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Unlocking the Methane Mystery

A tour of the Four Corners Hot Spot, where natural gas has a dark side

By Jonathan Thompson

CONTENTS

Methane gas escapes from a natural gas storage tank near Aztec, New Mexico, in this thermal camera image captured by Andrew Thorpe of NASA's Jet Propulsion Laboratory. SHAUN STANLEY

On the cover

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FEATURE

12 **Unlocking the Methane Mystery**
A tour of the Four Corners Hot Spot, where natural gas has a dark side
By Jonathan Thompson

16 Tracking air quality, from above By Sarah Tory

CURRENTS

5 **Last plants standing** The Clean Power Plan is not the only blow to coal
5 **Wild graffiti** Urban vandals target Western parks
6 **Triage in the Arctic** Ancient artifacts are emerging in the far North
7 **The Latest:** Gov. Inslee's cap-and-trade plan
8 **Cultivating climate literacy** Montana farmers get pragmatic
8 **The Latest:** Elwha River recovery
9 **Where FEMA fails** Pre-disaster money is in short supply

DEPARTMENTS

3 HCN.ORG NEWS IN BRIEF
4 LETTERS
10 THE HCN COMMUNITY Research Fund, Dear Friends
20 MARKETPLACE
24 WRITERS ON THE RANGE
An even bigger threat to rivers By Gary Wockner
26 BOOKS
The Wild Excellence by Leslie Patten. Reviewed by Marian Lyman Kirst
The Water Museum by Luis Alberto Urrea. Reviewed by Carson Vaughn
27 ESSAY False expectations By Erin Espelie
28 HEARD AROUND THE WEST By Betsy Marston

Editor's note

Our sly climate

It was bound to happen. Regardless of the cynical denialism of some politicians, climate change is now entering our lives in very real ways. This is especially true in the West, a region clearly defined by its environment and natural resources. In this issue, almost without our knowing it, the climate crept into nearly every story.

In Montana, for example, a farmers' union is trying to break through the politicization of climate change rhetoric, knowing that it is in its members' best interest to better understand what is happening to their crops. The group has begun inviting experts to talk to farmers, to help them prepare for what's coming.

The Federal Emergency Management Agency has been somewhat slower to react. As increased temperatures and drought bring more wildfires to mountain communities, floods from fire-scoured slopes become a real danger. But most FEMA money comes only after disaster strikes, rather than in ways that could improve infrastructure to mitigate the damage beforehand.

Meanwhile, President Barack Obama has finalized his Clean Power Plan, something that he and the EPA were required to do by law, following court decisions affirming carbon as a pollutant that must be regulated. That will have major implications for parts of the West, contributing editor Cally Carswell writes, sparking ire in places where jobs are closely linked to coal, like Wyoming, and adding to industry resentment. Still, the plan is not a death knell for King Coal or the West's oldest plants.

Regardless of its merits or weaknesses, the plan is a positive sign that our policymakers are starting to wise up. Yet some of their proposed solutions may not be solutions at all. For some time now, natural gas has been hailed as a "bridge fuel," the energy source that could ease us out of our dependence on fossil fuels and move us toward renewables. But, as senior editor Jonathan Thompson reports in our cover story, natural gas might prove less a bridge than the troll beneath it. Scientists are now trying to figure out how much methane — a potent greenhouse gas — leaks from oil and gas production. It's a potentially significant amount, and unless new regulations force the industry to plug or capture these fugitive emissions, natural gas will simply add to the climate problem.

Taken together, we're starting to see how real, and how complex, climate questions are in the Anthropocene, especially here in the West. Climate change is no longer just for scientists or environmentalists. Our ranchers and farmers, miners and drillers, county commissioners, mayors and city planners all have to deal with it. Ready or not.

—Brian Calvert, managing editor

CONTENTS

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8 **Cultivating climate literacy** Montana farmers get pragmatic
8 **The Latest:** Elwha River recovery
9 **Where FEMA fails** Pre-disaster money is in short supply

DEPARTMENTS

3 HCN.ORG NEWS IN BRIEF
4 LETTERS
10 THE HCN COMMUNITY Research Fund, Dear Friends
20 MARKETPLACE
24 WRITERS ON THE RANGE
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26 BOOKS
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—Brian Calvert, managing editor

Trending

Animas spill

In August, a plume of sludge spilled from a dormant mine and into the Animas River, which flows through Durango, Colorado, before joining the San Juan River, which runs into Lake Powell. The orange pollution plume transfixed communities downriver, as they waited for it to pass through. The spill — caused as the Environmental Protection Agency was working on cleaning up the defunct Gold King Mine — was an ugly reminder of the West's mining legacy. The spill could be an impetus for more meaningful measures to deal with mine waste. New Mexico Sen. Martin Heinrich, D, says he will seek to change federal mining law to allow for the collection of royalties from companies to help clean up contaminants. As for the spill itself, sampling done by the EPA upstream from Durango put the Animas River's water acidity on par with that of black coffee, with elevated levels of iron, manganese, zinc and copper. But by the time it reached town, the acidity had been diluted significantly, and levels of those metals were far lower, though still "scary," EPA officials said. **JONATHAN THOMPSON**
hcne.ws/orange-animas

The orange-tinted Animas River hairpins around a fish hatchery pond in Durango, on Aug. 7, approximately 24 hours after the Gold King Mine spill. JONATHAN THOMPSON

3 million
estimated number of gallons of contaminated water and sludge that flowed from the Gold King Mine in August

400
number of abandoned mines in the Silverton, Colorado, watershed, many of which leak acidic water that dissolves naturally occurring heavy metals, leaving dead zones downstream

1
number of fish that died, out of 108 tested, after being exposed to river water in the first 24 hours after the spill

You say

BOBBI MAIERS: "It's not just a Durango issue or a Colorado issue, but an entire Western water issue. Just because some fish haven't died yet doesn't mean there aren't myriad long-term negative effects."

CAROLE CLARK: "I live in New Mexico and am heartbroken for far too many reasons, as far too many unknowns will never be resolved."

MARIA HECKEL: "So very sad to return from a trip on the Green River to this news."

SCOTT CEJKA: "Blame falls squarely on the mining companies who leave their sites with these messes. They are the ones who should be vilified here. And they are the ones who should be paying in perpetuity to fix them."

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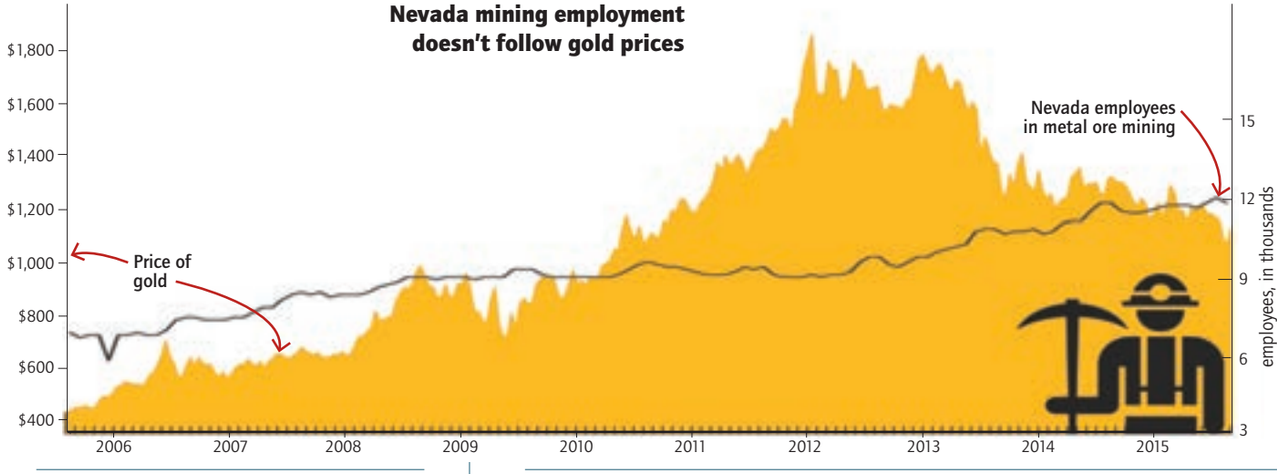

Gold in Nevada

Despite the drop in gold prices and stagnation of the industry globally, the gold-mining business in Elko, Nevada, seems to be doing fine. Elko has so far been immune to the downturns of a historically volatile industry. Over the past decade, the number of mining jobs in Nevada has grown 78 percent; the state mines 79 percent of all U.S.-produced gold. In 2013, Elko County alone produced nearly 670,000 ounces of gold, worth — in today's prices — more than $670 million.
PAIGE BLANKENBUEHLER
hcne.ws/NVgold

SOURCES: GOLDPRICES.ORG; NEVADA MINING ASSOCIATION

Quoted

"Racism has always been here — it's never left. Go to the jailhouse. (It's) full of Natives."

—Dean Goggles, chairman of the Northern Arapaho Business Council and cousin of James Goggles Jr., a tribal member shot by a white male at a detox facility in Riverton, Wyoming, in July. Northern Arapaho officials want the killings prosecuted as a hate crime.
SARAH TORY hcne.ws/WYshooting

Video

Birds, salt and a shrinking lake

There are more phalaropes at one time at the Great Salt Lake than are found anywhere else, with more than a third of the population in the world stopping there en route to South America. In the latest in *HCN*'s Wild Science video series, *Migratory birds on the Great Salt Lake*, a scientist looks at salt levels in the shrinking lake and their impact on the invertebrates and birds that rely on it.
DAKIN HENDERSON hcne.ws/phalaropes

DAKIN HENDERSON

"It kind of looks like they're swimming in the sky."

—Maureen Frank, Utah State University

Send letters to editor@hcn.org or
Editor, HCN, P.O. Box 1090, Paonia, CO 81428.

WHEN, NOT IF

Have we learned anything about wildfires and people living in high fire-hazard areas? ("The Bigger Burn," *HCN*, 8/3/15.) The late columnist Ed Quillen got it right when he challenged the "closer to nature" lifestyle of people unconcerned about wildfires until one was knocking on their front door. He called this living in "the stupid zone."

When I work as a consultant with people living in forested areas, I ask them, "What will you do when the fire comes? That's when, not if." I advise them on how to use fire-resistant construction materials and create a safe zone around their homes. But as good as these measures are, they are like putting a Band-Aid on the larger land-use issue. Should people even be living in high fire-risk areas? We have zoned floodplain areas to not allow buildings there. What stops us from zoning high fire-risk forested areas as unbuildable?

Arizona's Yarnell Hill Fire involved protecting homes that really should not have been built on the steep brush-covered hillsides outside of town. The tragedy of this fire is that 19 firefighters died trying to save homes.

Scientists are telling us that climate change conditions will result in an increase in the number of wildfires and their size. Fire scientist and author Stephen J. Pyne has told us it is time to rethink wildfire public policies. But equally important, we must rethink and create new land-use policies that regulate where we build our homes. The alternative is more Yarnell and Pateros "tragedies."

Jurgen Hess
Hood River, Oregon

SUPPRESSION WORKS

"Aerial firefighting: Is it worth it?" (*HCN*, 8/3/15) claims that wildland firefighting from the air has yet to be proven to work. Nothing could be further from the truth. Anyone knowledgeable about wildland firefighting understands that fixed-wing tankers and helicopters have always been used in an initial attack mode. Their mission was never meant to extinguish fires, but rather to suppress them, giving ground-based firefighters safer entry into the burn zone. Aerial firefighters provide time so that ground crews can do the extinguishing and mop up.

As for effectiveness, according to the most recent daily situation report issued by the National Interagency Fire Coordination Center, from Aug. 7 to Aug. 13, there were some 1,200 fires burning

GLENN FODEN/ARTIZANS.COM

throughout the United States. Thanks to the deployment of 25 large air tankers and over 100 helicopters, 96 percent were stopped in the initial attack stage. Without those aerial assets, it's not likely that level of success would have happened.

As for the argument that chemical retardants are environmentally harmful, we understand they aren't perfect. However, the Forest Service continues to refine retardant specs to make them more environmentally benign and engage in studies with a goal of making retardant more effective. Those studies, according to the Forest Service, should be completed within the next few years.

George Hill
American Helicopter Services and Aerial Firefighting Association
Washington, D.C.

FIGHT AT NIGHT

Your Aug. 3 article treated only one aspect of aerial firefighting — daytime activities, when fires are most active. Firefighting officials seem to have ruled out aerial operations at night when the fire has "laid down" and most often is not active. We see instead the photo ops of planes attacking fully active fires in the afternoon when no suppression activities can be effective. Thus, the aerial methods can easily be characterized as expensive and ineffective.

The problem is that any study of fire suppression over the past decade or more shows that no methods are effective. After 2010's Cerro Grande (40,000 acres) and 2011's Las Conchas (150,000 acres), examination showed that nowhere could we see that suppression efforts, costing millions of dollars, had made any difference.

Over the past 15 years, New Mexico and Arizona have lost approximately one-quarter of their conifer forests. Extrapolation of this rate, with current suppression methods, leads to the conclusion that in the next two decades, half or a third of these forests will be gone. Continuing to use outdated methods makes no sense. We have only two options: Change the way we fight fires, or lose our forests. There is no third option.

One solution is to fight fire from the air at night. This is often ridiculed by professional firefighters, as might be expected, since it would change an entire industry. But consider this: In the 21st century, we can use infrared imaging from drones or other aircraft to know exactly where a fire is at night. Tankers coming in at three-minute intervals can put some two acre-feet of water on a fire in one 14-hour period, when the fire is hardly active. Few fires can survive this.

In most cases, a fire can be put out in one night, allowing ground crews to safely finish the job. Once the proper techniques of attack are learned, we would have options to allow a fire to burn if beneficial (this includes prescribed burns), or to put it out. We would have real fire management ability. Such suppression would buy time to thin or otherwise make our forests healthy.

People say this would be too costly, but compare it with the costs of continuing current ineffective suppression methods added to the costs of forest loss.

It is time to seriously look at nighttime aerial suppression. The alternative is to continue to lose our forests, homes, businesses, historical structures and cultural assets.

Charles Keller
Los Alamos, New Mexico

High Country News

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Last plants standing

The Clean Power Plan is a blow to the struggling coal industry, but not the fatal one

BY CALLY CARSWELL

On a Thursday afternoon in early August, Wyoming's governor, both its U.S. senators and its lone House representative joined dozens of coal miners and other locals in a library in the town of Gillette. The Bureau of Land Management — under pressure to reform its coal-leasing program — was holding a listening session on royalty rates for federal coal, and Wyoming's political heavyweights had opinions to share.

They all vigorously opposed raising the rates. But the frustration and fear they expressed had at least as much to do with President Barack Obama's announcement a week earlier that power plants would soon have to answer for their carbon pollution.

Finalized Aug. 3, the Clean Power Plan sets carbon-reduction targets for 2030, for states and tribes with power plants. Nationwide, the plan is expected to yield a 32 percent cut in emissions from 2005 levels. From an environmental perspective, this is momentous: Carbon dioxide is easily the most abundant power-plant pollutant, and until now, the federal government has completely neglected regulating it at existing facilities. But Wyoming, which mines 40 percent of the nation's coal and claims 23,000 coal-related jobs, sees the plan as an existential threat. "What's happening to coal right now is a disaster for this state," Gov. Matt Mead, R, told BLM officials. "We just ask that you don't kill the golden goose," Republican Sen. Mike Enzi added. "If we put them out of business, it will ripple through the entire economy."

It's worth remembering that while Obama and the U.S. Environmental Protection Agency had some choice in *how* to regulate carbon dioxide, they had no choice in *whether* to regulate it. Supreme Court decisions since 2007 have affirmed that carbon is a pollutant the EPA is legally required to control.

Still, the coal states' hostility is understandable. Coal is responsible for 75 percent of the electricity sector's carbon emissions, and aside from improving energy efficiency, the easiest way to cut climate-changing pollution is to start burning less of it There's room under the plan for natural gas, wind and solar to grow, but barring major advancements in carbon-capture technology, coal has no option but to shrink.

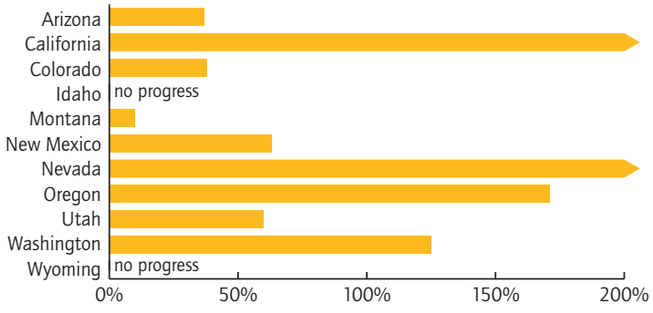
Despite this, the plan isn't a certain deathblow for the West's oldest facilities. That's partly because a number of those units are already slated for closure, either to comply with federal regulations to clear haze from national parks and wilderness areas, or to meet states' carbon goals. Any shutdowns after 2012 will count toward the 2030 targets and could go a long way toward helping to meet them.

Take the Navajo Generating Station and Four Corners Power Plant, both of which sit on the Navajo Nation. Under the Clean Power Plan's draft version, released last year, the Navajo would have

Please see **Power Plan**, *page 6*

HCN Contributing Editor Cally Carswell writes from Santa Fe, New Mexico. @callycarswell

STATE PROGRESS TOWARD 2030 CLEAN POWER PLAN TARGETS



Percentages indicate estimates of how close states will get to their 2030 goals using the plans they already have in place, based on rates of CO_2 emissions, a common method of measuring EPA compliance.

SOURCE: UNION OF CONCERNED SCIENTISTS

Snapshot

Wild graffiti

Urban vandals target Western parks

National Park System, vandalism of natural features, like rock faces and trees, has risen steadily in recent years, with more than 600 incidents reported since 2013. The hardest-hit areas are near large urban centers – such as Lake Mead National Recreation Area, a mere 39 miles from the Las Vegas Strip.

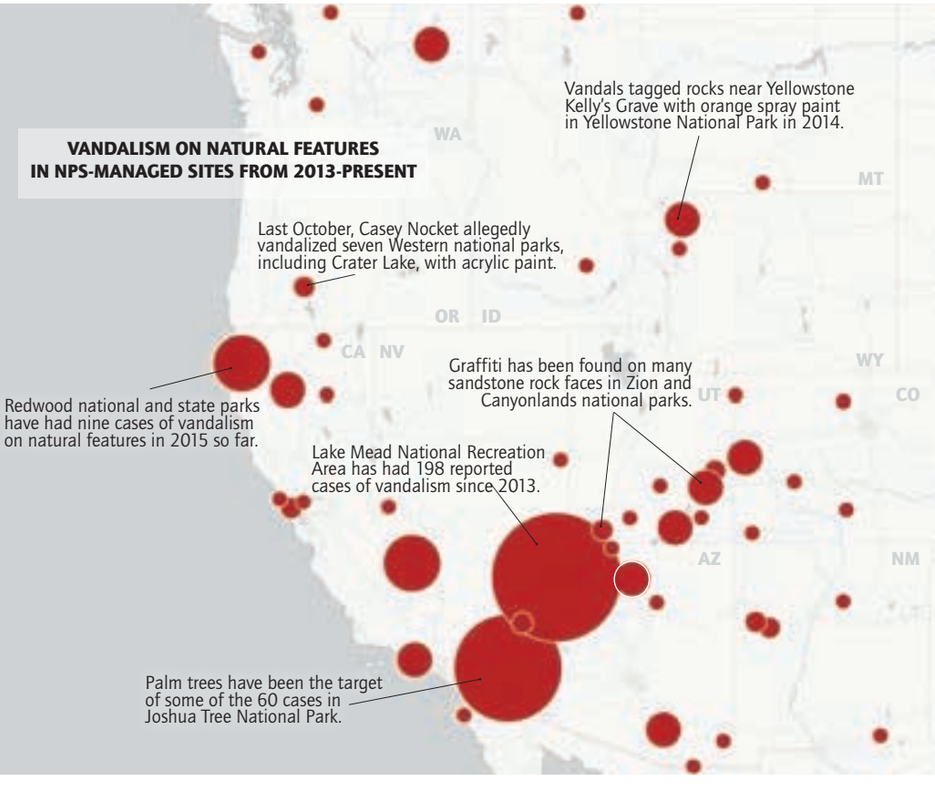
Joshua Tree, located about two and a half hours east of Los Angeles, had to close portions of its historic Barker Dam in February 2013, and, months later, it closed Rattlesnake Canyon as well. Superintendent David Smith says the vandalism ranges from run-of-the-mill high-school-type inscriptions ("Nancy ♥ Carl") to gang tags and unwanted works of "art," like the bright blue giraffe hikers found on a boulder in February.

