria, which is likely caused by too many cows in creeks and streams. *E. coli* is a public health issue, known to cause serious human illness and even death.

Tellingly, the Data Trespass Law specifies that data collected "illegally" are inadmissible as evidence in any court case. Not only that; the data will be removed from any agency's databases

Will I be fined \$1,000 for seeing and describing a red-breasted nuthatch?

and cannot be used "in determining any agency action."

What does this have to do, really, with citizen science? In my opinion, a lot.

Citizen science is a partnership between scientists and non-scientists that has revolutionized how and what kind of research gets done. Over 6,000 Americans like me, for example, document climate change by monitoring the lifecycles of plants and animals for Nature's Notebook, a national online program partly funded by the U.S. Geological Survey and National Park Service, where amateur and professional naturalists record their observations. Some 200,000 people track birds for the Cornell Lab of Ornithology, their studies used by government agencies to determine habitat restoration. (As a matter of course, these citizen scientists seek permission from landowners. No one wants to run afoul of trespassing laws.)

Across North America, sampling the quality of waterways is also a common and important citizen science task. With the help of volunteers — and sometimes

government agencies as well — scientists can now explore large-scale, continent-wide research questions.

For the citizen scientist, research questions can and do segue into environmental activism. Once you become more engaged with the world — and fall more in love with the world — you want to protect what you love. Citizen science is not just about democratizing science and making science more accessible to the general public. Citizen science is also about citizenship — citizens not of country but of place, citizens of a larger community, citizens of Earth itself. As citizens, we have certain responsibilities and certain rights. We expect our data to inform public policy. We expect our information to be welcomed, not censored, by our political leaders.

I am offended by the Wyoming Legislature's attempt to bully people who care about the place and community in which they live. I am offended by their efforts to prevent information from being freely shared and used.

Trespassing on private land is not the issue. This law could have been worded to specify private land. It did once: An earlier version of the bill made it clear that only private land was involved, but the language was changed in the committee process. Now, this law is primarily concerned with making resource data inadmissible in court. This law is about the fear of facts. This law is about discouraging citizenship. □

Sharman Apt Russell is the author of Diary of a Citizen Scientist and teaches writing at Western New Mexico University in Silver City, New Mexico, and at Antioch University in Los Angeles.

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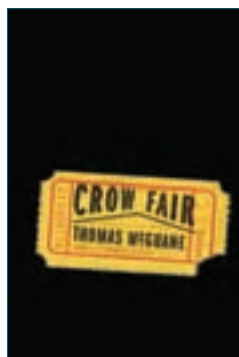
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Grave dangers and satisfying ends



Crow Fair
Thomas McGuane
267 pages, hardcover:
\$25.95.
Alfred A. Knopf, 2015.

Gripping beginnings are said to be the key to successful short stories, but it's the endings in Thomas McGuane's *Crow Fair* that make this collection stand out. Punchy, surprising, nebulous and even shattering conclusions mark these stories, with finales that can be as spectacular as explosions. McGuane has authored more than a dozen other books, but he hasn't published a story collection since the acclaimed *Gallatin Canyon* appeared, nine years ago.

In *Crow Fair*, the longtime Montana resident writes from his home state, pursuing the themes you'd expect to find in such a sparsely populated region: isolation, loneliness and rugged individualism. In "River Camp," for example, two childhood friends who take a fishing trip to confront their faltering friendship end up

facing grave dangers, including a lunatic guide, ravenous bears and death-trap rapids. The differences between the two men become starkly apparent in their reactions as they float away from their camp in a raft: "Tony thought that this was nature at its most benign, shepherding them away from the dreaded camp; but Jack, looking at the dark walls of trees enclosing the current, the ravens in the high branches, felt a malevolence in his bones."

Despite their vivid Western settings, these stories contain the kind of unexpected, quirky events that could happen anywhere: from the struggle to cope with an aging relative to something as dramatic as getting duped into a drug deal. In "A Long View to the West," a used car salesman juggles his job with caring for a

dying father, and in the collection's title story, two brothers take turns visiting their mother at an assisted living facility, where her habit of "loudly free-associating about her amorous adventures" gets her banned from the common room during visiting hours.

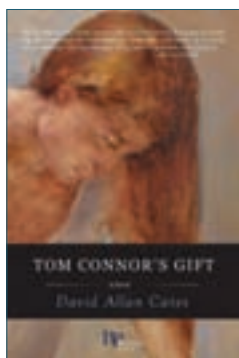
In a collection that often seems preoccupied with death, McGuane's darkly comedic style — together with a host of lively characters and surprise happenings — keeps the tone upbeat. If the knockout endings of these stories can help us understand anything about our lives, it's that death can elicit a myriad of unexpected responses: from sorrow and confusion to a little leap of joy — and maybe, at times, just a feeling of relief.

BY TRACI J. MACNAMARA



Bears run past pack rafts in Kamishak Bay, Alaska.
GROUND TRUTH TREKKING

Heart cracked wide-open



Tom Connor's Gift
David Allan Cates
334 pages, softcover:
\$19.95.
Bangtail Press, 2014.

Montana-based author David Allan Cates plunges us into the raw grief of a recently widowed doctor in his latest novel, *Tom Connor's Gift*. Janine has walked off her shift in a Wisconsin emergency room and driven to a friend's empty cabin in the Rocky Mountains to confront the emptiness of life without her husband, Mark. She hopes that "the shell of my body will crack and the cold dust inside will blow away in the wind." A stray puppy appears to keep her company as she revisits her past, reliving her marriage and reading old letters from a man named Tommy Connor, who was her first love, 30 years ago. Meanwhile, outside the cabin, a curious grizzly bear lurks.

This tautly written book, which the Independent Publisher Book Awards just named the year's best fiction from the Mountain West Region, explores the

continuum of human experience from ecstasy to bone-deep despair. Cates deftly weaves together three strands of life, using Tom's old letters, Janine's memories of her husband, and her present experience in a cold, remote corner of Montana. As she reads Tom's letters, she remembers where she was when she received them, and memories of her marriage surface as well. The letters serve as a kind of road map as she journeys through her grief; she ends up reliving her married life in all its complexity, relishing both the bitter and the delightful.

Tom's letters recount the years he spent living in Central America. He describes the poverty and unrest, but also shares his philosophical meditations and sexual escapades. Back when Janine first received these letters, she had trouble

appreciating them; she'd become too frustrated by Tom's half-crazy alcoholic instability. Now that grief has cracked open her heart, she finds an unexpected treasure in Tom's words. She reflects, "I feel ashamed at how little I was able to grasp of his struggle, not really to reconcile, but to stay open, to love the world so full of suffering and evil, betrayal and injustice. And isn't that the work of it? I mean, for all of us? To be brave enough to spread our arms and open our hearts and fill our lungs with the terrible beauty of living? And isn't that what he ... tried so hard and for so long to do?"

With down-to-earth detail and a refreshingly blunt narrator, Cates delivers a tale of transformation that rises to a crescendo with an unforgettable scene involving the bear. *Tom Connor's Gift* is a memorable reminder of the richness available to a wide-open heart.

BY MICHELLE PULICH STEWART

Fungal Lust

“Hey, Hal, come look at this.”
“Is it a morel?”

“No,” Hammer laughs. We are often laughing.

We are only a few hundred feet from where we parked the truck, and Hammer is examining an orange cup fungus, a peel of neon on the forest floor. Seconds later, she is making *pish-ing* sounds and coaxing kinglets down from the canopy. “You know,” I say, “maybe if you focused and found more morels, you’d be willing to experiment with them. Dress them up a touch.”

Hammer’s a purist. She doesn’t want to overpower the flavor of morel mushrooms. She sautés them in butter, adds a dash of salt, and serves them on a small side plate. But I am hungry for a big dish of pasta, for the recipe with nutmeg and Dijon and cream, and therefore I need to cover some ground. We spread apart and move sidehill through spires of true fir.

I scan the ground using the method I learned as a fire lookout: I take in swaths of 45 degrees and examine near to far. As I move, I filter the flow of images — moss-covered rock, cow pie, bark — through the baleen grill in my mind, searching for only one thing. I follow the trail of phenology: the wide white sails of trillium and the pink canoes of lady slippers. These passing features combine with the dappling of sunlight across the forest floor to make it seem, at times, as if the morel itself steps forward from the shadows. I stop.

All else shies away. Birdsong drops. I stare as the honeycomb pattern emerges. Underneath a curtain of scrubby chinquapin stands a small figurine of ribs and hollows. “*Morchella*,” I say.

I kneel and compress the cap with my fingertips to test the integrity of its tissue. It’s firm. That’s good. The cavities are also well-developed. I use this as a sign that the little spore factory has performed its reproductive duty. Perfect. I open my pearl-handled pocketknife and cut the stem flush with the ground. I turn the morel over in my hand.

Flecks of pollen shimmer inside its cocoa-colored pits. A silken web blocks the entrance to one micro-cavern; with the tip of my knife, I pry into the private chamber and evict a grub.

I peer into the open stem and look for ants. If necessary, I’ll blow them out with a few short blasts of air before dropping the morel into my cloth bag.

Morels have been found in World War II bomb craters and abandoned coal mines. They surged from the ash of Mount St. Helens soon after eruption, too gritty to eat. A scientist who

surveyed the westward spread of Dutch elm disease reported flushes of these mushrooms around the base of dead and dying trees. Morels have a unique relationship with disturbance. But aside from that, much about them remains a mystery. For me, that’s part of the appeal, the surprise of when and where they fruit.

In temperate forests around the world, fungal threads bind detritus to grains of ancient bedrock. They wrap and weave around tree roots, forming loose sheaths; transport nutrients to a variety of plant species; and function in other ways yet unknown. Beneath our feet, mycelial networks expand with the intricacy and unpredictability of in-cloud lightning.