This year, there have been more than 150 incidents in the Pacific West and Intermountain West regions. Such vandalism is difficult to undo, though workers can scrape off paint with spatulas, or use chemical treatments, provided they won't damage archaeological features.

People "have a desire to leave a permanent mark," says Smith, "but the difference between prehistoric times and now, is we have other mechanisms to leave a permanent record without defacing or destroying something that belongs to every American." **GLORIA DICKIE**

SOURCE: NPS

VANDALISM ON NATURAL FEATURES IN NPS-MANAGED SITES FROM 2013-PRESENT



Power Plan *continued from page 5*

been required to cut emissions by 6 percent, an easy goal since three units at Four Corners were idled in 2013, and one at the Navajo Generating Station will likely close in 2019. In the end, the EPA revamped how it calculated the targets, and the reservation's goal leapt to at least 38 percent. And that's a goal that the planned closures at the two plants could still achieve — or at least come close to — under one of the EPA's proposed compliance options, according to a rough calculation provided by the Natural Resources Defense Council.

One way or another, the states that are most reliant on coal will have to do more to cut pollution than they're currently planning, which is very little.

Similarly, New Mexico's existing renewable energy and efficiency standards, plus the planned closure of two units at the San Juan Generating Station, seem likely to put the state within striking distance of its 2030 goal. PNM, New Mexico's largest utility, agreed this month to reconsider the remaining units' future in 2018, and environmental groups remain hopeful it will abandon San Juan. Since the EPA is encouraging participation in emissions trading markets under the Clean Power Plan, PNM might even stand to profit from closing more units. If it reduces emissions more than required, it will have credits to sell on the market, explains Steve Michel, an attorney with Western Resource Advocates.

In the West as a whole, says Noah Long, director of NRDC's Western Energy Project, some additional coal-fired units will have to be shuttered to meet targets, even if it's currently unclear where those closures might happen. And one way or another, the states that are most reliant on coal, like Montana and Wyoming, will have to do more to cut pollution than they're currently planning, which is very little.

As the West's largest coal economy, Wyoming in particular faces big changes. Rob Godby, a University of Wyoming energy economist, says the concern is less how Wyoming will meet its own target than how other states — its coal customers — will meet theirs. Godby led a recent study that found that the regulations could reduce Wyoming coal production by 34 to 50 percent. How big the hit will be depends in part on how much coal power Wyoming's customers will have the option of keeping, which in turn depends on whether emissions can be offset elsewhere, by improving energy efficiency or buying emissions credits. "This isn't the death of coal," Godby says, but it is a formidable new challenge.

In the short term, the coal industry's wellbeing hinges primarily on gas prices. In the long run, however, carbon limits are one of its greatest threats — one it and the states it bankrolls may no longer be able to evade. □

Triage in the Arctic

Ancient artifacts in the thawing North are disappearing before archaeologists can document them

BY KRISTA LANGLOIS

We're speeding along a gravel spit north of Barrow, Alaska, plumes of dust rising behind our four-wheelers, the Arctic sea ice blindingly bright, when archaeologist Anne Jensen hits the brakes. "Hang on," she mutters, jumping off the machine. "I think I saw something."

Jensen stands with her hands on her hips, peering down at a human femur that's lying on the gravel as if dropped from the sky. In fact, the opposite is true: Just as cycles of freezing and thawing can churn up new rocks in a garden each spring, so the tundra occasionally spits out long-buried artifacts. Kneeling next to the bone, Jensen estimates it's a thousand years old.

In most places, the old is constantly replaced by the new, the bones and tools of our ancestors devoured by soil bacteria or washed into the sea. But in the Arctic, long winters, frozen soil and a dry climate have preserved remnants of the past in startling completeness. Jensen, senior scientist for the Ukpeaġvik Iñupiat Corporation, once unearthed an 800-year-old girl in Barrow whose skin, hair and stomach contents were perfectly intact. In comparison, she once tried to exhume a pair of draft horses in Pennsylvania that had been buried 70 years earlier and recovered only a bit of brass from their harnesses. "Not even tooth enamel — nothing!" she says, incredulous.

The organic remains that linger in Alaska's Arctic have allowed archaeologists to sketch a rough picture of early North Americans' migration routes and daily lives. Yet because the summers are brief and the distances so vast, much remains undiscovered. Where did Paleo-Eskimos come from, for example, and why did they disappear? Why did some groups survive climatic swings while others died out?

Jensen has spent decades chasing such questions. There were always more sites to excavate than there was money or manpower, but she spent winters working contentedly in her lab, knowing that whatever she didn't get to one summer could be explored the next. "If something stays frozen, it can be incredibly long-lived," she explains. "But once permafrost goes away, that kind of stuff will rot in no time at all."

Today, with climate change accelerating the rate of thawing permafrost and

HCN correspondent Krista Langlois lives in Durango, Colorado, and frequently covers Alaska. @KristaLanglois2

An archaeological field crew screens excavated soil to recover small artifacts and faunal material that might have been missed in the main excavation at Walakpa in 2013. Sites like Walakpa have many intact artifacts, but they are slowly eroding into the sea. COURTESY ANNE JENSEN

coastal erosion, archaeological sites across the Arctic are being exposed — "incredible amounts of information that we didn't know existed 10 years ago," Jensen says. But just as quickly as they emerge, the sites are lost again, rotting into earth or tumbling into the sea. Jensen is forced to perform triage, deciding which to ignore and which to save.

Gently wrapping the femur in her parka, Jensen scans the broken ice, which floats scattered across the ocean even in mid-June. The temperature is in the upper 30s and feels even colder, but it's warm by Arctic standards: Every year, the shelves of floating ice form later and melt earlier, and 2015 is shaping up to be among the lowest sea-ice years on record.

With less ice to break their force, waves build up and storms hit the coast with greater ferocity, accelerating erosion. Craig Tweedie, an Arctic ecologist and colleague of Jensen's, has transposed aerial photos from the 1940s onto modern maps and calculated that the coast where we're now standing is eroding at a rate of 10 to 12 meters a year. Not only that, but storm frequency may be increasing, and sea levels, of course, are rising. "Anne is running in crisis mode all the time," Tweedie says. "It's like she's literally trying to catch these things as they're falling off the cliff."

In 2013, Jensen was at a conference in Iceland, giving a presentation about how climate change is impacting Arctic archaeology, when she got an email: A group of ATVers from Barrow had found a sod house crumbling out of a bluff at an old hunting camp called Walakpa. Jensen had known that Walakpa existed — it was partially excavated in the 1960s — but the photos showed a more extensive, deeper and more intact site than anyone had imagined. Plus, because its layer-cake stratification spanned millennia, Walakpa had the potential to provide a unique record of daily life during the time when the Birnirk culture was dying out and the ancestors of today's Inupiat rose to dominance. Had there been war? Some natural disaster? Or did one culture gradually transition into the other?

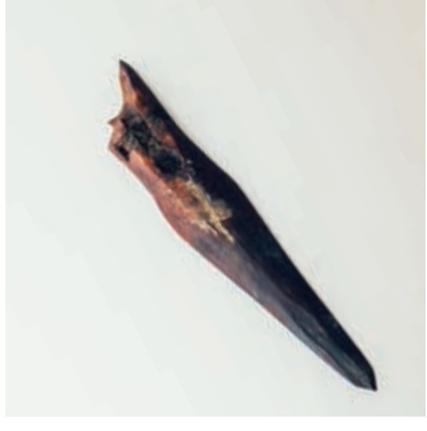
As soon as she got home, Jensen rushed out to Walakpa. She found artifacts spilling out of the dirt: carved ivory harpoons, a baleen spoon, waterproof bags made of skin. There were whale skulls, walrus tusks and thousands upon thousands of bones left over from successful hunts.

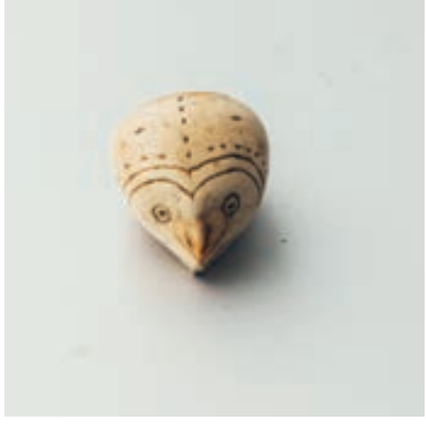
Jensen believed that artifacts from Walakpa could help determine whether the Birnirk people, who disappeared around 1000 A.D., were directly related to today's Inupiat — which could strengthen the tribe's argument for the repatriation of Birnirk remains from the Smithsonian. But she never got the chance to find out. Before she could secure funding from the National Science Foundation, a storm sent a 30-foot chunk of the site — including the oldest layers — crashing into the Chukchi Sea. "Three thousand years of pre-contact history, gone," she says, shaking her head.

As places like Walakpa disappear, we're losing a record of not only ancient humans, but also the environment they lived in. Because of Walakpa's location at the confluence of freshwater, marine and terrestrial hunting grounds, it offers an environmental record similar to an ice or bog core, but with samples from a wider variety of places — the next best thing to a time machine, Jensen says. Plant pollen, for example, can offer clues to how wet or dry the weather was. Walrus tusks reveal where the animals were feeding. Ring seals' body size directly corresponds to how long they spend on ice as juveniles, so bigger seal bones indicate periods of more stable sea ice. Combined with existing climate reconstructions, this knowledge can help scientists create more reliable climate models: the better such models simulate the past, the more confidence we gain in their predictions for the future.

"Ancient people have left behind these signals to tell us what their environment was really like," Tweedie says. "They could provide one of the only mechanisms we have to validate modern-day science."

Out on the gravel spit, the wind is picking up and the temperature dropping. Jensen's cheeks are red. Using a bungee cord, she secures the wrapped femur next to the polar bear gun on her ATV, and we start back toward town. On the way, Jensen thinks she sees another bone. But when we stop to look for it, there's nothing there but shifting gravel and the endless wind. □





Two ivory harpoon heads found at Walakpa in 2013 and an ivory toggle or bag fastener found at Nuvuk in 1998. FLORENCIA MAZZA RAMSAY

Washington Gov. Jay Inslee. SHORELINE COMMUNITY COLLEGE

THE LATEST

Backstory

Last year, **environmentalists spent millions of dollars on state-level elections in Oregon and Washington, hoping to secure sympathetic legislative majorities** ("Climate catalyst," *HCN*, 11/24/14). They needed only two more seats in Washington's Senate to tip the balance there, giving Democratic Gov. Jay Inslee an opportunity to pass laws to cut the state's carbon emissions. They didn't win those seats.

Followup

Inslee's cap-and-trade proposal failed this year, and in late July, the governor criticized state lawmakers for doing "zero, nada, zilch" to address climate change in remarks to a local newspaper's editorial board. Inslee had just directed the Washington Department of Ecology to begin a rulemaking process under the state's Clean Air Act to cap carbon emissions. It's not yet clear how aggressive the cap will be, and the process is expected to take at least a year. **Activists are separately pursuing 2016 ballot initiatives that would tax carbon or otherwise charge polluters for emissions.**

CALLY CARSWELL

The recovering coastline at the mouth of the Elwha River, August 2015. ANDREW RITCHIE/NPS

THE LATEST

Backstory

In September 2011, **two dams on the Elwha River in northern Washington, which between them supplied power for a single paper mill, were taken down to help struggling salmon runs**. One of them — Glines Dam — was the largest ever removed in the country. Federal and tribal biologists were thrilled: Because most of the Elwha is on national park land, development and pollution were not a factor in river restoration ("Rebuilding a river as Washington's Elwha dams come down," *HCN*, 9/19/11).

Followup

Now, new studies show that the dam removal is not only helping salmon populations recover; it's also rebuilding beaches. **Long-trapped sediment has washed downstream to the mouth of the Elwha, allowing diminished beaches to return and slowing coastal erosion**. Salmon have returned to stretches of the river that hadn't supported spawning for more than a century. Unfortunately, the fish are still under stress: The same unusually warm waters that have been killing salmon around the Northwest are affecting them as well.

PAIGE BLANKENBUEHLER

Cultivating climate literacy

A Montana farm group is fighting political polarization with pragmatic discussions about climate change

BY SARAH JANE KELLER

This June, at the western edge of the Montana prairie, several dozen farmers and ranchers in baseball caps and jeans gathered at Great Falls College to learn how to deal with climate change impacts: hotter growing seasons, reduced wheat yields, more severe storms, less rain in eastern Montana, and earlier snowmelt statewide, meaning less water for later in the growing season. Fabian Menalled, an affable noxious-weed scientist from Montana State University, spoke about the already aggressive heat-and-carbon-dioxide-loving cheatgrass, which could consume even more rangeland in the future. Yet, as Menalled acknowledged, only 40 percent of Montanans think that humans are causing global warming, compared to 97 percent of scientists.

The farmers in the audience either sided with the scientists or were too polite to disagree; there were no walkouts, or even skeptical questions. That's likely because climate change is getting harder for farmers and ranchers to ignore. The weather in recent years looks a lot like the extreme conditions scientists projected: floods in 2011, severe fires in 2012 and record-breaking hail damage in 2013. All that leads to lost income and the fear that crop insurance will be tougher to buy.

In a 2014 study, University of Montana ecologist Brady Allred found that the U.S. states richest in natural resource and agricultural lands are also the most likely to get hotter and drier. Those states — including Montana, where agriculture is the largest industry — also elect congressional representatives that resist climate change mitigation or adaptation policies. Agricultural lands are among the most vulnerable, says Allred. "And if (we) have this leadership that is not as likely to think about adaptation or mitigation policies going forward, that presents a concern."

The Montana Farmers Union is attempting to temper the partisan polarization around climate issues by inviting scientists like Menallad to forums and publishing scientific reports about what farmers can expect in the warming region. The Farmers Union has always focused on protecting family farmers, and its leaders worry that smaller operations will feel the impacts more acutely than large agribusiness. The risks to its members' livelihoods now outweigh any political fallout that could come from discussing the issue, says the union's president, Alan Merrill: "We just want to make people aware of what is happening. Learn what you can do on your operation, learn how to cope with what is happening right now."

Montana's other traditional ag groups have yet to take formal positions on climate change. Chelcie Cremer, the director of state affairs for the Montana Farm Bureau Federation, says that's because their members haven't sought more information. In the past, however, her group campaigned against cap-and-trade legislation that could impose costs on producers. But now, farmers' unions in the upper Midwest, Kansas and New England as well as Montana are confronting the issue. Merrill credits the National Farmers Union's willingness to tackle controversial topics, such as lobbying for country-of-origin labeling.

"It does sort of feel like we're reaching a tipping point where it's OK to talk about it now," says Montana Department of Agriculture Director Ron de Yong. "Farmers and ranchers, even if they aren't reading about it, they are experiencing it on their own farms."

Farmers are adapting, de Yong says. Merrill, who grows wheat in central Montana, has found that the planting schedules his father taught him no longer work on his farm, and Montana State researchers are developing spring wheat that matures faster to beat hotter, drier June weather. De Yong's office is encouraging producers to plant a more diverse array of crops as insurance against the erratic climate and volatile commodities markets. Montana farmers have taken advantage of high pea and lentil demand, rotating those drought-tolerant crops with wheat. No-till agriculture, which helps keep water in the soil and sequester carbon, is also becoming popular, as are cover crops like millet and soybeans, which help fight weeds and hold soil in place during intense rainfalls.

At a question-and-answer session in Great Falls, a farmer mentioned that irrigation season in western Montana started two weeks earlier than normal this year and was followed by an unusual frost. "Are these surprises, or are these things that we should be expecting?" he asked a panel that included de Yong, Menalled and Justin Derner, a rangeland scientist who runs the Northern Plains "climate hub" for the U.S. Department of Agriculture. The climate hub is part of a new network of regional climate centers that provide producers with data and help them solve problems like new pests or the need to switch seeds. Derner didn't miss a beat: "I think those sort of things are the new normal."

Rancher Rich Liebert stood up to say he wished Menalled would take his talk to Montana's elected officials. Two of the state's three congressmen have expressed skepticism about humans' role in causing climate change. But the panel's moderator quickly moved the discussion along, trying to avoid politics. "In their hearts, they know it's happening," Liebert said later, of his fellow food producers. "I think secretly there are farmers that vote red, but they are thinking green." □

Fabian Menalled speaks at the Montana Farmers Union talk at Great Falls College. He is one of the scientists helping local farmers understand how climate change is likely to impact agriculture. EVAN FROST/GREAT FALLS TRIBUNE

Sarah Jane Keller writes from Bozeman, Montana. @sjanekeller

A man looks over mud and debris left by a flood in Manitou Springs, Colorado, in 2013. The town was made vulnerable to severe flooding after the Waldo Canyon Fire burned vegetation in the foothills to the west. BRYAN OLLER/AP

Where FEMA fails

Despite increasingly severe fires and flooding, pre-disaster money is in short supply

BY ELIZABETH SHOGREN

When the 2012 Waldo Canyon Fire was finally snuffed out, the residents of Manitou Springs, Colorado, a small town on the Front Range of the Rocky Mountains, breathed a collective sigh of relief. The community had narrowly escaped what was then the most destructive fire in Colorado history. Not long afterward, Mayor Marc Snyder gave a tour to Carol Ekarius, the executive director of the Coalition for the Upper South Platte, a nonprofit that works to protect the watershed southwest of Denver. As the two walked through the picturesque town, with its eclectic historic buildings tucked between Pikes Peak and the Garden of the Gods, Ekarius pointed out structures she predicted would be damaged or destroyed when, inevitably, there would be flooding off the scorched slopes rising above them.

Snyder initially was appalled by this unsolicited warning. Ekarius, however, was persuasive: She had seen floods devastate her rural watershed in nearby Teller County after the 1996 Buffalo Creek Fire and again after the 2002 Hayman Fire, with catastrophic consequences for one of Denver's main reservoirs. "I wish I didn't have a crystal ball, but I've seen it so many times after fires in the mountains," Ekarius recalls. Snyder quickly recognized the danger his community faced, and he began trying to raise money to upgrade its drainage system — the best way, he thought, to avert impending disaster. "The consensus was it was coming, whether it came in year one or year 10," he says. "It keeps you up at night, let me tell you."