I break the internal tension of finding one by calling out: “Come out, come out, wherever you are.” I say this as I turn in a full circle and look around. When I spot a whopper, a mushroom with a stalk large enough to stuff a prawn, I holler, “Toad!”

No one responds. Hammer and I have parted ways in the forest. I loop around and whistle our three-note call. I listen and wait. I begin tracking back to the last place

I saw her, stooped over a sewer plate-sized stump, no doubt counting the growth rings and imagining the virgin forest. And then I find her.

She is half-hidden, frozen in a crouch beneath a young white fir with a full crown. Her bag lies open beside her. I can’t see the bounty, but I can tell she has found a patch. She parts the lowest limbs of the fir and looks out at me. Her eyes blaze with mischievous delight, yet she whispers to me, as softly as possible.

“Hal,” she says, “I’m having a holy experience.” □

Erin Halcomb writes (and hunts) in southern Oregon.



A morel mushroom. DANIELLE DELEON

Flecks of pollen shimmer inside its cocoa-colored pits. A silken web blocks the entrance to one micro-cavern; with the tip of my knife, I pry into the private chamber and evict a grub.



HEARD AROUND THE WEST | BY BETSY MARSTON

THE SOUTHWEST

A California condor with a yen for new places apparently got tired of southern Colorado. “N8” — identified by the number on the GPS transponder on his wing — left Cortez and took off for New Mexico, a state that had never, in all its recorded history, had a confirmed condor sighting. The appearance of the 2-year-old male in Los Alamos was an unexpected treat for Joe Fitzgibbon, an Audubon Society stalwart who was amazed to find the big bird in his backyard. Fitzgibbon told the *Santa Fe New Mexican* that he’d recently spent more than a day driving to the Grand Canyon’s North Rim in hopes of glimpsing one of the 71 condors that have been released there, but had no luck. So having a condor loiter in his backyard for a whole half hour left him “flabbergasted.” Condors can easily fly up to 200 miles in a day, said Eddie Feltes, field manager for the California Condor Recovery Project. He added that N8 appears to be flying solo, but is probably hanging out with fellow carrion eaters — agreeing with turkey vultures and ravens that the dinner menu matters much less than the fact that the entrées are truly dead.

UTAH

There will be “no legal freebies” for San Juan County Commissioner Phil Lyman, chortled a writer for *Redrock Wilderness*, the newsletter of the Southern Utah Wilderness Alliance. After he led “a motorized column of cultic anti-governmental lawbreakers” into Recapture Canyon to protest a road closure mandated by the Bureau of Land Management, Lyman, who was charged with, and ultimately convicted of, two misdemeanors, insisted he needed a public defender. According to the *Salt Lake Tribune*, however, Lyman was anything but needy: He earned \$50,000 a year in commissioner’s salary and owned property assessed at \$650,000, plus an investment firm that manages \$2.3 million in assets. From now on, said SUWA, Lyman “will not only have to pay his own legal freight ... but must reimburse taxpayers for work his federal defender had already done.”



IDAHO Flying cars looked so much cooler in the old *Jetsons* cartoons.. CARLEN DONOVAN

COLORADO AND UTAH

One of the nastiest interstate poaching and animal-cruelty cases came to trial this March after a three-year investigation, reports *Colorado Outdoors*, the magazine of the state’s Division of Wildlife. Mack, Colorado, outfitters Christopher Loncarich and Marvin Ellis did things to mountain lions and bobcats that are difficult to read about without wincing. The men confessed to systemically trapping, wounding and confining hundreds of big cats so that they would be easy prey for paying customers. Days before a hunter would arrive in Utah, the outfitters would spot lions by plane, then trap the animals and cage them, “shooting the cats in the paws, stomach or legs, or attaching leghold traps on them.” In one case, a client from Connecticut was instructed to shoot a lion from a distance of more than 100 yards so that he would not notice that it was pinned down by a leghold trap. These “hunts,” if you care to call them that, weren’t cheap, costing as much as \$7,500 for lions and \$1,500 for bob-

cats, and the judge concluded that the outfitters and their accomplices were motivated by greed. But Loncarich, the “brains” of the business, didn’t relish his work, according to one of his two daughters, who both worked with him. “He would get upset because (the clients) were too out of shape to hike and track animals, and they just wanted to shoot animals without having to hunt them.” The Utah Division of Wildlife and the U.S. Fish and Wildlife Service, which cooperated in the arrest, consider the case an anomaly in the annals of hunting.

COLORADO

Perhaps because of its eye for the telling detail, a simply written obituary in the Grand Junction *Daily Sentinel* caught our eye. Betty Lou Hawkins, 80, of Molina, in western Colorado, the youngest of eight children, ran a ranch with her eldest son, Daniel, for 47 years. Described by her family as “a very hard worker” — an understatement if there ever was one — “she managed up to 50 head of cattle nearly alone. She cooked at the Plateau Valley School and Job Corps over 40 years. She cleaned condos and houses everywhere. When things went wrong, she would simply say, ‘We just need to work harder.’ She made hundreds of quilts, sent thousands of cards to people for every occasion, and never forgot a face or a name.” Hats off to Betty Lou Hawkins, a true Western heroine.