The town applied for funding from FEMA, the Federal Emergency Management Agency, but the small amount Congress allocates to protect vulnerable communities before disaster was already depleted. Unable to upgrade the drainage system, town officials installed new emergency warning sirens, warned residents and steeled themselves for the calamity they knew was coming.

On Aug. 9, 2013, it arrived. Snyder spotted a heavy storm brewing over the mountains. "I'd been living under this shadow of doom for about a year," he says. "I remember looking over and seeing that ominous dark cloud over the burn scar, and I thought: This is it."

As rain pounded the charred slopes, a wall of muddy water carrying rocks, trees and other debris raced off them and raged through town, overwhelming the old drainage system. The torrent was so strong that it picked up cars on the highway and swept them downstream. Two people were killed nearby and dozens of homes and businesses were destroyed or damaged. So was the storm water system.

Afterward, FEMA's largess flowed, helping to repair City Hall and paying for much of a new $6 million drainage system. But upgrading it before the flood would have cost far less, and much of the destruction could have been averted. So why wasn't it?

FEMA says it receives requests for several times more funding than it has available each year for preventive projects. "There's a clear need there," says Michael Grimm, director of the risk reduction division of the federal insurance and mitigation administration at FEMA. (In recent years, President Barack Obama has asked Congress for more funding for pre-disaster hazard mitigation, but Congress has allocated only $25 million. In his 2016 budget request, Obama is seeking eight times that much, $200 million — though the likelihood of getting that is small.)

But the shortage of pre-disaster funding is just one of the ways that FEMA is out of sync with community needs, now that climate change is impacting the West. A close examination reveals policies that discourage upgrades to help structures withstand larger floods; favor flood control using pipes and pumps, instead of systems that mimic nature; or provide aid to communities damaged by floods after wildfires only if each flood has been declared a national disaster.

Billions of dollars are at stake. "Outside of defense spending, this is the biggest

Please see **FEMA**, *page 23*

Correspondent Elizabeth Shogren writes *HCN*'s DC Dispatches from Washington. @ShogrenE

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True Grit #2, 2008. DAVID BRADLEY

INDIAN COUNTRY: THE ART OF DAVID BRADLEY
Curator: Valerie K. Verzuh
143 pages, hardcover: $34.95
Museum of New Mexico Press, Santa Fe, 2014

"My art is about my life," says David Bradley, who was born in Eureka, California, to a white logger father and a mother who was a member of the Minnesota Chippewa Tribe. Though his childhood was challenging, his artistic talent blossomed early, and the two years he spent in the Peace Corps in Guatemala introduced him to folk art's vivid colors and social consciousness. His identity as an artist living in two worlds deepened after he enrolled at the Institute of American Indian Art in Santa Fe, in the late 1970s. Bradley's lively paintings reward close attention, revealing his sense of irony and enough humor to make you laugh out loud. But ultimately, he says, he looks to the land for inspiration: "The landscapes and the earth speak so loudly to me here. If I have a problem, I just step outside and am awed by what I see all around me."
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Summer visitors

Here in Paonia, Colorado, home of *HCN*, the peaches are ripe, the sweet corn is in and a series of monsoon thunderstorms has left the normally dry fields lush and lovely. We've had an abundance of visitors, too, and are always delighted to see our readers in person!

From Boulder, Colorado, came **Dennis Tharp**. He'd been hiking near the mountain resort town of Crested Butte, drove over the pass to the North Fork Valley, saw our sign and popped in to say hello.

Al Schroder and **Joan Groff** of Tucson visited the office for the third time since subscribing a decade ago. The pair were happy to have left 110 degree weather behind; they were on their way to visit Joan's father in Pennsylvania and enjoying a three-month camping trip. We'll give them a punch card next time!

Boise, Idaho, residents **Susan Weiner** and **Bruce Acherman** came by *HCN* headquarters "to see where the magic is made" while overseeing the groundbreaking of the new home they're building in Montrose, an hour southwest of Paonia. They hope to relocate from Boise next year. Welcome to the neighborhood!

Scott Hall of Farmington, New Mexico, dropped in to pick up another copy of a March issue; someone in his office, he said, absconded with his own. Scott, who works as a realty specialist for the local BLM field office, was on his way home from a vacation in nearby Glenwood Springs, sporting a bit of sunburn from a rafting trip.

Longtime reader **Marith Reheis**, a retired geologist from Golden, Colorado, stopped by with her husband, **John Cady**. The two were on a six-day road trip after Marith, who still works occasionally for the U.S. Geological Survey, did some soil sampling near Mesa Verde National Park in southwest Colorado. Marith has been a reader since 1975, when some friends at the USGS introduced to her to *HCN*.

Lynn Myre of Louisville, Colorado, a longtime reader, and her daughter, **Brianna Wilensky** of Glenwood Springs, made a special trip to Paonia just to see us in action. Lynn got her daughter a gift subscription and hopes to come back soon to check out the whole town. Lynn visited once in the 1960s, back when Paonia was just a "cute little farm town" without paved roads. Now it's a cute little farm town with paved roads.

CORRECTIONS

In our July 20 issue, the story "Living the dream, plus overtime" referred to the Bob Marshall National Forest, accidentally compressing two names; we meant the Bob Marshall Wilderness in the Flathead National Forest.

The author bio at the end of the essay "Dreaming where I walk," in the Aug. 17 issue, mysteriously lost a word after the issue went to press. The ending should have read "… starring Martin Scorsese and Peter Rainier."

—Jodi Peterson for the staff

Lynn Myre and her daughter, Brianna Wilensky, visit *HCN*. BROOKE WARREN

UNLOCKING THE M

A tour of the Four Corners Hot Spot, where natural gas has a

A SILVER VAN ROLLS SLOWLY down a narrow road on the edge of the small town of Bayfield, Colorado, a farming-turned-bedroom community 20 miles east of Durango. With its darkly tinted windows and government plates, the van has an ominous appearance, not helped by the long, fishing-pole-like appendage, accessorized with wires and tubes, that extends from its top. Impatient drivers pull around the creeping vehicle, peering suspiciously as they pass. Just behind the local high school, the van stops abruptly, then reverses, then pulls forward again onto the shoulder before stopping.

The passenger-side door swings open and Gabrielle Petron, an atmospheric scientist with The National Oceanic and Atmospheric Administration and the Cooperative Institute for Research in Environmental Sciences at the University of Colorado, Boulder, hops out, gesturing to the following journalists to pull over and do the same. Petron wears jeans and hiking boots, a black jacket and sunglasses, all given flair by the saffron-orange scarf wrapped loosely around her neck and shoulders. Speaking with a slight French accent, she explains the van's erratic behavior: Its sensors indicate the presence of above-background levels of methane, a potent greenhouse gas.

It's not hard to find the probable source. Inside a chain-link-fenced enclosure next to the school's tennis court, the pipes, valves and other equipment of a BP America natural gas well jut from the ground. Everything's painted gold and purple, the school colors, with "Wolverine Pride" emblazoned on a metal box. Like many of the 40,000 or so oil and gas wells here in the San Juan Basin, this one extracts natural gas from the Fruitland coal formation. The natural gas, which is largely methane, is gathered here, processed and piped to market. Or at least most of it is: Some of that methane is apparently leaking from the wellhead and drifting into the atmosphere, contributing in its own small way to the notorious Four Corners Methane Hot Spot, a highly concentrated plume of greenhouse gas that hovers over the region. When scientists first noticed the hot spot in satellite imagery captured nearly a decade ago, it was so intense that they thought their equipment was malfunctioning. But more satellite imagery from 2009 confirmed the anomaly's existence, and in 2014 a team of scientists published a paper on it that garnered widespread media attention.

ETHANE MYSTERY

dark side

FEATURE BY JONATHAN THOMPSON | PHOTOGRAPHS BY JEREMY WADE SHOCKLEY

The obvious suspect behind the hot spot is the vast oil and natural gas industry infrastructure, which is woven like rebar into the landscape here, and burps and leaks methane and other hydrocarbons from valves, pipes, compressors and newly fractured wells. Other known contributors include an underground coal mine, from which methane is vented for safety, and a few landfills and two coal-burning power plants, which emit relatively small amounts of the gas.

But there's a 155,000-ton gap between the emissions these facilities collectively report to the Environmental Protection Agency's greenhouse gas inventory, and the amount of emissions the scientists estimate is needed to produce a plume as concentrated as the hot spot. Petron, along with a swarm of scientists under the aegis of the National Aeronautics and Space Administration and NOAA, descended on the region this spring, using planes, satellites and automobiles to try to account for all that unaccounted-for methane. *(See sidebar, page 16.)*

What they find could have wide-ranging implications. Natural gas emits about half the carbon per unit of energy generated as coal, and about a third less than oil, making it a good "bridge" fuel for transitioning from a coal-heavy energy system to one that's carbon-free. Yet the main ingredient of natural gas — methane — has 30 times more global warming potential than carbon dioxide. If the scientists were to find that the natural gas industry is behind the extra emissions, it could further cloud the fuel's current climate-friendly status. It might also indicate how hard the region's oil and gas industry will be hit by regulations from the Obama administration as part of its strategy for reducing emissions from the industry by 45 percent.

The industry, however, blames the gap on another methane-spewing villain that lurks here in the San Juan Basin and in other coal- and natural gas-rich areas: geologic seeps, where methane leaks unbidden from the earth, as it has done for millennia. Environmentalists scoff at the theory, but researchers aren't discounting it. "The seeps are definitely a piece of the puzzle," says Devin Hencmann, with LT Environmental, the company that has monitored the seeps in the San Juan Basin for the last decade.

But just how big a piece? And where exactly does it fit into the hot spot puzzle?

Flaring from natural gas wells lights up the night sky in the San Juan Basin of northern New Mexico.

Gabrielle Petron, top, a scientist with CIRES at the University of Colorado, stands near a facility that uses methane seeping from the ground to generate enough electricity to power six homes. Above, Petron's research assistant Eryka Thorley checks readings in the "Methane Mystery Mobile," which is shown at right, with its sensor arm extended above the van.

A FEW HOURS BEFORE HER STOP AT THE SCHOOL-GROUNDS GAS WELL in Bayfield, Petron and her research assistant, Eryka Thorley, who looks like she just stepped out of a Patagonia catalog in her skinny jeans, fleece jacket and white-rimmed shades, show a couple of journalists around what I've privately christened the Methane Mystery Mobile. On a cool, moist late April morning, it sits in the parking lot for a popular trailhead known as Carbon Junction. The Animas River — not yet polluted by the mining spill that will make national headlines later in August — runs by below, and just beyond it looms Carbon "Moving" Mountain, so nicknamed because, back in the 1930s, it grew violent for several months, shifting and sloughing and sliding for reasons unknown.

A computer monitor mounted on the van's dash, between the driver and passenger seats, reveals current concentrations of carbon dioxide, methane and carbon monoxide in the air around the vehicle. In the back are more instruments, along with burly black plastic boxes containing glass cylinders for capturing air samples at specific sites. Petron initially studied mathematics in France, but eventually switched her focus to the atmosphere. "The beauty of the air and the abstractness of it reminded me of math," she says. That very abstractness, unfortunately, makes it difficult for many of us to really grasp concepts such as climate change or greenhouse gases.

In pre-industrial times, the background level of methane on Earth was about 750 parts per billion. But beginning in about 1850, that level started shooting up, and now it's approximately 1,800 parts per billion, or 1.8 parts per million. Here in the parking lot, the methane line jumps up and down with shifts in the wind, but remains higher than background levels, occasionally rising to 5 or more parts per million.

I look around me. The nearest natural gas or oil well is at least a mile away. There are no coal mines nearby, no feedlots, wetlands, rice paddies, landfills or any of the other common sources of methane emissions. But then again, there doesn't need to be. The parking lot sits in a notch, formed by the Animas River, in the Hogback Monocline. If you think of the San Juan Basin as a lopsided bowl-shaped sandstone-, shale- and coal-filled layer cake, then the steep ridge of the monocline is the cake's outer rim, where the layers are exposed. Petron leads us up a little canyon and points to the critical layer of the cake, an outcrop of the Fruitland coal formation. It's the souvenir of a sultry swamp that lurked along the shores of a receding sea some 65 million years ago, and it's brimming with methane, some of which is leaking out here. Despite its apparent enthusiasm to escape the earth, this methane was economically infeasible to extract until, in the 1980s, government-subsidized technology and tax credits combined to

make it a moneymaker. That launched a boom that would make the San Juan Basin the nation's number one coalbed methane producer.

In 1993, at the tail end of the first major wave of drilling, a resident of the Pine River Ranch subdivision north of Bayfield complained to the Colorado oil and gas regulators that, after 10 years of providing clean water, his well had begun spewing methane. Similar phenomena had been reported in other parts of the basin, but those had been traced back to particular wells that had bad casing, which allowed methane to migrate from the gas well into the aquifer. This one was different. Investigators couldn't find any leaky or badly cased gas wells nearby, but they noticed that the house and well were located along a low point in the Hogback Monocline, where the Pine River had eroded through it, right on top of the Fruitland outcrop. The methane, it appeared, was coming straight out of the coalbed.

Such natural seeps had been witnessed along the outcrop for a century or more, but it gradually became clear that they were getting more intense. Trees and bushes began dying off in places where they had long thrived, like Carbon Junction. Near Valencia Canyon Gap on the Southern Ute Indian Reservation, where the glowing embers of an underground coal fire had become visible, methane emanated with enough pressure to fling grains of sand several inches into the air, and hydrogen sulfide levels, at a hazardous 200 parts per million, forced the closure of a nearby road.

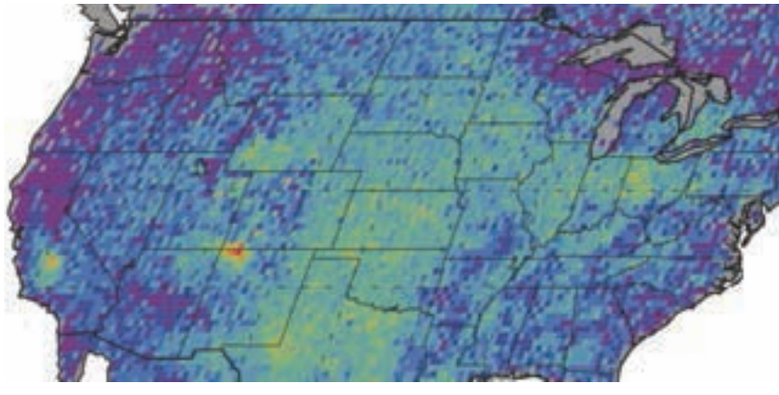
Things only got worse. Within a year after the changes were observed, "a half-mile long by 50- to 75-foot wide swath of previously healthy piñon and juniper trees, sagebrush and saltbrush stood dead as stark testimony to recent environmental changes," lamented a comprehensive 1999 Bureau of Land Management report on the issue. Methane was seeping from some spots at 1 million parts per million, or 100 percent concentration. Back at the subdivision, methane invaded more wells and pooled in the crawlspaces of homes. Breathing methane poses no immediate threat to human health, but potential explosions were a serious concern. At the time, the methane's effects on the climate remained in the background.

The Colorado Oil and Gas Conservation Commission formed an investigative team, and in 1995, it concluded that the most likely explanation for the sudden increase in methane seep at the subdivision — and by extension the cause for the apparent exacerbation at the other "natural" seeps — was the vast "dewatering" of the coal seam. Unlike "conventional" reservoirs of oil and gas found in sandstone or shales, coalbed methane is adsorbed, or bonded, to tiny pores in the coal by water pressure. In order to "liberate" the methane, drillers must first pump out the water from the coal seam. By 1999, just a decade or so after the boom had begun, coalbed methane wells on the Colorado side of the San Juan Basin alone had produced over 10 billion gallons of water, freeing the methane to migrate up the coal seam and escape from the outcrop.

LT Environmental workers monitor methane emissions from geologic seeps in the Fruitland coal outcrop. At right, methane bubbles up through the streambed in Archuleta County, Colorado.

Amoco — now BP, the biggest operator in the region — pushed back, bringing in its own consultants, who dusted off every historic account of flaming streams and wells and presented them as proof that the problem had always been there. The stories were entertaining and sometimes dramatic: A group of kids on a camping trip watch as an ember from their fire sets the Pine River aflame; ranchers light methane seeps to serve as natural Christmas lights; a man who likes his drink finds himself locked out by his wife, so he ignites the water well vent in order to stay warm. The consultants even brought up Carbon "Moving" Mountain, and suggested that its perturbations were the result of subterranean methane seep explosions.

They posited other possible causes for the exacerbated leakage: Perhaps drought or an increase in domestic wells was drying up the coalbed and liberating the methane, or maybe an uptick in precipitation was causing more water to leak through the outcrops into the coal seam,



Methane concentrations across the United States are low on the coasts (dark blues and purples) and higher in the country's midsection (light blue, green and yellow), with the Four Corners hot spot, the red area highlighted with a circle, above, highest in concentration.
NASA/JPL-CALTECH/UNIVERSITY OF MICHIGAN

Wells dot the landscape of the Permian Basin — the most prolific oil field in the nation — on the New Mexico-Texas border. ALAN LEVINE/CC VIA FLICKR

Tracking air quality, from above

WEB EXTRA
Taku Ide has a vision: Mini power plants fueled by fugitive methane providing electricity for those without access to the grid. **hcn.org**

THE FOUR-ENGINE TURBO-PROP PLANE, built for hurricane research and surveillance, dips low over the pancake-flat plains that sweep from southeastern New Mexico across the Texas border. Huge irrigation circles are tattooed across the land in varying shades of brown and green. Then the well pads appear. From 1,000 feet in the air, they look like hundreds of sandboxes, connected by a maze of dirt roads.

"That's a lot of wells," says Joost de Gouw, a scientist with the National Oceanic and Atmospheric Association and the Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder. As the lead researcher tracking the emissions over America's energy hot spots, de Gouw has flown over oil and gas fields from North Dakota to Pennsylvania. Nowhere, however, has he seen a greater density of drilling operations than here in the Permian Basin, a 250-mile-wide-by-300-mile-long stretch of Texas and New Mexico — the nation's most prolific oil field.

Joost de Gouw, left, Jessica Gilman of CIRES/NOAA and Drew Gentner of Yale University study readings aboard the CIRES research plane. DAVID OONK/CIRES

But De Gouw isn't interested in the energy being produced here; he's tracking the "fugitive emissions" leaking into the atmosphere. They include substances like methane, an odorless, colorless greenhouse gas far more potent than carbon dioxide, on a per-molecule basis, and volatile organic compounds, gases that produce a thick layer of pollution in the atmosphere linked to cancer and other health problems.

As part of NOAA's Shale Oil and Natural Gas Nexus, or SONGNEX, project, de Gouw and 40 other researchers are trying to quantify those emissions and their effects on everything from the quality of the air we breathe to how much and how fast the planet will warm. Little attention was paid to methane emissions in the past, but with the current energy boom, the amount that's being pulled from the earth and put into the air is rapidly increasing, and the need to understand emissions is becoming critical.

De Gouw earned his doctorate in atomic and molecular physics, but got into atmospheric science because he wanted to focus on something larger than the interactions of tiny particles no one could see. He has small wire-framed glasses and close-cropped sandy hair, and he speaks calmly, with a trace of a Dutch accent.

The inside of the plane is crammed with people and machinery. Scientists stare at monitors hooked up to air sensors outside the plane. The plane costs $5,000 an hour to operate, and today's flight will last seven hours. It crisscrosses back and forth across the basin in a grid pattern, to better enable researchers to pinpoint the sources of the emissions.

Methane can come from a variety of sources, from a leaking pipeline to a landfill to a feedlot. So in order to find the source, the researchers must analyze the emission's chemical signature: If the methane is accompanied by ethane and butane, it comes from oil and gas fields. If not, then it probably comes from somewhere else.

Getting these "top-down" readings from the air is crucial because it can

provide a snapshot of an entire region. Previously, most measurements were taken at ground level, directly at a potential emissions source, which meant that scientists had to estimate the full scope of methane leaks and VOC pollution. The lack of concrete data meant anti-drilling proponents could cite certain studies that found high leak rates, while industry proponents could point to studies that found the opposite.

"There was no way to get to rational policy discussion," says Drew Nelson, an expert on natural gas with the Environmental Defense Fund, which is sponsoring a series of studies to track down methane leaks and quantify them.

After more than 20 flights, de Gouw sees big differences between different basins. Over in Pennsylvania's Marcellus shale formation, for instance, the researchers found a leak rate of less than 1 percent, compared to parts of Utah, where it was as high as 11 percent. The discrepancy is partly due to the formation's composition: In Pennsylvania, it's almost entirely "dry gas," but out West, the gas is much wetter and requires a lot more processing before it's ready for market. The liquid hydrocarbons are separated from the natural gas at the wellhead, and that creates a greater potential for leaks.

But de Gouw suspects that regulations — or the lack of them — also play a role. In Utah's Uinta Basin, for instance, oil development was supposed to be a short-term project when it began back in the early 1980s. As a result, most pipelines were built aboveground, which is cheaper than burying them, but also leads to higher leak rates. Thirty years later, they're still in use.

Ahead of us, flames erupt in the Guadalupe Mountains. Oil is almost always accompanied by natural gas, and it's often not cost-effective for an oil company to build infrastructure to capture the natural gas released during the drilling. So most of the natural gas, along with other unwanted byproducts, is burned off, a process known as "flaring" that releases pollutants like benzene and VOCs into the atmosphere. De Gouw notes his data show that refiners in Utah are sending around 200,000 tons of VOCs into the air each year, double what producers have reported to the EPA.

Does de Gouw believe that methane leaks are cooking the planet faster than previously thought? The scientist won't say. "I like to keep my opinions out of it," he says. A moment later, the plane dips precipitously and de Gouw, unaffected by the stomach-churning turbulence, politely excuses himself. He turns toward where his computer sits at the back of the plane: "I'm going to go see what the data says." SARAH TORY

Eric Kort, an atmospheric scientist from the University of Michigan and one of the authors of last year's methane hot spot paper, explains how aerial efforts work with the ground campaign to map emissions in the San Juan Basin and elsewhere.

thus displacing methane and pushing it to the surface. They introduced enough uncertainty to obfuscate the official findings.

But even when Amoco's consultants acknowledged that the industry, as a whole, might be to blame for the increased leakage, there was no way to pin a particular seep's behavior on any particular well or company. And since no baseline data existed, there was really no way to know, for sure, that the leakage had increased, dying vegetation notwithstanding. The uncertainty was enough to help Amoco dodge litigation; when the homeowners sued the company, they lost. The company did purchase four contaminated homes and bulldoze them, and it has continued to help fund a multi-agency effort to map, model, monitor and mitigate the seeps. (When I asked BP representatives what they're doing to mitigate leaks in their systems, they told me no one was available to speak to me.) As time went by, and no more homes were contaminated and the price of natural gas crashed, the issue faded from the public consciousness.

Until now.

ERIC KORT, AN ATMOSPHERIC SCIENTIST with the University of Michigan, is the lead author of last year's hot-spot study, and on an April morning he is preparing to lead a forum on methane in Farmington, New Mexico. Kort, who is tall and lanky with a light beard, his hair pulled back into a little bun, is clearly amazed at the turnout. Some 200 people have crowded into a college lecture room to hear scientists talk for four hours about hyperspectral imaging, isotopes and teragrams.

There's a palpable tension in the room, hinting at what's at stake in this fossil fuel-heavy region. Shirley "Sug" McNall, a local who has been butting heads for years with the oil and gas industry over its impacts on air quality, is here, listening anxiously, as are members of regional environmental groups, such as the San Juan Citizens Alliance and Western Environmental Law Center. Officials from the two huge coal power plants west of town, which together with the accompanying coal mines employ hundreds of people, look on somberly. Most anxious, though, are the natural gas industry leaders present, recognizable in part by their uniform: jeans, button-up shirt, fleece vest with company logo.

For them, the hot spot is like a big bull's-eye, centered right over their heads, drawing unwanted attention to them and their industry. The San Juan Basin is one of the nation's most prolific natural gas fields, and the economy was built on the industry's shoulders. As goes national sentiment toward the fuel, so goes the financial fate of Farmington restaurants and Wal-Marts, schools and government. And for now, at least, it appears as if these scientists hold that fate in their hands.

The hot spot is like a big bull's-eye, centered right over their heads, drawing unwanted attention to the natural gas industry.

Beginning a decade or so ago, environmentalists and politicians of all stripes began hailing natural gas as the most potent weapon to dethrone King Coal and reduce carbon emissions. From 2007 to 2010, in fact, the Sierra Club's Beyond Coal campaign was largely funded by $26 million in donations from natural gas giant Chesapeake Energy. Not only does natural gas burn more cleanly than coal, emitting half the carbon and a fraction of the sulfur dioxide, particulates, mercury

and other pollutants; it's also more versatile. Like coal, gas can be used to produce steam to turn turbines that produce round-the-clock baseload power. But gas can also be used to power combustion turbines — similar to jet engines — that can be ramped up to produce juice in a matter of minutes to provide backup for variable solar and wind energy.

As the so-called shale revolution yielded a natural gas glut and decreased prices, the fuel became affordable enough to compete with coal. After chipping away at coal's supremacy for several years, this April, for the first time, natural gas generated more electricity in the U.S. than coal. That same month, carbon dioxide emissions from the electric power sector reached a 27-year low, after steadily declining for the last several years. It was a big win for the climate. Or was it?

In 2011, Cornell University's Robert Howarth dropped a bomb on the natural gas party when he published a study suggesting not only that natural gas wasn't as clean as hyped, but that it may ultimately have a larger greenhouse gas footprint than coal, thanks to methane leakage. Though the study's conclusions and methods remain in dispute, it woke people up to the fact that, in addition to the on-the-ground environmental impacts of drilling, the fuel has a tender Achilles' heel when it comes to saving the climate. Methane has 86 times more global warming potential than carbon dioxide over a 20-year span, and up to 30 times over a century. That means that for every 100 tons of carbon dioxide kept out of the atmosphere, it only takes three or four tons of methane leaking from a pipeline or other infrastructure to offset the gain. Howarth concluded that in order for natural gas to retain its greenhouse gas superiority over coal, leakage rates had to stay below 2.8 percent.

EPA greenhouse gas inventory data show that the national leakage rate is about 1.5 percent, which sounds pretty good. Unfortunately, several independent studies have found that actual emissions are often far higher than what gets reported to the agency. Petron and her colleagues, for example, found that oil and gas production in the Denver-Julesburg Basin in Colorado emitted three times more methane than the EPA inventory showed. And in 2014, Kort, Petron and others published a paper in *Science* documenting that, nationwide, measured emissions were 1.5 times higher than those in the inventory. Now they're trying to see if the same is true here in the Four Corners. To achieve concentrations like those found in this hot spot, says Kort, emissions would need to total about 590,000 metric tons per year. That's upwards of 150,000 metric tons more than the amount all the emitters in the region report to the EPA's greenhouse gas inventory.

Kort had speculated that the increase could result from fugitive emissions that the companies don't know about, like the apparent slow leak in the wellhead that showed up on Petron's monitor, or perhaps from known emissions from facilities that fall below the inventory's reporting threshold. Pipelines frequently rupture, releasing huge quantities of gas: A *High Country News* analysis of data from the Pipeline and Hazardous Materials Safety Administration revealed that ruptured pipes have leaked enough methane since 2010 to heat 170,000 homes for a year. Perhaps hundreds of abandoned gas and oil wells, leaking but unaccounted for, are to blame. If this is true, it could put the coalbed methane field's leakage rate as high as 8 percent.

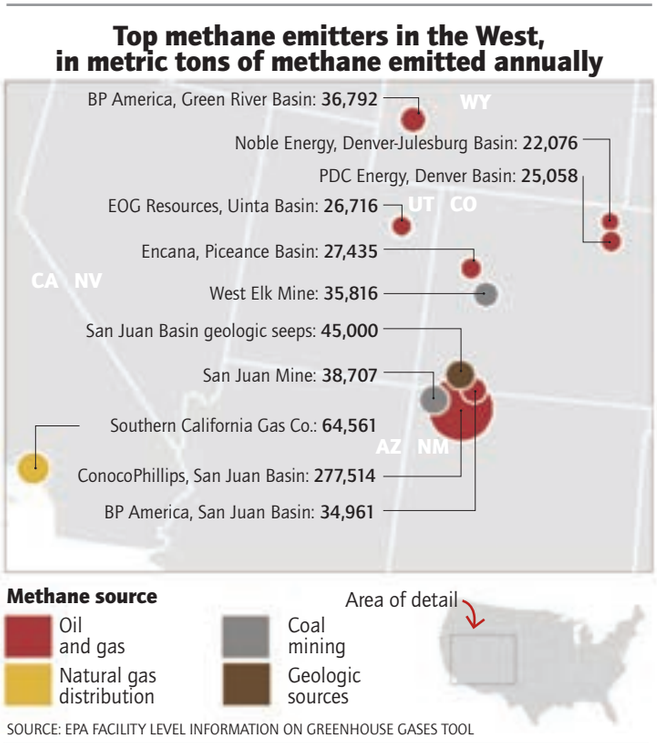
Industry flacks balk at such hypotheses, though. "The San Juan Basin is well-known as a large area of natural seepage — when methane emissions are naturally occurring and not the result of energy development," writes Katie Brown for *Energy In Depth*, a PR outlet for the Independent Petroleum Association of America. Such claims, however, are "little more than a bogus, rhetorical diversion to avoid responsibility and to undermine ongoing rule-making efforts," says Erik Schlenker-Goodrich, executive director of the Western Environmental Law Center.

At the forum, Kort, Petron and other scientists assure the audience that they have no ax to grind, and that they will look at all potential sources, including geologic seeps. This, along with Kort's Zen-like demeanor, seems to ease the earlier tension. The scientists' analysis of what Kort calls a "fire hose of data" won't be published until next year, but ongoing research hints at what they might find. Monitored seeps along the Colorado side of the coal outcrop have leaked more than 45,000 metric tons of methane per year, which has the same warming potential as the carbon dioxide emitted from more than 200,000 cars annually. And still more methane is leaking from other parts of the outcrop that aren't monitored, in New Mexico, or on the Southern Ute Reservation, where data about the seeps has not been made public. The seeps are a significant source. But by its own count, ConocoPhillips' San Juan Basin operations collectively released six times that amount — 277,000 tons — in 2013, making it the largest such emitter in the nation.

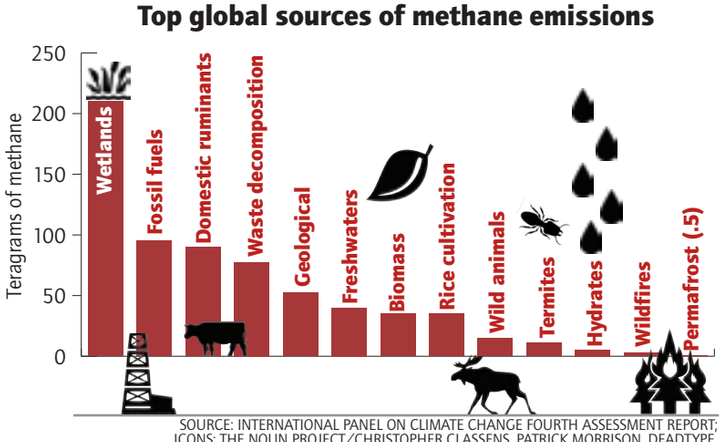
Also lingering is the question of how much, if any, of the seeps' emissions can or should be attributed to the coalbed methane industry. A report published in 2000 as part of the multi-agency project to map, model and monitor the coal outcrop again established a link between drilling and the seeps, but some mystery remains. "How much is natural and how much is exacerbated," Petron says, "it's not something we understand yet." And we probably won't understand it anytime soon. While Hencmann and his colleagues continue to collect reams of data, the stats mostly fall into an analytic void. The researchers have found, for example, that the total emissions from the seeps in their monitoring zone has increased each year since 2007, yet no one is currently trying to determine why. It could be drought, it could be changes in the gas field, or it could be something else entirely. Hencmann hopes the attention on the hot spot will revive flagging efforts to decipher the seeps.

Without understanding the connection between the anthropogenic and the natural seeps, there's no real mechanism for encouraging or requiring companies to mitigate those seeps. Unless we know how much the industry is responsible for, we can't truly calculate the leakage rate of the region's natural gas systems and therefore can't ever really know how big its greenhouse gas footprint is.

A new round of research could have global implications. Similar basins, with similar geologies and seeps, exist all over the world, says Taku Ide, a petroleum engineer who studied methane-fueled fires in the coal outcrop on Southern Ute land. The Intergovernmental Panel on Climate Change estimates that, worldwide,



SOURCE: EPA FACILITY LEVEL INFORMATION ON GREENHOUSE GASES TOOL



SOURCE: INTERNATIONAL PANEL ON CLIMATE CHANGE FOURTH ASSESSMENT REPORT; ICONS: THE NOUN PROJECT/CHRISTOPHER CLASSENS, PATRICK MORRISON, DEADTYPE, HEBERTE ALMEIDA, MEGAN MITCHELL, RICHARD CORDERO

geologic seeps could be emitting as much as 40 to 60 million metric tons of methane per year, putting them on par with landfills or coal mines. "The San Juan Basin is the most advanced in terms of work that's been done to serve as a model, to drive the conversation across the U.S.," says Ide. "It could be a model child." If, that is, the national conversation sparked by the hot spot kicks new studies into gear.

JUST SOUTH OF FARMINGTON, white sandstone cliffs rise from the swatch of green along the San Juan River. From atop these cliffs, you can look out over a landscape that is beautiful and battered, sacred and sacrificed. You can see the nation's energy past, and perhaps its future, from here.

To the west, two massive coal-burning power plants stand in the high desert. Each kicks out more than 11 million tons of carbon dioxide each year, along with a soup of particulates, sulfur dioxide and mercury. When the wind rises, as it does frequently, a fine gray dust lifts up into the air from the multimillion-ton piles of coal-combustion waste piled near the Four Corners plant, its sooty gray stacks juxtaposed against the beige backside of the Hogback monocline.

Environmentalists and Navajo activists have struggled for years to shut down the plants, protesting and filing lawsuits, and recently their efforts have had some success. Four Corners recently shut down three of its five generators to comply with regional haze rules, and San Juan Generating Station plans to shut down two of four units and replace one with a natural gas-fired "peaker" plant — if opponents don't succeed in retiring the plant altogether.

The victories have come in part with the help of an unexpected ally, also visible from this cliff-top vantage point: The coalbed methane and conventional natural gas fields that pockmark thousands of square miles here. Much of this gas is piped to California, where utilities buy it at a relatively cheap price to run power plants, thereby helping to wean themselves from the two coal plants here. President Obama's Clean Power Plan, released this summer, will likely tilt the nation's energy balance further away from coal and toward natural gas, at least until more renewables take hold. That could do more to clean up this area's coal-sullied air and landscape.

But it would also increase demand on, and activity in, the natural gas fields. More wells would be drilled and more pipelines built, providing more avenues for methane to escape, adding to the hot spot and further diminishing natural gas' green cred in the battle to curb climate change. Unless, that is, the gas companies can get a handle on all those leaks.

This summer, the EPA announced an overhauled program designed to get companies to voluntarily clean up their act, and industry officials have promised to comply, since it's in their best interest to keep their cash crop from slipping away. A spokesperson with ConocoPhillips says that the company has already reduced overall emissions by 48 percent on its own, mostly by using "off-the-shelf" solutions. But just 10 of New Mexico's 475 natural gas producers participate in the EPA's current EnergySTAR program, and with natural gas prices so low, there's little incentive to invest much into leak prevention. That's why activists are pressing for strong regulations that will push the entire industry to tighten up.

In August, the EPA released its new rules requiring operators to plug leaks of methane, ozone-forming volatile organic compounds and other toxics on new and modified facilities. They'll also require drillers to capture the methane that burps out of any newly fractured oil or gas well. Since the rules don't apply to existing infrastructure, they will do little to reduce the methane cloud already hovering over the San Juan Basin. But the BLM will hand down its own rules in coming months, and they are expected to apply to these existing facilities. The majority of the wells in the San Juan Basin are under BLM jurisdiction, so the new rules should have an effect on the hot spot. Indeed, Interior Secretary Sally Jewell invoked the Four Corners hot spot when announcing the need for such rules in March. The BLM regulations may resemble Colorado's, implemented last year, which require companies to install leak-detection and prevention equipment and take other measures to reduce emissions. Chris Colclasure of the Colorado Air Pollution Control Division says it's too soon to quantify the effects of the rules, but he believes they work and are not too onerous for the companies. In fact, several energy firms have endorsed the regulations, saying they're good for business.

While some oil and gas lobbyists have portrayed the new rules as an attack on the industry, the Environmental Defense Fund's Mark Brownstein says that compliance won't require that much from operators, many of whom say they're already doing what the regulations require. Whereas the administration's limits on carbon dioxide emissions make it virtually impossible to build a new coal-fired power plant, and are thus aimed at phasing out coal in the long run, the methane rules seem intended to sharpen up the natural gas industry's green credentials, making it more appealing in the future.

The scientists working to decipher the methane mystery remain mum when it comes to specific regulations, but they have discussed what they think needs to be done. "If natural gas is to be a 'bridge' to a more sustainable energy future," wrote Kort, Petron and several other researchers in a paper published by *Science* last fall, "it is a bridge that must be traversed carefully: Diligence will be required to ensure that leakage rates are low enough to achieve sustainability goals."

Back at the gas well behind the high school, Petron lets me flip the little switch that snatches an air sample from the breeze for later analysis. It will tell Petron and Thorley precisely what isotopes of methane are here, and, just as importantly, what other compounds may be seeping out of the well. Methane's not going to hurt anyone in the short term unless it builds up enough to explode, but benzene, another pollutant emitted by oil and gas wells, has both short- and long-term health effects and is a known carcinogen — certainly not something you want your high-schoolers inhaling every day.

As we pull back onto the road and head toward another sample site, Petron reminds me of one simple, enduring fact of life here in oil and gas country: "Your air is being impacted," she says bluntly. "You live on the edge of the gas field." □

Coal from the nearby San Juan Mine is piled up at the San Juan Generating Station in northwestern New Mexico. The power plant emits huge amounts of carbon dioxide, but relatively little methane. The mine, however, is one of the biggest single methane emitters in the region.