NEVADA

When the 60-year-old Riviera hotel-casino closed, the *Las Vegas Review-Journal* dripped with nostalgia: “No longer can you stay in the penthouse where Sinatra once lived,” it reported. The real loss may be this, however: “No longer can you see the Sin City Roller Girls kick butt in the ballroom.”

WEB EXTRA For more from Heard around the West, see hcn.org.

Tips and photos of Western oddities are appreciated and often shared in this column. Write betSYM@hcn.org.



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Ted Williams, in his essay, “The Pleistocene and the present don’t compute,” from *Writers on the Range*, hcn.org/wotr

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Writing Workshop — Deepen the impact of your writing and learn how to keep your submission off the slush pile with author Amy Irvine McHarg and Torrey House Press

co-publisher Kirsten Allen. Oct. 3-5 in Torrey, Utah. See more at redrockwritingworkshops.submittable.com/submit.

Cortez Farmers Market — Every Saturday morning from June through October. Locally grown and produced fruits, vegetables, eggs, pork, bison, honey, jams, jellies, breakfast foods, plants, jewelry, pottery, gourd and other arts. Live music and storytelling for children. The place to be in Cortez on Saturday mornings! www.cortezfarmmarket.com.

Friends of the Florissant Fossil Beds Summer Seminar Series begins June 13 through July 29 at the Florissant Fossil Beds National Monument in Colorado's Pikes Peak Region. Birds, fossils, wildflowers, park pioneers, geocaching and archaeology, with undergrad and graduate credit available. www.fossilbeds.org. 719-748-3253, extension 109.

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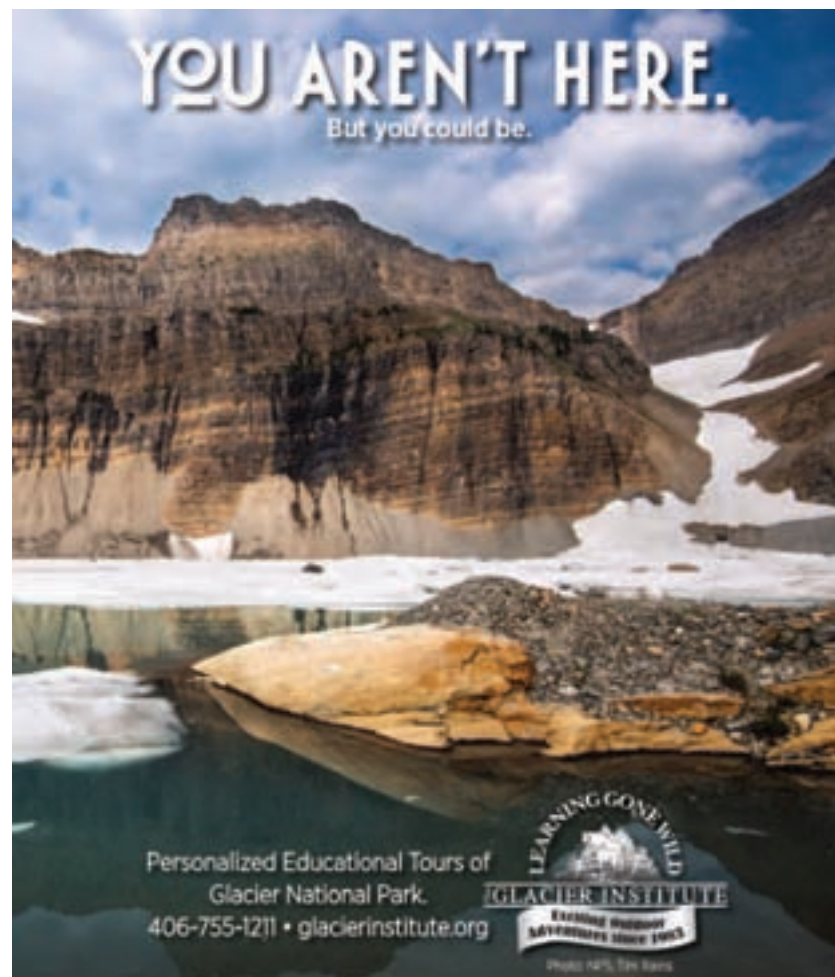
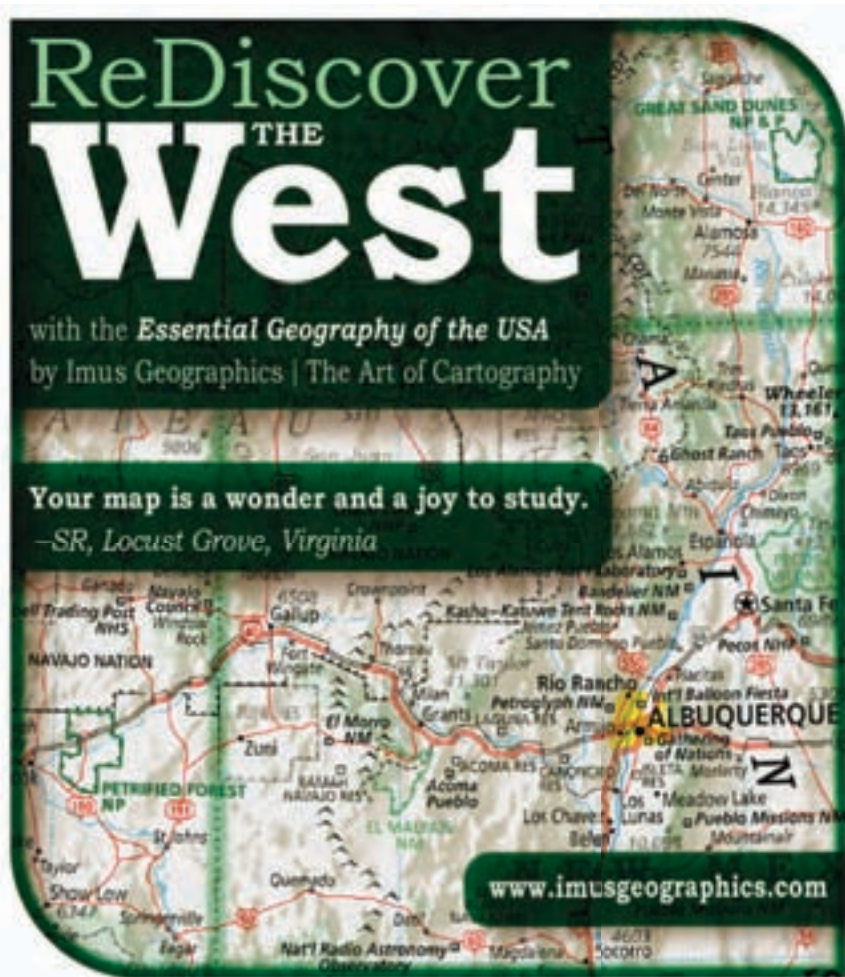
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District Manager for Trinity County Resource Conservation District in Weaverville, Calif. For full description, visit www.trcrd.net.

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Citizen scientists observe tundra life in Glacier National Park. Citizen science like this could be outlawed under a new Wyoming law.

COURTESY GLACIER NATIONAL PARK

Wyoming acts to discourage citizen scientists



OPINION BY
SHARMAN APT
RUSSELL

I am a longtime and enthusiastic citizen scientist. As part of various citizen-science projects, I've banded birds, chased tiger beetles, counted frogs, monitored archaeological sites, and documented the lifecycles of plants in my backyard. So I am particularly interested in Wyoming's new Data Trespass Bill, passed by legislators this March. While some say the bill simply toughens existing no-trespassing laws, others charge that it will criminalize citizen science.

Specifically, the bill says that anyone who "enters onto open land for the purpose of collecting resource data" without the landowner's permission can be fined and imprisoned for up to a year. More specifically, the term "collect" is defined as acquiring or preserving any information, including photographs, "which is submitted or intended to be submitted to any agency of the state or federal government."

But what is "open land?" Is it public as well as private land? If I am hiking on state land and discover an illegal toxic dump, and if I then photograph that dump and give a copy of the image to an "agency of the state," could I be charged under this law? Maybe. What if I am observing birds for the Audubon Christmas Bird Count, and Audubon passes on that information for a government report on climate change? Will I be fined \$1,000 for seeing and describing a red-breasted nuthatch? Maybe.

The law is vague, badly worded and probably unconstitutional. Ultimately, the courts will decide. But what does seem clear is that Wyoming legislators are scared of data — of facts. Environmentalists in Wyoming believe the bill is a response to the recent discovery by an environmental group of high levels of *E. coli* bacteria in the riparian areas of public land leased by ranchers. A group of Wyoming ranchers is now suing that group, the Western Watersheds Project, for allegedly taking water samples from

their private land without permission. Western Watersheds says it took samples only from public land and public access roads.

I don't know all the details. But as the environmental group says, the bigger issue should be the bacteria, which is likely caused by too many cows in creeks and streams. *E. coli* is a public health issue, known to cause serious human illness and even death.

Tellingly, the Data Trespass Law specifies that data collected "illegally" are inadmissible as evidence in any court case. Not only that; the data will be removed from any agency's databases

Will I be fined \$1,000 for seeing and describing a red-breasted nuthatch?

and cannot be used "in determining any agency action."

What does this have to do, really, with citizen science? In my opinion, a lot.

Citizen science is a partnership between scientists and non-scientists that has revolutionized how and what kind of research gets done. Over 6,000 Americans like me, for example, document climate change by monitoring the lifecycles of plants and animals for Nature's Notebook, a national online program partly funded by the U.S. Geological Survey and National Park Service, where amateur and professional naturalists record their observations. Some 200,000 people track birds for the Cornell Lab of Ornithology, their studies used by government agencies to determine habitat restoration. (As a matter of course, these citizen scientists seek permission from landowners. No one wants to run afoul of trespassing laws.)