Senior editor Jonathan Thompson writes from Durango, Colorado. @jonnypeace

This story was funded by a grant from the McCune Charitable Foundation.

BUSINESS OPPORTUNITIES

Conservationist? Irrigable Land? Stellar seed-saving NGO is available to serious partner. Package must include financial support. Details: http://seeds.ojaidigital.net.

CONFERENCES AND EVENTS

Oct. 7-10, 2015, SHIFT Festival, Jackson, Wyo. An in-depth exploration of outdoor access, responsible recreation, conservation leadership and youth engagement for communities striving to live in balance with nature. Tickets at www.shiftjh.org.

The Public Land and Resources Law Review will host the 36th Public Land Law Conference on Oct. 1-2, 2015. This year's Conference focuses on "Transcending Boundaries: Achieving Success in Cooperative Management of Natural Resources." The opening Keynote Address will be presented by Hilary Tompkins, solicitor, U.S. Department of the Interior.

Sixth Annual Roundtable on the Crown of the Continent Conference, Missoula, Mont., Sept. 16-18, 2015. Please visit www.crownroundtable.org/6thconference2015.html.

EMPLOYMENT

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Rocky Mountain Youth Corps, a Taos, N.M.-based Youth Conservation Corps, is hiring a Development Director. Qualified applicants will have experience in grant writing and management, fundraising experience and donor relations expertise. More information at www.youthcorps.org.

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Director of Development — Located in Crested Butte, Colo., the Rocky Mountain Biological Laboratory is hiring a Director of Development. This individual will help drive revenue growth to support scientific field research and education. For more information, visit: http://www.rmbl.org/about-us-2/jobs/.

Seeking Executive Director — The Gila Watershed Partnership, a nonprofit Arizona corporation, is seeking an Executive Director. Requirements are: Person must reside in Graham or Greenlee counties during employment; have nonprofit administrative experience; write or assist in writing grants for projects and programs; have experience in public communications; and excel in verbal and written communication skills. Details regarding the position may be found at www.gwpaz.org. Please email a letter of interest with résumé to Steve Eady, Executive Director, steve@gwpaz.org, due Sept. 11, 2015, or until position is filled. Applications will be reviewed as received.

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FEMA *continued from page 9*

area where the feds are spending money to build things," says Jeffrey Thomas, a Louisiana lawyer and former FEMA contractor. "Are they compatible with the high aims we are articulating for our cities to be more resilient to climate change?"

A White House task force recently called for reforms, and Obama responded with an executive order in January. He directed federal agencies to create a new standard, one that requires that projects constructed with federal funds be built on higher ground or elevated to withstand the floods expected with rising sea levels, greater deluges and other consequences of climate change. Obama also encouraged FEMA to support green infrastructure projects, such as moving buildings out of floodplains and planting trees and shrubs instead, to soak up floodwaters and make communities more resilient.

It's too early to judge the effectiveness of the executive order, which FEMA has yet to implement. But it wouldn't even address the dilemma faced by mountain communities like Manitou Springs. The necessary fixes, experts say, won't come from FEMA or the White House alone. Lawmakers need to act, but, as Steve Adams, director of strategic initiatives for the Institute for Sustainable Communities, says: "Nobody thinks you could successfully amend statutes at this time because of the Congress."

There are other possible sources of federal assistance for vulnerable communities. The Federal Agriculture Department's Natural Resources Conservation Service can fund projects, even if the destruction doesn't warrant a federal disaster declaration.

There's not enough money, though, to do very much. For example, the program helped buy concrete jersey barriers and sandbags to protect rural developments near Flagstaff, Arizona, against anticipated flooding after the 2010 Shultz Fire. But "what did come was orders of magnitude worse than anyone predicted" and quickly overwhelmed those barriers, says Dustin Woodman, engineering division manager for Coconino County, Arizona. The torrential rain washed soil, trees and other debris down steep slopes into two rural neighborhoods, killing a 12-year-old girl and filling dozens of homes with several feet of mud.

Woodman has spent the last five years designing and funding $30 million in projects to handle floodwaters to protect the Timberline and Doney Park subdivisions outside Flagstaff. He quickly learned that FEMA would fund projects that used concrete or metal pipes to direct floodwaters, but not the green infrastructure favored by many scientists and communities. He sought funding elsewhere for such remedies, like meandering channels planted with grasses and shrubs to absorb and direct floodwaters. "FEMA is focused more on traditionally engineered flood-mitigation structures — levees and retention basins," Woodman says. "Rather than fight that fight, we focused the FEMA funds we had on projects where we wanted to do more traditional projects."

FEMA also resisted when Woodman wanted to use its money to replace a 2-by-4-foot roadside ditch with a channel 10 times larger. "Those public assistance funds are only able to be used for replacement in-kind," Woodman says. That makes it difficult for communities to upgrade drainage ditches, bridges or other structures when risks increase. But since the flooding had already carved a ditch the size Woodman wanted, he was eventually able to get a waiver for that project.

Other towns haven't been as lucky. In Williamstown, near Vermont's Green Mountains, for instance, FEMA paid to replace a pair of culverts four times — after they washed out — in 2004, 2007, 2011 and 2013. Each time, the agency refused to pay to upgrade the corrugated metal culverts, but it spent a total of about $1 million to repeatedly repair the stretch of road destroyed by flooding. Town manager Jackie Higgins remembers telling a FEMA representative in 2013: "You're still only going to put back what was there? You're wasting money." Late that year, Williamstown finally replaced one of the culverts with a much larger concrete structure. The project was funded by the state.

For years, counties have been asking FEMA and Congress to acknowledge that major fires often cause flooding and should be treated as one disaster. Currently, unless each flood is declared a federal disaster, victims likely won't qualify for FEMA's help.

Kayle Higinbotham, 68, lives in an 1880 Victorian ranch house five miles west of Manitou Springs, at the base of Pike's Peak. Her home flooded this spring when a 12-foot-deep gulch next to her house filled up with debris, and sediment washed down from the slopes. But even though three feet of muddy water filled her family room, her house isn't in a mapped floodplain, so Higinbotham doesn't qualify to have it bought out or moved to a safer location. Before the fire, her house and the 60 acres she inherited were valued at $1.7 million. Now, her real estate agent tells her she couldn't find a buyer.

The risk of a dangerous flood is so great that the fire department advised her to leave home during the summer monsoon. When Higinbotham is home, she anxiously monitors the weather and listens for a flood warning on her radio. All this has left her with post-traumatic stress disorder. "You get on your feet from the fire, and then comes the flood," Higinbotham says. "And then you get on your feet from the flood, and here comes the next flood. There's just no end in sight."

The plight of people like Higinbotham has inspired community leaders to compete for federal grants, call for changes in federal policy and even levy new taxes. Other communities, however, have yet to awaken to their increased vulnerability to the bigger fires and bigger storms that are likely on the way. □

Chris Wareham, left, and Andrew O'Banion, of Flagstaff, Arizona, survey damage in Wareham's living room after a wall of water pushed mud and other debris into his house during a 2010 flood caused by erosion from the Schultz Fire.
JOSH BIGGS/AP PHOTO/THE ARIZONA DAILY SUN

This story was funded in part by the New England Center for Investigative Reporting and the Fund for Investigative Reporting.

An even bigger threat to rivers

OPINION BY
GARY WOCKNER

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

If there's any good news to be gained from the toxic spill of mine wastes into the Animas River upstream of Durango, Colorado, it's that public attention has suddenly shifted to the health of rivers in the West.

The 3-million-gallon accident riveted the media, even rating a story in England's *The Guardian* newspaper. Here at home, officials took action almost immediately: Biologists put out fish cages to see if the sludge was killing fish, and chemists began testing the murky water for acidity and heavy metal concentrations. Within a few days, the governor of Colorado, both Colorado U.S. senators, and the administrator of the Environmental Protection Agency — whose contractors triggered the spill — showed up in Durango to express their regret, outrage, support, etc. They promised that it would never happen again.

But of course a disaster is sure to occur again, because there are thousands of century-old abandoned mines in the region that have never been thoroughly cleaned up. And as the saying goes: Acid mine drainage is forever.

Yet while an orange plume of heavy metals moving through a river system toward a major reservoir like Lake Powell is certainly a serious problem, there's another danger targeting rivers in the West. It's the kind of disaster that sometimes kills every living creature in a river, imperils the river's health for weeks and months, causes extensive contaminations of *E. coli* and heavy metals, and destroys the recreational economy — rafting, tubing, fishing — for months at a time.

This disaster is caused by dams. Whether they are large or small, they block a river so that water can be diverted for farms, ranches or domestic use. From its beginnings high on the Continental Divide, for example, the Colorado River loses 90 percent of its flow to diversion in the first 40 miles.

Once the Arkansas River leaves the mountains and heads for Kansas, it becomes a dribble of its former self. The dammed and diverted South Platte River through Denver is often a putrid, algae-ridden and depleted mess, and when it exits town, most of its flow is made up of discharge from Denver's sewage treatment plant.

The Cache la Poudre, near my home in northern Colorado, is sometimes drained bone-dry as it moves through downtown Fort Collins, and when it does have water in it, its native flow is diminished over 50 percent by dams and diversions.

Colorado is just the tip of the iceberg of river destruction. Rivers across New Mexico and Utah are in a similar desperate condition. And in Southern California and Arizona, most rivers are drained completely dry every single year. The Gila River in Arizona, once a large and beautiful tributary of the Colorado River, is now completely dead except during rare monsoon rains that fall perhaps once every 20 years.

But there's worse to come. The states of Colorado, Wyoming, New Mexico and Utah have all just gone through official water-planning processes and are proposing even more dams and river-draining activity. The governor of Wyoming has called for "10 new dams in 10 years." The state of Utah wants to put "a dam on every river in the state," and water agencies in Colorado are proposing large new diversions out of the Colorado River.

In addition, Colorado yearns to retain every legal drop before its rivers cross the state's boundaries.

As you watch the media focus for a while on river health, consider this trivia question: Where was the last major dam and river-destroying project in Colorado?

If you guessed it was on the Animas River, southwest of Durango, you're right. The controversial Animas-La Plata Project erected a huge dam and reservoir, a pumping station to divert water out of the Animas River, and the federal government did it all with virtually no mitigation to offset the impacts to the river.

Were elected officials outraged at this project? No, they celebrated it and named the reservoir Lake Nighthorse after former Colorado Sen. Ben Nighthorse Campbell.

If this plume of poisoned water moving downstream teaches us anything, maybe it ought to be this: All of our rivers are at risk so long as we continue to prevent them from running free. □

Gary Wockner directs Save The Poudre and Save The Colorado, and lives in Fort Collins, Colorado.

Lake Nighthorse, the reservoir filled with water from the Animas River.
SHAUN STANLEY

Writers on the Range is a syndicated service of *High Country News*, providing three opinion columns each week to more than 70 newspapers around the West. For more information, contact Betsy Marston, betsym@hcn.org, 970-527-4898.

Renewal through exploration in Greater Yellowstone

The Wild Excellence: Notes from Untamed America
Leslie Patten
256 pages, softcover: $20.
Wordsworth Publishing, 2014.

It's not that uncommon for weary Californians to uproot from the chaotic coast and replant in the big-skied wilds of the Interior West. Few transplants, however, re-root as deeply or earnestly as Leslie Patten, author of the new collection of essays, *The Wild Excellence*.

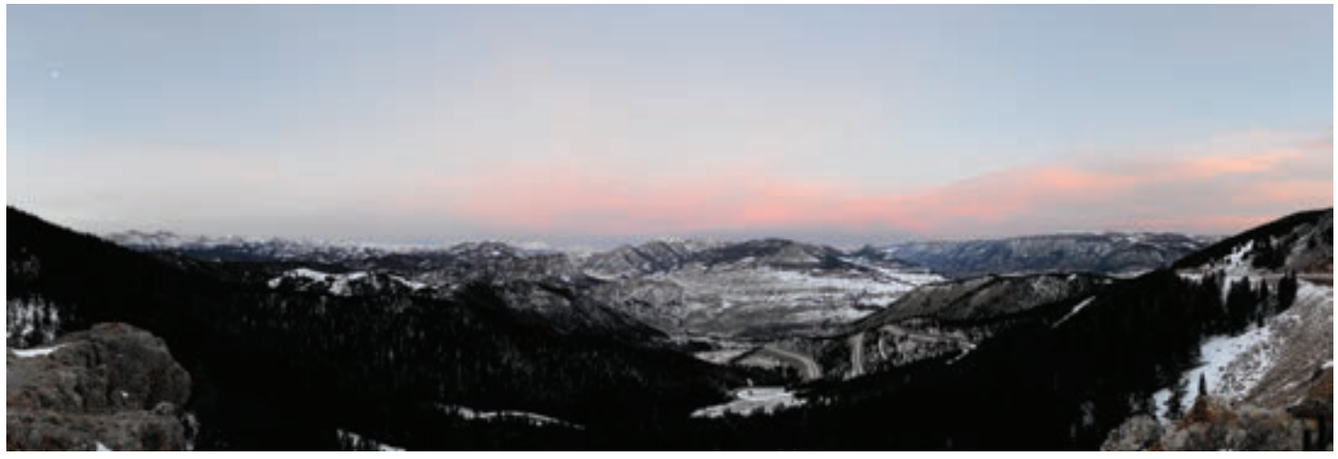
In 2005, the Bay Area landscape designer — fueled by memories of summers spent in Wyoming and a needling urge to cut through emotional unrest with the "sharp edge" of backcountry living — bought a leaky, ragged cabin in Sunlight Basin, 50 miles from Cody. A few years (and cabin repairs) later, Patten, in her early 50s, moved alone to northwestern Wyoming for good. Armed with a rare curiosity and fearlessness, she began exploring her surroundings: the richly forested and glacier-hewed heart of the Greater Yellowstone ecosystem.

Patten's investigation of this landscape, and her place within it, forms the basis of *The Wild Excellence*, which chronicles her "day to day, season by season" integration into habitat as rich in beasts as it is in beauty.

But *The Wild Excellence* is more than a personal meditation on place. From her humble six-acre patch among the pines, Patten has experienced more land-use and wildlife issues than most Westerners encounter in a lifetime. Patten digs into everything, from archaeological preservation to trapping to wolf and grizzly management, probing the bones of each with a thoughtful calm born of research and experience. Her prose is fresh, clean and occasionally profound, as when she describes her approach to the basin's grizzlies: "To walk with the Great Bear," she writes, "one must be alert, fully awake and aware. ... You cannot walk lost in thought, or conversation. You must be present. This alone is a gift that only another top predator can bring to man."

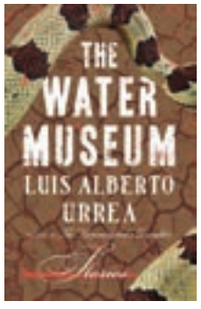
As Patten shares her adventures, from her initially awkward attempts to fence her property and camera-trap local wildlife to her later exploration of her neighbor's — and the area's — homesteading history, it becomes clear that she didn't move to the mountains to idle in a scenery-soaked stupor. Rather, Patten writes, the Greater Yellowstone Ecosystem is an elemental place that seems "to hold the essence of what (is) required to be a human being ... a landscape demanding vigilance and clear-eyed thinking."

BY MARIAN LYMAN KIRST



Sunrise over Sunlight Basin from the summit of Chief Joseph Scenic Highway. SCOTT COPELAND

The lonesome, crowded West



The Water Museum
Luis Alberto Urrea
272 pages, hardcover: $25.
Little, Brown and Company, 2015.

In "Mountains Without Numbers," the first short story in Luis Alberto Urrea's latest collection, *The Water Museum*, a middle-aged woman pages through her high school yearbook before heading into work. Frankie, as the locals call her, owns the only diner left in her washed-up uranium town. "The sky feels like it's on fire as she drives into town," the Pulitzer Prize finalist writes. "Her morning clients are always there before she is. Waiting for her. Feels like the last six people in the West." When she can, she keeps her back to the butte where, for decades, the most daring seniors had scaled the cliffs to paint their graduation date. The dates, the stories — all serve as *memento mori*, painful reminders of better times. "Is a town dead," she wonders, "when the old men die, or when the children leave?"

The stories in *The Water Museum* stretch from South Dakota to California — from divorced Ivy League professors to illegal immigrants — but all of them share a peculiar loneliness. And though in many cases that isolation is buttressed by a stark Western landscape, it is rooted in the insecurities and restless minds of the stories' protagonists. A Chicano graffiti artist slips into reverie after finding strands of long blonde hair stuck to the windshield of a scrapyard vehicle. An Oglala Sioux encounters a white man passed out on the hood of his Volvo on a country road in Wyoming. A widower struggles to follow his minister's advice and "bend like a reed in the wind," even as he finds himself deeply agitated by the influx of immigrants in his community. All of these characters are cut off from the world, lost in their own psychic territory, stumbling in their search for a way back home.

Throughout the collection, Urrea uses both Chicano slang and a rural Midwest vernacular with unassailable authority. These pages are filled with language so electric that you'll want to reread the sentences, relishing Urrea's sharp eye for description. ("Dexter watched her bottom work the bright blue skirt like a couple of tractor motors under a tarp.") But the rich language is simply a bonus; it's the subtle revelations hidden in the stories that satisfy the reader. They reveal themselves in the barest details: "The old motor court sits across the street. And a couple of white houses and two trailers," Urrea writes. "Frankie thinks about how each of those little places is a story."

BY CARSON VAUGHAN

False expectations

Yesterday, an hour before dusk, a black bear padded across my front porch and meandered up the Rocky Mountain hillside through a mix of conifers. It was a mid-sized male with a scruffy coat, disproportionately tiny eyes, and thick haunches that it lifted with every step to accommodate the long claws on its back feet. The bear paused a couple of times, once to sniff the compost pile and once to rub its scent against a tree trunk. Nothing spectacular or particularly personal happened. Yet the encounter still gave me a thrill: A 250-pound wild animal had wandered freely into and then out of my day.

Over the last century or so, as our world population has grown by 600 percent — to more than 7 billion people — wildlife has become ghettoized, cinched into increasingly limited zones. The Wilderness Act, signed into law 51 years ago this September, states that people should remain "visitors" in certain "untrammeled" U.S. landscapes. Yet even in wilderness areas, animals are managed, tracked, counted, collared and culled, lending a surrealistic, *Truman Show*-like quality to the pretense of isolation and free will.

Our encounters with the natural world are increasingly mediated, too, particularly by the moving image. Our experiences of nature on film have led us to expect the same from reality: We demand to see the whale spout, the Komodo dragon spit, the booby dance, the monkey swoop, the African lion make the kill — even though those moments never look quite as good as they did on TV in HD, in the 10-second "money shot" that took a cadre of cinematographers four years of frostbite and celibacy to obtain.

Such dramatic expectations of nature date back at least 75 years, when Walt Disney began to "let nature write the screenplays." (The actual cinematic lineage goes back even further to early nature filmmakers such as Percy Smith, who pioneered time-lapse photography, and Jean Painlevé, who built the first underwater housing for a camera.) As the story goes, Walt was ambling through his animation studios during the production of *Bambi* when he noticed the live footage of a fawn that his animators were using as a model. Walt found the "factual" footage as enticing as the fictional version; he had been striving for the utmost realism in *Bambi*, which was arguably a prescient animal-rights piece about human incursions in the forest. (The film lost money when it was released in 1942, partly due to the vocal outcry of gun-owners and deer hunters steamed about the portrayal of the heartless doe-killing hunter.) By 1945, Walt had hired a couple, Edna and Alfred Milotte, to make a Disney "True-Life Adventure" film, *Seal Island*, in the Alaskan wilderness. It was the first non-animated Disney film, and it went on to win an Academy Award in 1949 — as did seven subsequent others in the series, including *The Living Desert* in 1953 and *The Vanishing Prairie* in 1954.

The films were technically groundbreaking, and they still look stunning today. Their voice-of-God narration, *Fantasia*-like music, and outdoor choreography make them the clear progenitors of every PBS, National Geographic, IMAX and Discovery Channel nature show. Early viewers in the 1940s supposedly asked Disney how he got the animals to "perform" in sync with the sound. While there were no performing animals, the filmmakers did manipulate nature, most notoriously by slinging lemmings off a Canadian cliff during the making of the film *White Wilderness*: It was there that the myth of lemming mass suicide was born.

Last year, a new Disney "True-Life Adventure" film was released, called *Bears*. It begins not in the wilds of Alaska, as the narrator suggests, but on a controlled set with a captive bear giving birth. A quick cut to the exterior of a den elides the switcheroo, and we embark on the perilous mission of a female Alaskan brown bear, dubbed Sky, who is attempting to feed and protect her two anthropomorphic cubs, a "curious" male named Scout and a drowsy "mama's girl" named Amber. The trio must battle a "mischievous, scheming" wolf, Tikaani (the only "character" with an Inuit name) and more. Clearly, mainstream media still has a long way to go in how it portrays wildlife.

It all makes for theatrical viewing, yet could the contrast between that kind of colorful drama and real life trivialize, or even sour, our actual outdoor experiences? Me, I'd rather keep an eye out on my porch for another chance sighting of a live bear, even if I only catch a glimpse of its anonymous haunches. □

Filmmaker and writer Erin Espelie is editor in chief of *Natural History* magazine. She recently joined the faculty in film studies and critical media practices at the University of Colorado Boulder.

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HEARD AROUND THE WEST | BY BETSY MARSTON

CALIFORNIA

The people-magnet at the botanical garden of the University of California, Berkeley, recently was a bilious yellow-green "corpse flower" dubbed "Trudy." Locals always have to wait a long time before the six-foot-tall Sumatran plant decides to open its purple petals, and the wait this time was unusually long — seven years. About 1,000 admirers — the most in more than a decade — lined up, not so much to see the plant, as to smell it. "Dirty socks wrapped around a rotting steak" was one of the more poetic descriptions of the plant's odor, reports KPIX-TV. Another visitor said the plant smelled like a "rotting fish carcass." Carrion beetles or flies are believed to come flying when the Sumatran titan aran prepares to flower, but pollinators have to be quick: The come-hither halitosis lasts only for a day.

WYOMING

Nobody had ever persuaded imperiled sage grouse to relocate their mating grounds until two eight-graders did so this spring, by creating impostor birds out of papier-mâché near Pinedale, reports Angus Thuermer in *Wyofile.com*. Maggie Majhanovich and Nora Legerski worked with state biologist Therese Hartman, who says that studies showed that leks — traditional places where the birds strut, court and mate — lose birds if they're within a mile of oil and gas drilling. In some places, the decline has been catastrophic. "The oilfield is real loud, and it's hard for (the grouse) to hear," explains Maggie. The students used carpentry shims to imitate the birds' splayed back feathers, and faux fur for the white, vest-like chest feathers; they even carefully painted the skin above the birds' eyes a gaudy gold. Because studies show that artificial leks that are too far away failed, they planted their 16 fake male birds slightly closer, wiring them to the ground. A final touch involved playing a recording of the booming chest sounds real males make as dawn arose. Surprise: For the first time ever, decoys worked, luring the birds into the quieter lek. Perhaps best of all for the real birds, the dummies offered no romantic competition. Hartman said that another way to help grouse survive in industrialized areas might be the erection of sound barriers around rigs. The birds are used to a natural background noise of 16 to 20 decibels, but drilling rigs can be as loud as 62 decibels, even from 100 yards away. For the students, the experiment was eye-opening: "If (the birds) were gone, who knows what might happen," asks Maggie. "It would affect other things — everything's balanced." The work isn't over yet; the girls' project will be entered in a science fair next year, so, as Nora says: "Now that we have our data, we have to type everything out."

WASHINGTON **Life skills.** KATHERINE DARROW

ARIZONA

Acting on a social media "tip," 11 armed, self-proclaimed bounty hunters recently swarmed the house of the Phoenix police chief, demanding that he release a fugitive allegedly hiding inside, reports *The Associated Press*. The tip was bogus, and the chief called his office, which sent police out to the standoff. They arrested the leader, Brent Farley, for criminal trespassing and disorderly conduct, and discovered that he was not even a registered bail recovery agent. It turns out, though, that *anybody* can become a bounty hunter in Arizona. Just register yourself with the state, and you can "walk out, go to the local gun shop, buy a gun, handcuffs, and 'Now, I'm a bounty hunter,' " says Joe Burns, former president of the Arizona Bail Bondsmen Association. Burns has been lobbying the Legislature unsuccessfully for years, he explains sadly, trying to mandate training and continuing education in the bail bonds industry.

SOUTH DAKOTA

Too shy? Motorcyclists at the annual Sturgis Motorcycle Rally lacked the necessary get-up-and-go-mostly-nude spirit to beat the world record for "most people assembled in one spot wearing only their underwear," reports the *Jackson Hole News&Guide*. Only 182 people showed up for the photo; the record remains untouched — 2,270 people.

NEVADA

In the last 17 years, Lake Mead has fallen 951 feet, reports the *Los Angeles Times*, and this summer it has sunk to its lowest level in 80 years. So come September, the lake's third and deepest intake pipe will be opened to ensure that Las Vegas stays watered. The reservoir's depletion has meant an upside for boaters: The once-submerged Mormon ghost town of St. Thomas is open for nostalgic sightseers, and a B-29 bomber that sank during a 1948 accident has become visible. The Lake Mead National Recreation Area remains the sixth most popular of the nation's 407 national parks, attracting 7 million visitors a year. But as the reservoir falls and the shoreline expands, there is a downside: Officials have spent $36 million extending boat launches — sometimes more than once.

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 or tag photos #heardaroundthewest on Instagram.

"Small rural radio stations are just as important in their communities as the big stations are in theirs — perhaps more so, since the **smaller communities lack the cultural and educational resources of urban areas.**"

Marty Durlin, in her essay, "CPB pulls the plug on Moab community radio," from Writers on the Range, hcn.org/wotr

Trending

Animas spill

In August, a plume of sludge spilled from a dormant mine and into the Animas River, which flows through Durango, Colorado, before joining the San Juan River, which runs into Lake Powell. The orange pollution plume transfixed communities downriver, as they waited for it to pass through. The spill — caused as the Environmental Protection Agency was working on cleaning up the defunct Gold King Mine — was an ugly reminder of the West's mining legacy. The spill could be an impetus for more meaningful measures to deal with mine waste. New Mexico Sen. Martin Heinrich, D, says he will seek to change federal mining law to allow for the collection of royalties from companies to help clean up contaminants. As for the spill itself, sampling done by the EPA upstream from Durango put the Animas River's water acidity on par with that of black coffee, with elevated levels of iron, manganese, zinc and copper. But by the time it reached town, the acidity had been diluted significantly, and levels of those metals were far lower, though still "scary," EPA officials said. **JONATHAN THOMPSON**
hcne.ws/orange-animas

The orange-tinted Animas River hairpins around a fish hatchery pond in Durango, on Aug. 7, approximately 24 hours after the Gold King Mine spill. JONATHAN THOMPSON

3 million
estimated number of gallons of contaminated water and sludge that flowed from the Gold King Mine in August

400
number of abandoned mines in the Silverton, Colorado, watershed, many of which leak acidic water that dissolves naturally occurring heavy metals, leaving dead zones downstream

1
number of fish that died, out of 108 tested, after being exposed to river water in the first 24 hours after the spill

You say

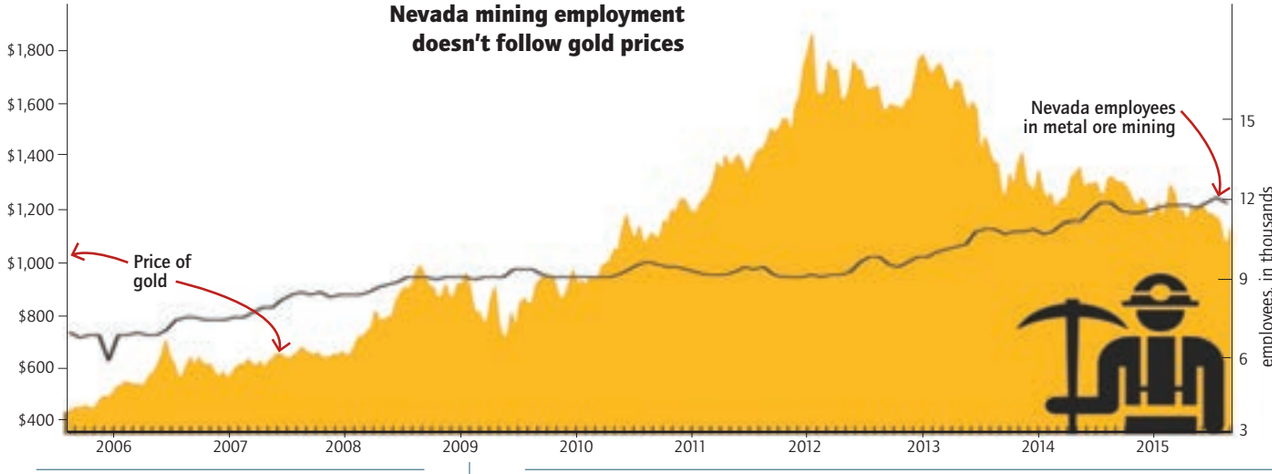
BOBBI MAIERS: "It's not just a Durango issue or a Colorado issue, but an entire Western water issue. Just because some fish haven't died yet doesn't mean there aren't myriad long-term negative effects."

CAROLE CLARK: "I live in New Mexico and am heartbroken for far too many reasons, as far too many unknowns will never be resolved."

MARIA HECKEL: "So very sad to return from a trip on the Green River to this news."

SCOTT CEJKA: "Blame falls squarely on the mining companies who leave their sites with these messes. They are the ones who should be vilified here. And they are the ones who should be paying in perpetuity to fix them."

facebook.com/highcountrynews



Gold in Nevada

Despite the drop in gold prices and stagnation of the industry globally, the gold-mining business in Elko, Nevada, seems to be doing fine. Elko has so far been immune to the downturns of a historically volatile industry. Over the past decade, the number of mining jobs in Nevada has grown 78 percent; the state mines 79 percent of all U.S.-produced gold. In 2013, Elko County alone produced nearly 670,000 ounces of gold, worth — in today's prices — more than $670 million.
PAIGE BLANKENBUEHLER
hcne.ws/NVgold

SOURCES: GOLDPRICES.ORG; NEVADA MINING ASSOCIATION

Quoted

"Racism has always been here — it's never left. Go to the jailhouse. (It's) full of Natives."

—Dean Goggles, chairman of the Northern Arapaho Business Council and cousin of James Goggles Jr., a tribal member shot by a white male at a detox facility in Riverton, Wyoming, in July. Northern Arapaho officials want the killings prosecuted as a hate crime.
SARAH TORY hcne.ws/WYshooting

Video

Birds, salt and a shrinking lake

There are more phalaropes at one time at the Great Salt Lake than are found anywhere else, with more than a third of the population in the world stopping there en route to South America. In the latest in *HCN*'s Wild Science video series, *Migratory birds on the Great Salt Lake*, a scientist looks at salt levels in the shrinking lake and their impact on the invertebrates and birds that rely on it.
DAKIN HENDERSON hcne.ws/phalaropes

DAKIN HENDERSON

"It kind of looks like they're swimming in the sky."

—Maureen Frank, Utah State University

Send letters to editor@hcn.org or
Editor, HCN, P.O. Box 1090, Paonia, CO 81428.

WHEN, NOT IF

Have we learned anything about wildfires and people living in high fire-hazard areas? ("The Bigger Burn," *HCN*, 8/3/15.) The late columnist Ed Quillen got it right when he challenged the "closer to nature" lifestyle of people unconcerned about wildfires until one was knocking on their front door. He called this living in "the stupid zone."

When I work as a consultant with people living in forested areas, I ask them, "What will you do when the fire comes? That's when, not if." I advise them on how to use fire-resistant construction materials and create a safe zone around their homes. But as good as these measures are, they are like putting a Band-Aid on the larger land-use issue. Should people even be living in high fire-risk areas? We have zoned floodplain areas to not allow buildings there. What stops us from zoning high fire-risk forested areas as unbuildable?

Arizona's Yarnell Hill Fire involved protecting homes that really should not have been built on the steep brush-covered hillsides outside of town. The tragedy of this fire is that 19 firefighters died trying to save homes.

Scientists are telling us that climate change conditions will result in an increase in the number of wildfires and their size. Fire scientist and author Stephen J. Pyne has told us it is time to rethink wildfire public policies. But equally important, we must rethink and create new land-use policies that regulate where we build our homes. The alternative is more Yarnell and Pateros "tragedies."

Jurgen Hess
Hood River, Oregon

SUPPRESSION WORKS

"Aerial firefighting: Is it worth it?" (*HCN*, 8/3/15) claims that wildland firefighting from the air has yet to be proven to work. Nothing could be further from the truth. Anyone knowledgeable about wildland firefighting understands that fixed-wing tankers and helicopters have always been used in an initial attack mode. Their mission was never meant to extinguish fires, but rather to suppress them, giving ground-based firefighters safer entry into the burn zone. Aerial firefighters provide time so that ground crews can do the extinguishing and mop up.

As for effectiveness, according to the most recent daily situation report issued by the National Interagency Fire Coordination Center, from Aug. 7 to Aug. 13, there were some 1,200 fires burning

GLENN FODEN/ARTIZANS.COM

throughout the United States. Thanks to the deployment of 25 large air tankers and over 100 helicopters, 96 percent were stopped in the initial attack stage. Without those aerial assets, it's not likely that level of success would have happened.

As for the argument that chemical retardants are environmentally harmful, we understand they aren't perfect. However, the Forest Service continues to refine retardant specs to make them more environmentally benign and engage in studies with a goal of making retardant more effective. Those studies, according to the Forest Service, should be completed within the next few years.

George Hill
American Helicopter Services and Aerial Firefighting Association
Washington, D.C.

FIGHT AT NIGHT

Your Aug. 3 article treated only one aspect of aerial firefighting — daytime activities, when fires are most active. Firefighting officials seem to have ruled out aerial operations at night when the fire has "laid down" and most often is not active. We see instead the photo ops of planes attacking fully active fires in the afternoon when no suppression activities can be effective. Thus, the aerial methods can easily be characterized as expensive and ineffective.

The problem is that any study of fire suppression over the past decade or more shows that no methods are effective. After 2010's Cerro Grande (40,000 acres) and 2011's Las Conchas (150,000 acres), examination showed that nowhere could we see that suppression efforts, costing millions of dollars, had made any difference.

Over the past 15 years, New Mexico and Arizona have lost approximately one-quarter of their conifer forests. Extrapolation of this rate, with current suppression methods, leads to the conclusion that in the next two decades, half or a third of these forests will be gone. Continuing to use outdated methods makes no sense. We have only two options: Change the way we fight fires, or lose our forests. There is no third option.

One solution is to fight fire from the air at night. This is often ridiculed by professional firefighters, as might be expected, since it would change an entire industry. But consider this: In the 21st century, we can use infrared imaging from drones or other aircraft to know exactly where a fire is at night. Tankers coming in at three-minute intervals can put some two acre-feet of water on a fire in one 14-hour period, when the fire is hardly active. Few fires can survive this.

In most cases, a fire can be put out in one night, allowing ground crews to safely finish the job. Once the proper techniques of attack are learned, we would have options to allow a fire to burn if beneficial (this includes prescribed burns), or to put it out. We would have real fire management ability. Such suppression would buy time to thin or otherwise make our forests healthy.

People say this would be too costly, but compare it with the costs of continuing current ineffective suppression methods added to the costs of forest loss.

It is time to seriously look at nighttime aerial suppression. The alternative is to continue to lose our forests, homes, businesses, historical structures and cultural assets.

Charles Keller
Los Alamos, New Mexico

High Country News

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Last plants standing

The Clean Power Plan is a blow to the struggling coal industry, but not the fatal one

BY CALLY CARSWELL

On a Thursday afternoon in early August, Wyoming's governor, both its U.S. senators and its lone House representative joined dozens of coal miners and other locals in a library in the town of Gillette. The Bureau of Land Management — under pressure to reform its coal-leasing program — was holding a listening session on royalty rates for federal coal, and Wyoming's political heavyweights had opinions to share.

They all vigorously opposed raising the rates. But the frustration and fear they expressed had at least as much to do with President Barack Obama's announcement a week earlier that power plants would soon have to answer for their carbon pollution.

Finalized Aug. 3, the Clean Power Plan sets carbon-reduction targets for 2030, for states and tribes with power plants. Nationwide, the plan is expected to yield a 32 percent cut in emissions from 2005 levels. From an environmental perspective, this is momentous: Carbon dioxide is easily the most abundant power-plant pollutant, and until now, the federal government has completely neglected regulating it at existing facilities. But Wyoming, which mines 40 percent of the nation's coal and claims 23,000 coal-related jobs, sees the plan as an existential threat. "What's happening to coal right now is a disaster for this state," Gov. Matt Mead, R, told BLM officials. "We just ask that you don't kill the golden goose," Republican Sen. Mike Enzi added. "If we put them out of business, it will ripple through the entire economy."

It's worth remembering that while Obama and the U.S. Environmental Protection Agency had some choice in *how* to regulate carbon dioxide, they had no choice in *whether* to regulate it. Supreme Court decisions since 2007 have affirmed that carbon is a pollutant the EPA is legally required to control.

Still, the coal states' hostility is understandable. Coal is responsible for 75 percent of the electricity sector's carbon emissions, and aside from improving energy efficiency, the easiest way to cut climate-changing pollution is to start burning less of it There's room under the plan for natural gas, wind and solar to grow, but barring major advancements in carbon-capture technology, coal has no option but to shrink.

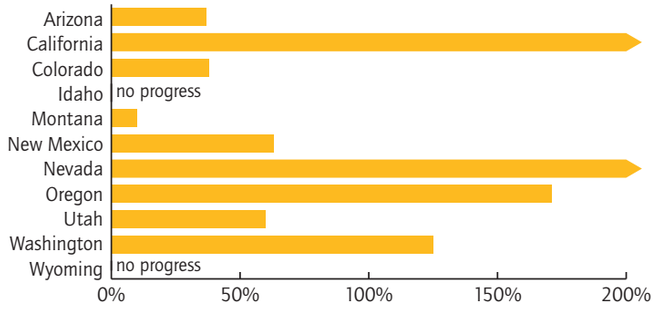
Despite this, the plan isn't a certain deathblow for the West's oldest facilities. That's partly because a number of those units are already slated for closure, either to comply with federal regulations to clear haze from national parks and wilderness areas, or to meet states' carbon goals. Any shutdowns after 2012 will count toward the 2030 targets and could go a long way toward helping to meet them.