Across North America, sampling the quality of waterways is also a common and important citizen science task. With the help of volunteers — and sometimes

government agencies as well — scientists can now explore large-scale, continent-wide research questions.

For the citizen scientist, research questions can and do segue into environmental activism. Once you become more engaged with the world — and fall more in love with the world — you want to protect what you love. Citizen science is not just about democratizing science and making science more accessible to the general public. Citizen science is also about citizenship — citizens not of country but of place, citizens of a larger community, citizens of Earth itself. As citizens, we have certain responsibilities and certain rights. We expect our data to inform public policy. We expect our information to be welcomed, not censored, by our political leaders.

I am offended by the Wyoming Legislature's attempt to bully people who care about the place and community in which they live. I am offended by their efforts to prevent information from being freely shared and used.

Trespassing on private land is not the issue. This law could have been worded to specify private land. It did once: An earlier version of the bill made it clear that only private land was involved, but the language was changed in the committee process. Now, this law is primarily concerned with making resource data inadmissible in court. This law is about the fear of facts. This law is about discouraging citizenship. □

Sharman Apt Russell is the author of Diary of a Citizen Scientist and teaches writing at Western New Mexico University in Silver City, New Mexico, and at Antioch University in Los Angeles.

WEB EXTRA

To see all the current Writers on the Range columns, and archives, visit HCN's Web site, hcn.org

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Grave dangers and satisfying ends



Crow Fair
Thomas McGuane
267 pages, hardcover:
\$25.95.
Alfred A. Knopf, 2015.

Gripping beginnings are said to be the key to successful short stories, but it's the endings in Thomas McGuane's *Crow Fair* that make this collection stand out. Punchy, surprising, nebulous and even shattering conclusions mark these stories, with finales that can be as spectacular as explosions. McGuane has authored more than a dozen other books, but he hasn't published a story collection since the acclaimed *Gallatin Canyon* appeared, nine years ago.

In *Crow Fair*, the longtime Montana resident writes from his home state, pursuing the themes you'd expect to find in such a sparsely populated region: isolation, loneliness and rugged individualism. In "River Camp," for example, two childhood friends who take a fishing trip to confront their faltering friendship end up

facing grave dangers, including a lunatic guide, ravenous bears and death-trap rapids. The differences between the two men become starkly apparent in their reactions as they float away from their camp in a raft: "Tony thought that this was nature at its most benign, shepherding them away from the dreaded camp; but Jack, looking at the dark walls of trees enclosing the current, the ravens in the high branches, felt a malevolence in his bones."

Despite their vivid Western settings, these stories contain the kind of unexpected, quirky events that could happen anywhere: from the struggle to cope with an aging relative to something as dramatic as getting duped into a drug deal. In "A Long View to the West," a used car salesman juggles his job with caring for a

dying father, and in the collection's title story, two brothers take turns visiting their mother at an assisted living facility, where her habit of "loudly free-associating about her amorous adventures" gets her banned from the common room during visiting hours.

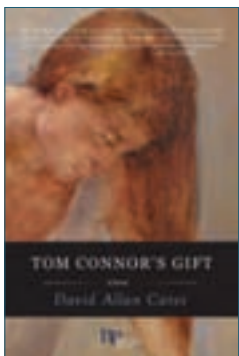
In a collection that often seems preoccupied with death, McGuane's darkly comedic style — together with a host of lively characters and surprise happenings — keeps the tone upbeat. If the knockout endings of these stories can help us understand anything about our lives, it's that death can elicit a myriad of unexpected responses: from sorrow and confusion to a little leap of joy — and maybe, at times, just a feeling of relief.

BY TRACI J. MACNAMARA



Bears run past pack rafts in Kamishak Bay, Alaska.
GROUND TRUTH TREKKING

Heart cracked wide-open



Tom Connor's Gift
David Allan Cates
334 pages, softcover:
\$19.95.
Bangtail Press, 2014.

Montana-based author David Allan Cates plunges us into the raw grief of a recently widowed doctor in his latest novel, *Tom Connor's Gift*. Janine has walked off her shift in a Wisconsin emergency room and driven to a friend's empty cabin in the Rocky Mountains to confront the emptiness of life without her husband, Mark. She hopes that "the shell of my body will crack and the cold dust inside will blow away in the wind." A stray puppy appears to keep her company as she revisits her past, reliving her marriage and reading old letters from a man named Tommy Connor, who was her first love, 30 years ago. Meanwhile, outside the cabin, a curious grizzly bear lurks.