Take the Navajo Generating Station and Four Corners Power Plant, both of which sit on the Navajo Nation. Under the Clean Power Plan's draft version, released last year, the Navajo would have

Please see **Power Plan**, *page 6*

HCN Contributing Editor Cally Carswell writes from Santa Fe, New Mexico. @callycarswell

STATE PROGRESS TOWARD 2030 CLEAN POWER PLAN TARGETS



Percentages indicate estimates of how close states will get to their 2030 goals using the plans they already have in place, based on rates of CO_2 emissions, a common method of measuring EPA compliance.

SOURCE: UNION OF CONCERNED SCIENTISTS

Snapshot

Wild graffiti

Urban vandals target Western parks

National Park System, vandalism of natural features, like rock faces and trees, has risen steadily in recent years, with more than 600 incidents reported since 2013. The hardest-hit areas are near large urban centers – such as Lake Mead National Recreation Area, a mere 39 miles from the Las Vegas Strip.

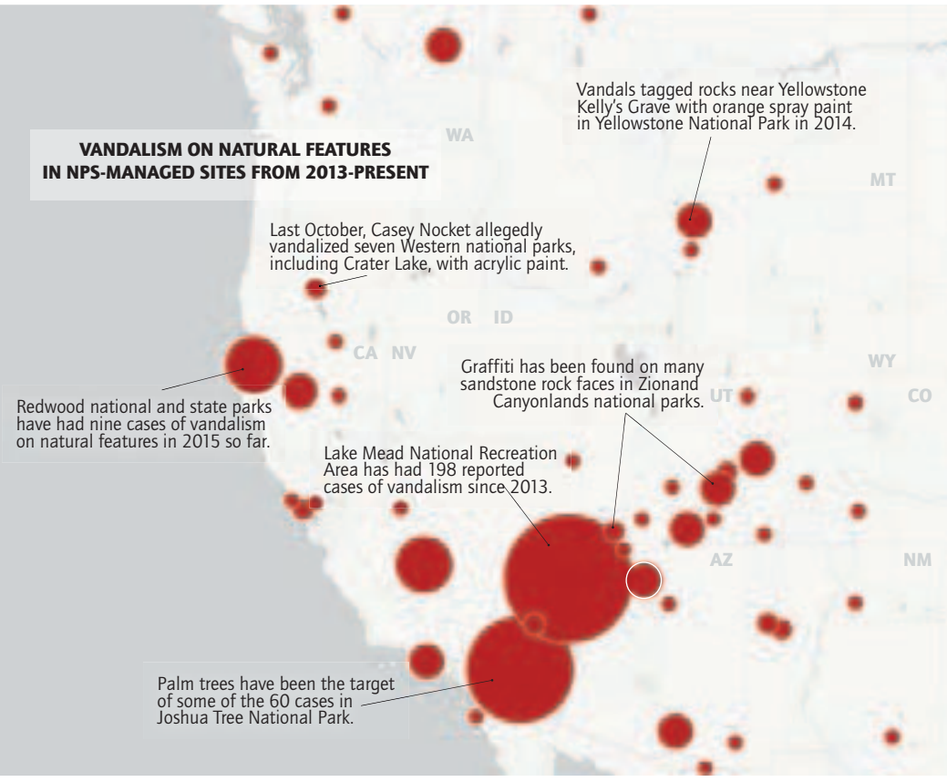
Joshua Tree, located about two and a half hours east of Los Angeles, had to close portions of its historic Barker Dam in February 2013, and, months later, it closed Rattlesnake Canyon as well. Superintendent David Smith says the vandalism ranges from run-of-the-mill high-school-type inscriptions ("Nancy ♥ Carl") to gang tags and unwanted works of "art," like the bright blue giraffe hikers found on a boulder in February.

This year, there have been more than 150 incidents in the Pacific West and Intermountain West regions. Such vandalism is difficult to undo, though workers can scrape off paint with spatulas, or use chemical treatments, provided they won't damage archaeological features.

People "have a desire to leave a permanent mark," says Smith, "but the difference between prehistoric times and now, is we have other mechanisms to leave a permanent record without defacing or destroying something that belongs to every American." **GLORIA DICKIE**

SOURCE: NPS

VANDALISM ON NATURAL FEATURES IN NPS-MANAGED SITES FROM 2013-PRESENT



Power Plan *continued from page 5*

been required to cut emissions by 6 percent, an easy goal since three units at Four Corners were idled in 2013, and one at the Navajo Generating Station will likely close in 2019. In the end, the EPA revamped how it calculated the targets, and the reservation's goal leapt to at least 38 percent. And that's a goal that the planned closures at the two plants could still achieve — or at least come close to — under one of the EPA's proposed compliance options, according to a rough calculation provided by the Natural Resources Defense Council.

One way or another, the states that are most reliant on coal will have to do more to cut pollution than they're currently planning, which is very little.

Similarly, New Mexico's existing renewable energy and efficiency standards, plus the planned closure of two units at the San Juan Generating Station, seem likely to put the state within striking distance of its 2030 goal. PNM, New Mexico's largest utility, agreed this month to reconsider the remaining units' future in 2018, and environmental groups remain hopeful it will abandon San Juan. Since the EPA is encouraging participation in emissions trading markets under the Clean Power Plan, PNM might even stand to profit from closing more units. If it reduces emissions more than required, it will have credits to sell on the market, explains Steve Michel, an attorney with Western Resource Advocates.

In the West as a whole, says Noah Long, director of NRDC's Western Energy Project, some additional coal-fired units will have to be shuttered to meet targets, even if it's currently unclear where those closures might happen. And one way or another, the states that are most reliant on coal, like Montana and Wyoming, will have to do more to cut pollution than they're currently planning, which is very little.

As the West's largest coal economy, Wyoming in particular faces big changes. Rob Godby, a University of Wyoming energy economist, says the concern is less how Wyoming will meet its own target than how other states — its coal customers — will meet theirs. Godby led a recent study that found that the regulations could reduce Wyoming coal production by 34 to 50 percent. How big the hit will be depends in part on how much coal power Wyoming's customers will have the option of keeping, which in turn depends on whether emissions can be offset elsewhere, by improving energy efficiency or buying emissions credits. "This isn't the death of coal," Godby says, but it is a formidable new challenge.

In the short term, the coal industry's wellbeing hinges primarily on gas prices. In the long run, however, carbon limits are one of its greatest threats — one it and the states it bankrolls may no longer be able to evade. □

Triage in the Arctic

Ancient artifacts in the thawing North are disappearing before archaeologists can document them

BY KRISTA LANGLOIS

We're speeding along a gravel spit north of Barrow, Alaska, plumes of dust rising behind our four-wheelers, the Arctic sea ice blindingly bright, when archaeologist Anne Jensen hits the brakes. "Hang on," she mutters, jumping off the machine. "I think I saw something."

Jensen stands with her hands on her hips, peering down at a human femur that's lying on the gravel as if dropped from the sky. In fact, the opposite is true: Just as cycles of freezing and thawing can churn up new rocks in a garden each spring, so the tundra occasionally spits out long-buried artifacts. Kneeling next to the bone, Jensen estimates it's a thousand years old.

In most places, the old is constantly replaced by the new, the bones and tools of our ancestors devoured by soil bacteria or washed into the sea. But in the Arctic, long winters, frozen soil and a dry climate have preserved remnants of the past in startling completeness. Jensen, senior scientist for the Ukpeaġvik Iñupiat Corporation, once unearthed an 800-year-old girl in Barrow whose skin, hair and stomach contents were perfectly intact. In comparison, she once tried to exhume a pair of draft horses in Pennsylvania that had been buried 70 years earlier and recovered only a bit of brass from their harnesses. "Not even tooth enamel — nothing!" she says, incredulous.

The organic remains that linger in Alaska's Arctic have allowed archaeologists to sketch a rough picture of early North Americans' migration routes and daily lives. Yet because the summers are brief and the distances so vast, much remains undiscovered. Where did Paleo-Eskimos come from, for example, and why did they disappear? Why did some groups survive climatic swings while others died out?

Jensen has spent decades chasing such questions. There were always more sites to excavate than there was money or manpower, but she spent winters working contentedly in her lab, knowing that whatever she didn't get to one summer could be explored the next. "If something stays frozen, it can be incredibly long-lived," she explains. "But once permafrost goes away, that kind of stuff will rot in no time at all."

Today, with climate change accelerating the rate of thawing permafrost and

HCN correspondent Krista Langlois lives in Durango, Colorado, and frequently covers Alaska. @KristaLanglois2

An archaeological field crew screens excavated soil to recover small artifacts and faunal material that might have been missed in the main excavation at Walakpa in 2013. Sites like Walakpa have many intact artifacts, but they are slowly eroding into the sea. COURTESY ANNE JENSEN

coastal erosion, archaeological sites across the Arctic are being exposed — "incredible amounts of information that we didn't know existed 10 years ago," Jensen says. But just as quickly as they emerge, the sites are lost again, rotting into earth or tumbling into the sea. Jensen is forced to perform triage, deciding which to ignore and which to save.

Gently wrapping the femur in her parka, Jensen scans the broken ice, which floats scattered across the ocean even in mid-June. The temperature is in the upper 30s and feels even colder, but it's warm by Arctic standards: Every year, the shelves of floating ice form later and melt earlier, and 2015 is shaping up to be among the lowest sea-ice years on record.

With less ice to break their force, waves build up and storms hit the coast with greater ferocity, accelerating erosion. Craig Tweedie, an Arctic ecologist and colleague of Jensen's, has transposed aerial photos from the 1940s onto modern maps and calculated that the coast where we're now standing is eroding at a rate of 10 to 12 meters a year. Not only that, but storm frequency may be increasing, and sea levels, of course, are rising. "Anne is running in crisis mode all the time," Tweedie says. "It's like she's literally trying to catch these things as they're falling off the cliff."

In 2013, Jensen was at a conference in Iceland, giving a presentation about how climate change is impacting Arctic archaeology, when she got an email: A group of ATVers from Barrow had found a sod house crumbling out of a bluff at an old hunting camp called Walakpa. Jensen had known that Walakpa existed — it was partially excavated in the 1960s — but the photos showed a more extensive, deeper and more intact site than anyone had imagined. Plus, because its layer-cake stratification spanned millennia, Walakpa had the potential to provide a unique record of daily life during the time when the Birnirk culture was dying out and the ancestors of today's Inupiat rose to dominance. Had there been war? Some natural disaster? Or did one culture gradually transition into the other?

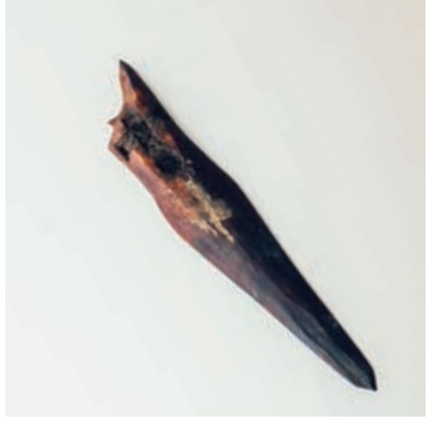
As soon as she got home, Jensen rushed out to Walakpa. She found artifacts spilling out of the dirt: carved ivory harpoons, a baleen spoon, waterproof bags made of skin. There were whale skulls, walrus tusks and thousands upon thousands of bones left over from successful hunts.

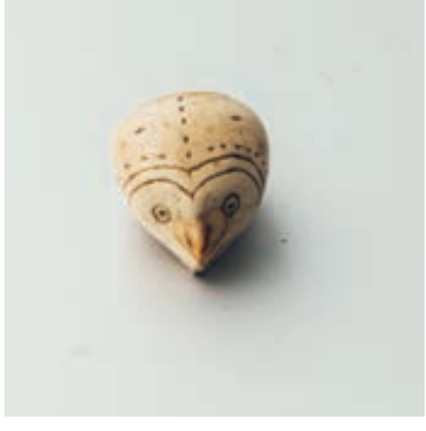
Jensen believed that artifacts from Walakpa could help determine whether the Birnirk people, who disappeared around 1000 A.D., were directly related to today's Inupiat — which could strengthen the tribe's argument for the repatriation of Birnirk remains from the Smithsonian. But she never got the chance to find out. Before she could secure funding from the National Science Foundation, a storm sent a 30-foot chunk of the site — including the oldest layers — crashing into the Chukchi Sea. "Three thousand years of pre-contact history, gone," she says, shaking her head.

As places like Walakpa disappear, we're losing a record of not only ancient humans, but also the environment they lived in. Because of Walakpa's location at the confluence of freshwater, marine and terrestrial hunting grounds, it offers an environmental record similar to an ice or bog core, but with samples from a wider variety of places — the next best thing to a time machine, Jensen says. Plant pollen, for example, can offer clues to how wet or dry the weather was. Walrus tusks reveal where the animals were feeding. Ring seals' body size directly corresponds to how long they spend on ice as juveniles, so bigger seal bones indicate periods of more stable sea ice. Combined with existing climate reconstructions, this knowledge can help scientists create more reliable climate models: the better such models simulate the past, the more confidence we gain in their predictions for the future.

"Ancient people have left behind these signals to tell us what their environment was really like," Tweedie says. "They could provide one of the only mechanisms we have to validate modern-day science."

Out on the gravel spit, the wind is picking up and the temperature dropping. Jensen's cheeks are red. Using a bungee cord, she secures the wrapped femur next to the polar bear gun on her ATV, and we start back toward town. On the way, Jensen thinks she sees another bone. But when we stop to look for it, there's nothing there but shifting gravel and the endless wind. □





Two ivory harpoon heads found at Walakpa in 2013 and an ivory toggle or bag fastener found at Nuvuk in 1998. FLORENCIA MAZZA RAMSAY

Washington Gov. Jay Inslee. SHORELINE COMMUNITY COLLEGE

THE LATEST

Backstory

Last year, **environmentalists spent millions of dollars on state-level elections in Oregon and Washington, hoping to secure sympathetic legislative majorities** ("Climate catalyst," *HCN*, 11/24/14). They needed only two more seats in Washington's Senate to tip the balance there, giving Democratic Gov. Jay Inslee an opportunity to pass laws to cut the state's carbon emissions. They didn't win those seats.

Followup

Inslee's cap-and-trade proposal failed this year, and in late July, the governor criticized state lawmakers for doing "zero, nada, zilch" to address climate change in remarks to a local newspaper's editorial board. Inslee had just directed the Washington Department of Ecology to begin a rulemaking process under the state's Clean Air Act to cap carbon emissions. It's not yet clear how aggressive the cap will be, and the process is expected to take at least a year. **Activists are separately pursuing 2016 ballot initiatives that would tax carbon or otherwise charge polluters for emissions.**

CALLY CARSWELL

The recovering coastline at the mouth of the Elwha River, August 2015. ANDREW RITCHIE/NPS

THE LATEST

Backstory

In September 2011, **two dams on the Elwha River in northern Washington, which between them supplied power for a single paper mill, were taken down to help struggling salmon runs**. One of them — Glines Dam — was the largest ever removed in the country. Federal and tribal biologists were thrilled: Because most of the Elwha is on national park land, development and pollution were not a factor in river restoration ("Rebuilding a river as Washington's Elwha dams come down," *HCN*, 9/19/11).

Followup

Now, new studies show that the dam removal is not only helping salmon populations recover; it's also rebuilding beaches. **Long-trapped sediment has washed downstream to the mouth of the Elwha, allowing diminished beaches to return and slowing coastal erosion**. Salmon have returned to stretches of the river that hadn't supported spawning for more than a century. Unfortunately, the fish are still under stress: The same unusually warm waters that have been killing salmon around the Northwest are affecting them as well.

PAIGE BLANKENBUEHLER

Cultivating climate literacy

A Montana farm group is fighting political polarization with pragmatic discussions about climate change

BY SARAH JANE KELLER

This June, at the western edge of the Montana prairie, several dozen farmers and ranchers in baseball caps and jeans gathered at Great Falls College to learn how to deal with climate change impacts: hotter growing seasons, reduced wheat yields, more severe storms, less rain in eastern Montana, and earlier snowmelt statewide, meaning less water for later in the growing season. Fabian Menalled, an affable noxious-weed scientist from Montana State University, spoke about the already aggressive heat-and-carbon-dioxide-loving cheatgrass, which could consume even more rangeland in the future. Yet, as Menalled acknowledged, only 40 percent of Montanans think that humans are causing global warming, compared to 97 percent of scientists.

The farmers in the audience either sided with the scientists or were too polite to disagree; there were no walkouts, or even skeptical questions. That's likely because climate change is getting harder for farmers and ranchers to ignore. The weather in recent years looks a lot like the extreme conditions scientists projected: floods in 2011, severe fires in 2012 and record-breaking hail damage in 2013. All that leads to lost income and the fear that crop insurance will be tougher to buy.

In a 2014 study, University of Montana ecologist Brady Allred found that the U.S. states richest in natural resource and agricultural lands are also the most likely to get hotter and drier. Those states — including Montana, where agriculture is the largest industry — also elect congressional representatives that resist climate change mitigation or adaptation policies. Agricultural lands are among the most vulnerable, says Allred. "And if (we) have this leadership that is not as likely to think about adaptation or mitigation policies going forward, that presents a concern."

The Montana Farmers Union is attempting to temper the partisan polarization around climate issues by inviting scientists like Menallad to forums and publishing scientific reports about what farmers can expect in the warming region. The Farmers Union has always focused on protecting family farmers, and its leaders worry that smaller operations will feel the impacts more acutely than large agribusiness. The risks to its members' livelihoods now outweigh any political fallout that could come from discussing the issue, says the union's president, Alan Merrill: "We just want to make people aware of what is happening. Learn what you can do on your operation, learn how to cope with what is happening right now."

Montana's other traditional ag groups have yet to take formal positions on climate change. Chelcie Cremer, the director of state affairs for the Montana Farm Bureau Federation, says that's because their members haven't sought more information. In the past, however, her group campaigned against cap-and-trade legislation that could impose costs on producers. But now, farmers' unions in the upper Midwest, Kansas and New England as well as Montana are confronting the issue. Merrill credits the National Farmers Union's willingness to tackle controversial topics, such as lobbying for country-of-origin labeling.

"It does sort of feel like we're reaching a tipping point where it's OK to talk about it now," says Montana Department of Agriculture Director Ron de Yong. "Farmers and ranchers, even if they aren't reading about it, they are experiencing it on their own farms."

Farmers are adapting, de Yong says. Merrill, who grows wheat in central Montana, has found that the planting schedules his father taught him no longer work on his farm, and Montana State researchers are developing spring wheat that matures faster to beat hotter, drier June weather. De Yong's office is encouraging producers to plant a more diverse array of crops as insurance against the erratic climate and volatile commodities markets. Montana farmers have taken advantage of high pea and lentil demand, rotating those drought-tolerant crops with wheat. No-till agriculture, which helps keep water in the soil and sequester carbon, is also becoming popular, as are cover crops like millet and soybeans, which help fight weeds and hold soil in place during intense rainfalls.