This tautly written book, which the Independent Publisher Book Awards just named the year's best fiction from the Mountain West Region, explores the

continuum of human experience from ecstasy to bone-deep despair. Cates deftly weaves together three strands of life, using Tom's old letters, Janine's memories of her husband, and her present experience in a cold, remote corner of Montana. As she reads Tom's letters, she remembers where she was when she received them, and memories of her marriage surface as well. The letters serve as a kind of road map as she journeys through her grief; she ends up reliving her married life in all its complexity, relishing both the bitter and the delightful.

Tom's letters recount the years he spent living in Central America. He describes the poverty and unrest, but also shares his philosophical meditations and sexual escapades. Back when Janine first received these letters, she had trouble

appreciating them; she'd become too frustrated by Tom's half-crazy alcoholic instability. Now that grief has cracked open her heart, she finds an unexpected treasure in Tom's words. She reflects, "I feel ashamed at how little I was able to grasp of his struggle, not really to reconcile, but to stay open, to love the world so full of suffering and evil, betrayal and injustice. And isn't that the work of it? I mean, for all of us? To be brave enough to spread our arms and open our hearts and fill our lungs with the terrible beauty of living? And isn't that what he ... tried so hard and for so long to do?"

With down-to-earth detail and a refreshingly blunt narrator, Cates delivers a tale of transformation that rises to a crescendo with an unforgettable scene involving the bear. *Tom Connor's Gift* is a memorable reminder of the richness available to a wide-open heart.

BY MICHELLE PULICH STEWART

Fungal Lust

“Hey, Hal, come look at this.”
“Is it a morel?”

“No,” Hammer laughs. We are often laughing.

We are only a few hundred feet from where we parked the truck, and Hammer is examining an orange cup fungus, a peel of neon on the forest floor. Seconds later, she is making *pish-ing* sounds and coaxing kinglets down from the canopy. “You know,” I say, “maybe if you focused and found more morels, you’d be willing to experiment with them. Dress them up a touch.”

Hammer’s a purist. She doesn’t want to overpower the flavor of morel mushrooms. She sautés them in butter, adds a dash of salt, and serves them on a small side plate. But I am hungry for a big dish of pasta, for the recipe with nutmeg and Dijon and cream, and therefore I need to cover some ground. We spread apart and move sidehill through spires of true fir.

I scan the ground using the method I learned as a fire lookout: I take in swaths of 45 degrees and examine near to far. As I move, I filter the flow of images — moss-covered rock, cow pie, bark — through the baleen grill in my mind, searching for only one thing. I follow the trail of phenology: the wide white sails of trillium and the pink canoes of lady slippers. These passing features combine with the dappling of sunlight across the forest floor to make it seem, at times, as if the morel itself steps forward from the shadows. I stop.

All else shies away. Birdsong drops. I stare as the honeycomb pattern emerges. Underneath a curtain of scrubby chinquapin stands a small figurine of ribs and hollows. “*Morchella*,” I say.

I kneel and compress the cap with my fingertips to test the integrity of its tissue. It’s firm. That’s good. The cavities are also well-developed. I use this as a sign that the little spore factory has performed its reproductive duty. Perfect. I open my pearl-handled pocketknife and cut the stem flush with the ground. I turn the morel over in my hand.

Flecks of pollen shimmer inside its cocoa-colored pits. A silken web blocks the entrance to one micro-cavern; with the tip of my knife, I pry into the private chamber and evict a grub.

I peer into the open stem and look for ants. If necessary, I’ll blow them out with a few short blasts of air before dropping the morel into my cloth bag.

Morels have been found in World War II bomb craters and abandoned coal mines. They surged from the ash of Mount St. Helens soon after eruption, too gritty to eat. A scientist who

surveyed the westward spread of Dutch elm disease reported flushes of these mushrooms around the base of dead and dying trees. Morels have a unique relationship with disturbance. But aside from that, much about them remains a mystery. For me, that’s part of the appeal, the surprise of when and where they fruit.

In temperate forests around the world, fungal threads bind detritus to grains of ancient bedrock. They wrap and weave around tree roots, forming loose sheaths; transport nutrients to a variety of plant species; and function in other ways yet unknown. Beneath our feet, mycelial networks expand with the intricacy and unpredictability of in-cloud lightning.

I break the internal tension of finding one by calling out: “Come out, come out, wherever you are.” I say this as I turn in a full circle and look around. When I spot a whopper, a mushroom with a stalk large enough to stuff a prawn, I holler, “Toad!”

No one responds. Hammer and I have parted ways in the forest. I loop around and whistle our three-note call. I listen and wait. I begin tracking back to the last place

I saw her, stooped over a sewer plate-sized stump, no doubt counting the growth rings and imagining the virgin forest. And then I find her.

She is half-hidden, frozen in a crouch beneath a young white fir with a full crown. Her bag lies open beside her. I can’t see the bounty, but I can tell she has found a patch. She parts the lowest limbs of the fir and looks out at me. Her eyes blaze with mischievous delight, yet she whispers to me, as softly as possible.

“Hal,” she says, “I’m having a holy experience.” □

Erin Halcomb writes (and hunts) in southern Oregon.



A morel mushroom. DANIELLE DELEON

Flecks of pollen shimmer inside its cocoa-colored pits. A silken web blocks the entrance to one micro-cavern; with the tip of my knife, I pry into the private chamber and evict a grub.



HEARD AROUND THE WEST | BY BETSY MARSTON

THE SOUTHWEST

A California condor with a yen for new places apparently got tired of southern Colorado. “N8” — identified by the number on the GPS transponder on his wing — left Cortez and took off for New Mexico, a state that had never, in all its recorded history, had a confirmed condor sighting. The appearance of the 2-year-old male in Los Alamos was an unexpected treat for Joe Fitzgibbon, an Audubon Society stalwart who was amazed to find the big bird in his backyard. Fitzgibbon told the *Santa Fe New Mexican* that he’d recently spent more than a day driving to the Grand Canyon’s North Rim in hopes of glimpsing one of the 71 condors that have been released there, but had no luck. So having a condor loiter in his backyard for a whole half hour left him “flabbergasted.” Condors can easily fly up to 200 miles in a day, said Eddie Feltes, field manager for the California Condor Recovery Project. He added that N8 appears to be flying solo, but is probably hanging out with fellow carrion eaters — agreeing with turkey vultures and ravens that the dinner menu matters much less than the fact that the entrées are truly dead.

UTAH

There will be “no legal freebies” for San Juan County Commissioner Phil Lyman, chortled a writer for *Redrock Wilderness*, the newsletter of the Southern Utah Wilderness Alliance. After he led “a motorized column of cultic anti-governmental lawbreakers” into Recapture Canyon to protest a road closure mandated by the Bureau of Land Management, Lyman, who was charged with, and ultimately convicted of, two misdemeanors, insisted he needed a public defender. According to the *Salt Lake Tribune*, however, Lyman was anything but needy: He earned \$50,000 a year in commissioner’s salary and owned property assessed at \$650,000, plus an investment firm that manages \$2.3 million in assets. From now on, said SUWA, Lyman “will not only have to pay his own legal freight ... but must reimburse taxpayers for work his federal defender had already done.”



IDAHO Flying cars looked so much cooler in the old *Jetsons* cartoons.. CARLEN DONOVAN

COLORADO AND UTAH

One of the nastiest interstate poaching and animal-cruelty cases came to trial this March after a three-year investigation, reports *Colorado Outdoors*, the magazine of the state’s Division of Wildlife. Mack, Colorado, outfitters Christopher Loncarich and Marvin Ellis did things to mountain lions and bobcats that are difficult to read about without wincing. The men confessed to systemically trapping, wounding and confining hundreds of big cats so that they would be easy prey for paying customers. Days before a hunter would arrive in Utah, the outfitters would spot lions by plane, then trap the animals and cage them, “shooting the cats in the paws, stomach or legs, or attaching leghold traps on them.” In one case, a client from Connecticut was instructed to shoot a lion from a distance of more than 100 yards so that he would not notice that it was pinned down by a leghold trap. These “hunts,” if you care to call them that, weren’t cheap, costing as much as \$7,500 for lions and \$1,500 for bob-

cats, and the judge concluded that the outfitters and their accomplices were motivated by greed. But Loncarich, the “brains” of the business, didn’t relish his work, according to one of his two daughters, who both worked with him. “He would get upset because (the clients) were too out of shape to hike and track animals, and they just wanted to shoot animals without having to hunt them.” The Utah Division of Wildlife and the U.S. Fish and Wildlife Service, which cooperated in the arrest, consider the case an anomaly in the annals of hunting.

COLORADO

Perhaps because of its eye for the telling detail, a simply written obituary in the Grand Junction *Daily Sentinel* caught our eye. Betty Lou Hawkins, 80, of Molina, in western Colorado, the youngest of eight children, ran a ranch with her eldest son, Daniel, for 47 years. Described by her family as “a very hard worker” — an understatement if there ever was one — “she managed up to 50 head of cattle nearly alone. She cooked at the Plateau Valley School and Job Corps over 40 years. She cleaned condos and houses everywhere. When things went wrong, she would simply say, ‘We just need to work harder.’ She made hundreds of quilts, sent thousands of cards to people for every occasion, and never forgot a face or a name.” Hats off to Betty Lou Hawkins, a true Western heroine.

NEVADA

When the 60-year-old Riviera hotel-casino closed, the *Las Vegas Review-Journal* dripped with nostalgia: “No longer can you stay in the penthouse where Sinatra once lived,” it reported. The real loss may be this, however: “No longer can you see the Sin City Roller Girls kick butt in the ballroom.”

WEB EXTRA For more from Heard around the West, see hcn.org.

Tips and photos of Western oddities are appreciated and often shared in this column. Write betsym@hcn.org.



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“Rest assured, Pleistocene Parks Inc. is doing everything possible to recapture our escaped ice age megafauna. Please back away slowly from any African lion you encounter.”

Ted Williams, in his essay, “The Pleistocene and the present don’t compute,” from *Writers on the Range*, hcn.org/wotr