At a question-and-answer session in Great Falls, a farmer mentioned that irrigation season in western Montana started two weeks earlier than normal this year and was followed by an unusual frost. "Are these surprises, or are these things that we should be expecting?" he asked a panel that included de Yong, Menalled and Justin Derner, a rangeland scientist who runs the Northern Plains "climate hub" for the U.S. Department of Agriculture. The climate hub is part of a new network of regional climate centers that provide producers with data and help them solve problems like new pests or the need to switch seeds. Derner didn't miss a beat: "I think those sort of things are the new normal."

Rancher Rich Liebert stood up to say he wished Menalled would take his talk to Montana's elected officials. Two of the state's three congressmen have expressed skepticism about humans' role in causing climate change. But the panel's moderator quickly moved the discussion along, trying to avoid politics. "In their hearts, they know it's happening," Liebert said later, of his fellow food producers. "I think secretly there are farmers that vote red, but they are thinking green." □

Fabian Menalled speaks at the Montana Farmers Union talk at Great Falls College. He is one of the scientists helping local farmers understand how climate change is likely to impact agriculture. EVAN FROST/GREAT FALLS TRIBUNE

Sarah Jane Keller writes from Bozeman, Montana. @sjanekeller

A man looks over mud and debris left by a flood in Manitou Springs, Colorado, in 2013. The town was made vulnerable to severe flooding after the Waldo Canyon Fire burned vegetation in the foothills to the west. BRYAN OLLER/AP

Where FEMA fails

Despite increasingly severe fires and flooding, pre-disaster money is in short supply

BY ELIZABETH SHOGREN

When the 2012 Waldo Canyon Fire was finally snuffed out, the residents of Manitou Springs, Colorado, a small town on the Front Range of the Rocky Mountains, breathed a collective sigh of relief. The community had narrowly escaped what was then the most destructive fire in Colorado history. Not long afterward, Mayor Marc Snyder gave a tour to Carol Ekarius, the executive director of the Coalition for the Upper South Platte, a nonprofit that works to protect the watershed southwest of Denver. As the two walked through the picturesque town, with its eclectic historic buildings tucked between Pikes Peak and the Garden of the Gods, Ekarius pointed out structures she predicted would be damaged or destroyed when, inevitably, there would be flooding off the scorched slopes rising above them.

Snyder initially was appalled by this unsolicited warning. Ekarius, however, was persuasive: She had seen floods devastate her rural watershed in nearby Teller County after the 1996 Buffalo Creek Fire and again after the 2002 Hayman Fire, with catastrophic consequences for one of Denver's main reservoirs. "I wish I didn't have a crystal ball, but I've seen it so many times after fires in the mountains," Ekarius recalls. Snyder quickly recognized the danger his community faced, and he began trying to raise money to upgrade its drainage system — the best way, he thought, to avert impending disaster. "The consensus was it was coming, whether it came in year one or year 10," he says. "It keeps you up at night, let me tell you."

The town applied for funding from FEMA, the Federal Emergency Management Agency, but the small amount Congress allocates to protect vulnerable communities before disaster was already depleted. Unable to upgrade the drainage system, town officials installed new emergency warning sirens, warned residents and steeled themselves for the calamity they knew was coming.

On Aug. 9, 2013, it arrived. Snyder spotted a heavy storm brewing over the mountains. "I'd been living under this shadow of doom for about a year," he says. "I remember looking over and seeing that ominous dark cloud over the burn scar, and I thought: This is it."

As rain pounded the charred slopes, a wall of muddy water carrying rocks, trees and other debris raced off them and raged through town, overwhelming the old drainage system. The torrent was so strong that it picked up cars on the highway and swept them downstream. Two people were killed nearby and dozens of homes and businesses were destroyed or damaged. So was the storm water system.

Afterward, FEMA's largess flowed, helping to repair City Hall and paying for much of a new $6 million drainage system. But upgrading it before the flood would have cost far less, and much of the destruction could have been averted. So why wasn't it?

FEMA says it receives requests for several times more funding than it has available each year for preventive projects. "There's a clear need there," says Michael Grimm, director of the risk reduction division of the federal insurance and mitigation administration at FEMA. (In recent years, President Barack Obama has asked Congress for more funding for pre-disaster hazard mitigation, but Congress has allocated only $25 million. In his 2016 budget request, Obama is seeking eight times that much, $200 million — though the likelihood of getting that is small.)

But the shortage of pre-disaster funding is just one of the ways that FEMA is out of sync with community needs, now that climate change is impacting the West. A close examination reveals policies that discourage upgrades to help structures withstand larger floods; favor flood control using pipes and pumps, instead of systems that mimic nature; or provide aid to communities damaged by floods after wildfires only if each flood has been declared a national disaster.

Billions of dollars are at stake. "Outside of defense spending, this is the biggest

Please see **FEMA**, *page 23*

Correspondent Elizabeth Shogren writes *HCN*'s DC Dispatches from Washington. @ShogrenE

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True Grit #2, 2008. DAVID BRADLEY

INDIAN COUNTRY: THE ART OF DAVID BRADLEY
Curator: Valerie K. Verzuh
143 pages, hardcover: $34.95
Museum of New Mexico Press, Santa Fe, 2014

"My art is about my life," says David Bradley, who was born in Eureka, California, to a white logger father and a mother who was a member of the Minnesota Chippewa Tribe. Though his childhood was challenging, his artistic talent blossomed early, and the two years he spent in the Peace Corps in Guatemala introduced him to folk art's vivid colors and social consciousness. His identity as an artist living in two worlds deepened after he enrolled at the Institute of American Indian Art in Santa Fe, in the late 1970s. Bradley's lively paintings reward close attention, revealing his sense of irony and enough humor to make you laugh out loud. But ultimately, he says, he looks to the land for inspiration: "The landscapes and the earth speak so loudly to me here. If I have a problem, I just step outside and am awed by what I see all around me."
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Summer visitors

Here in Paonia, Colorado, home of *HCN*, the peaches are ripe, the sweet corn is in and a series of monsoon thunderstorms has left the normally dry fields lush and lovely. We've had an abundance of visitors, too, and are always delighted to see our readers in person!

From Boulder, Colorado, came **Dennis Tharp**. He'd been hiking near the mountain resort town of Crested Butte, drove over the pass to the North Fork Valley, saw our sign and popped in to say hello.

Al Schroder and **Joan Groff** of Tucson visited the office for the third time since subscribing a decade ago. The pair were happy to have left 110 degree weather behind; they were on their way to visit Joan's father in Pennsylvania and enjoying a three-month camping trip. We'll give them a punch card next time!

Boise, Idaho, residents **Susan Weiner** and **Bruce Acherman** came by *HCN* headquarters "to see where the magic is made" while overseeing the groundbreaking of the new home they're building in Montrose, an hour southwest of Paonia. They hope to relocate from Boise next year. Welcome to the neighborhood!

Scott Hall of Farmington, New Mexico, dropped in to pick up another copy of a March issue; someone in his office, he said, absconded with his own. Scott, who works as a realty specialist for the local BLM field office, was on his way home from a vacation in nearby Glenwood Springs, sporting a bit of sunburn from a rafting trip.

Longtime reader **Marith Reheis**, a retired geologist from Golden, Colorado, stopped by with her husband, **John Cady**. The two were on a six-day road trip after Marith, who still works occasionally for the U.S. Geological Survey, did some soil sampling near Mesa Verde National Park in southwest Colorado. Marith has been a reader since 1975, when some friends at the USGS introduced to her to *HCN*.

Lynn Myre of Louisville, Colorado, a longtime reader, and her daughter, **Brianna Wilensky** of Glenwood Springs, made a special trip to Paonia just to see us in action. Lynn got her daughter a gift subscription and hopes to come back soon to check out the whole town. Lynn visited once in the 1960s, back when Paonia was just a "cute little farm town" without paved roads. Now it's a cute little farm town with paved roads.

CORRECTIONS

In our July 20 issue, the story "Living the dream, plus overtime" referred to the Bob Marshall National Forest, accidentally compressing two names; we meant the Bob Marshall Wilderness in the Flathead National Forest.

The author bio at the end of the essay "Dreaming where I walk," in the Aug. 17 issue, mysteriously lost a word after the issue went to press. The ending should have read "… starring Martin Scorsese and Peter Rainier."

—Jodi Peterson for the staff

Lynn Myre and her daughter, Brianna Wilensky, visit *HCN*. BROOKE WARREN

UNLOCKING THE M

A tour of the Four Corners Hot Spot, where natural gas has a

A SILVER VAN ROLLS SLOWLY down a narrow road on the edge of the small town of Bayfield, Colorado, a farming-turned-bedroom community 20 miles east of Durango. With its darkly tinted windows and government plates, the van has an ominous appearance, not helped by the long, fishing-pole-like appendage, accessorized with wires and tubes, that extends from its top. Impatient drivers pull around the creeping vehicle, peering suspiciously as they pass. Just behind the local high school, the van stops abruptly, then reverses, then pulls forward again onto the shoulder before stopping.

The passenger-side door swings open and Gabrielle Petron, an atmospheric scientist with The National Oceanic and Atmospheric Administration and the Cooperative Institute for Research in Environmental Sciences at the University of Colorado, Boulder, hops out, gesturing to the following journalists to pull over and do the same. Petron wears jeans and hiking boots, a black jacket and sunglasses, all given flair by the saffron-orange scarf wrapped loosely around her neck and shoulders. Speaking with a slight French accent, she explains the van's erratic behavior: Its sensors indicate the presence of above-background levels of methane, a potent greenhouse gas.

It's not hard to find the probable source. Inside a chain-link-fenced enclosure next to the school's tennis court, the pipes, valves and other equipment of a BP America natural gas well jut from the ground. Everything's painted gold and purple, the school colors, with "Wolverine Pride" emblazoned on a metal box. Like many of the 40,000 or so oil and gas wells here in the San Juan Basin, this one extracts natural gas from the Fruitland coal formation. The natural gas, which is largely methane, is gathered here, processed and piped to market. Or at least most of it is: Some of that methane is apparently leaking from the wellhead and drifting into the atmosphere, contributing in its own small way to the notorious Four Corners Methane Hot Spot, a highly concentrated plume of greenhouse gas that hovers over the region. When scientists first noticed the hot spot in satellite imagery captured nearly a decade ago, it was so intense that they thought their equipment was malfunctioning. But more satellite imagery from 2009 confirmed the anomaly's existence, and in 2014 a team of scientists published a paper on it that garnered widespread media attention.

ETHANE MYSTERY

dark side

FEATURE BY JONATHAN THOMPSON | PHOTOGRAPHS BY JEREMY WADE SHOCKLEY

The obvious suspect behind the hot spot is the vast oil and natural gas industry infrastructure, which is woven like rebar into the landscape here, and burps and leaks methane and other hydrocarbons from valves, pipes, compressors and newly fractured wells. Other known contributors include an underground coal mine, from which methane is vented for safety, and a few landfills and two coal-burning power plants, which emit relatively small amounts of the gas.

But there's a 155,000-ton gap between the emissions these facilities collectively report to the Environmental Protection Agency's greenhouse gas inventory, and the amount of emissions the scientists estimate is needed to produce a plume as concentrated as the hot spot. Petron, along with a swarm of scientists under the aegis of the National Aeronautics and Space Administration and NOAA, descended on the region this spring, using planes, satellites and automobiles to try to account for all that unaccounted-for methane. *(See sidebar, page 16.)*

What they find could have wide-ranging implications. Natural gas emits about half the carbon per unit of energy generated as coal, and about a third less than oil, making it a good "bridge" fuel for transitioning from a coal-heavy energy system to one that's carbon-free. Yet the main ingredient of natural gas — methane — has 30 times more global warming potential than carbon dioxide. If the scientists were to find that the natural gas industry is behind the extra emissions, it could further cloud the fuel's current climate-friendly status. It might also indicate how hard the region's oil and gas industry will be hit by regulations from the Obama administration as part of its strategy for reducing emissions from the industry by 45 percent.

The industry, however, blames the gap on another methane-spewing villain that lurks here in the San Juan Basin and in other coal- and natural gas-rich areas: geologic seeps, where methane leaks unbidden from the earth, as it has done for millennia. Environmentalists scoff at the theory, but researchers aren't discounting it. "The seeps are definitely a piece of the puzzle," says Devin Hencmann, with LT Environmental, the company that has monitored the seeps in the San Juan Basin for the last decade.

But just how big a piece? And where exactly does it fit into the hot spot puzzle?

Flaring from natural gas wells lights up the night sky in the San Juan Basin of northern New Mexico.

Gabrielle Petron, top, a scientist with CIRES at the University of Colorado, stands near a facility that uses methane seeping from the ground to generate enough electricity to power six homes. Above, Petron's research assistant Eryka Thorley checks readings in the "Methane Mystery Mobile," which is shown at right, with its sensor arm extended above the van.

A FEW HOURS BEFORE HER STOP AT THE SCHOOL-GROUNDS GAS WELL in Bayfield, Petron and her research assistant, Eryka Thorley, who looks like she just stepped out of a Patagonia catalog in her skinny jeans, fleece jacket and white-rimmed shades, show a couple of journalists around what I've privately christened the Methane Mystery Mobile. On a cool, moist late April morning, it sits in the parking lot for a popular trailhead known as Carbon Junction. The Animas River — not yet polluted by the mining spill that will make national headlines later in August — runs by below, and just beyond it looms Carbon "Moving" Mountain, so nicknamed because, back in the 1930s, it grew violent for several months, shifting and sloughing and sliding for reasons unknown.

A computer monitor mounted on the van's dash, between the driver and passenger seats, reveals current concentrations of carbon dioxide, methane and carbon monoxide in the air around the vehicle. In the back are more instruments, along with burly black plastic boxes containing glass cylinders for capturing air samples at specific sites. Petron initially studied mathematics in France, but eventually switched her focus to the atmosphere. "The beauty of the air and the abstractness of it reminded me of math," she says. That very abstractness, unfortunately, makes it difficult for many of us to really grasp concepts such as climate change or greenhouse gases.

In pre-industrial times, the background level of methane on Earth was about 750 parts per billion. But beginning in about 1850, that level started shooting up, and now it's approximately 1,800 parts per billion, or 1.8 parts per million. Here in the parking lot, the methane line jumps up and down with shifts in the wind, but remains higher than background levels, occasionally rising to 5 or more parts per million.

I look around me. The nearest natural gas or oil well is at least a mile away. There are no coal mines nearby, no feedlots, wetlands, rice paddies, landfills or any of the other common sources of methane emissions. But then again, there doesn't need to be. The parking lot sits in a notch, formed by the Animas River, in the Hogback Monocline. If you think of the San Juan Basin as a lopsided bowl-shaped sandstone-, shale- and coal-filled layer cake, then the steep ridge of the monocline is the cake's outer rim, where the layers are exposed. Petron leads us up a little canyon and points to the critical layer of the cake, an outcrop of the Fruitland coal formation. It's the souvenir of a sultry swamp that lurked along the shores of a receding sea some 65 million years ago, and it's brimming with methane, some of which is leaking out here. Despite its apparent enthusiasm to escape the earth, this methane was economically infeasible to extract until, in the 1980s, government-subsidized technology and tax credits combined to

make it a moneymaker. That launched a boom that would make the San Juan Basin the nation's number one coalbed methane producer.

In 1993, at the tail end of the first major wave of drilling, a resident of the Pine River Ranch subdivision north of Bayfield complained to the Colorado oil and gas regulators that, after 10 years of providing clean water, his well had begun spewing methane. Similar phenomena had been reported in other parts of the basin, but those had been traced back to particular wells that had bad casing, which allowed methane to migrate from the gas well into the aquifer. This one was different. Investigators couldn't find any leaky or badly cased gas wells nearby, but they noticed that the house and well were located along a low point in the Hogback Monocline, where the Pine River had eroded through it, right on top of the Fruitland outcrop. The methane, it appeared, was coming straight out of the coalbed.

Such natural seeps had been witnessed along the outcrop for a century or more, but it gradually became clear that they were getting more intense. Trees and bushes began dying off in places where they had long thrived, like Carbon Junction. Near Valencia Canyon Gap on the Southern Ute Indian Reservation, where the glowing embers of an underground coal fire had become visible, methane emanated with enough pressure to fling grains of sand several inches into the air, and hydrogen sulfide levels, at a hazardous 200 parts per million, forced the closure of a nearby road.

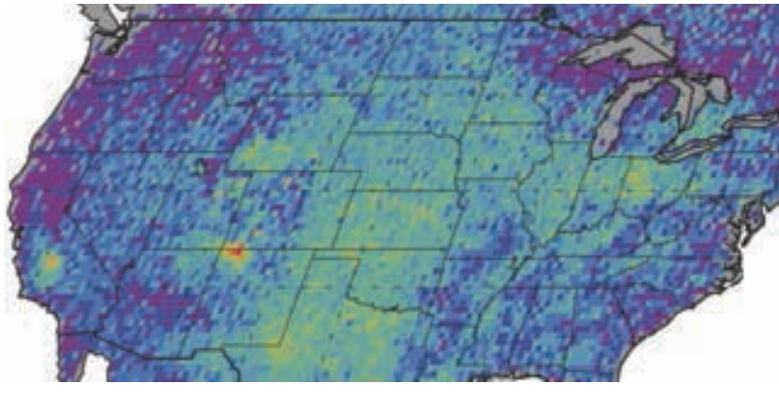
Things only got worse. Within a year after the changes were observed, "a half-mile long by 50- to 75-foot wide swath of previously healthy piñon and juniper trees, sagebrush and saltbrush stood dead as stark testimony to recent environmental changes," lamented a comprehensive 1999 Bureau of Land Management report on the issue. Methane was seeping from some spots at 1 million parts per million, or 100 percent concentration. Back at the subdivision, methane invaded more wells and pooled in the crawlspaces of homes. Breathing methane poses no immediate threat to human health, but potential explosions were a serious concern. At the time, the methane's effects on the climate remained in the background.

The Colorado Oil and Gas Conservation Commission formed an investigative team, and in 1995, it concluded that the most likely explanation for the sudden increase in methane seep at the subdivision — and by extension the cause for the apparent exacerbation at the other "natural" seeps — was the vast "dewatering" of the coal seam. Unlike "conventional" reservoirs of oil and gas found in sandstone or shales, coalbed methane is adsorbed, or bonded, to tiny pores in the coal by water pressure. In order to "liberate" the methane, drillers must first pump out the water from the coal seam. By 1999, just a decade or so after the boom had begun, coalbed methane wells on the Colorado side of the San Juan Basin alone had produced over 10 billion gallons of water, freeing the methane to migrate up the coal seam and escape from the outcrop.

LT Environmental workers monitor methane emissions from geologic seeps in the Fruitland coal outcrop. At right, methane bubbles up through the streambed in Archuleta County, Colorado.

Amoco — now BP, the biggest operator in the region — pushed back, bringing in its own consultants, who dusted off every historic account of flaming streams and wells and presented them as proof that the problem had always been there. The stories were entertaining and sometimes dramatic: A group of kids on a camping trip watch as an ember from their fire sets the Pine River aflame; ranchers light methane seeps to serve as natural Christmas lights; a man who likes his drink finds himself locked out by his wife, so he ignites the water well vent in order to stay warm. The consultants even brought up Carbon "Moving" Mountain, and suggested that its perturbations were the result of subterranean methane seep explosions.

They posited other possible causes for the exacerbated leakage: Perhaps drought or an increase in domestic wells was drying up the coalbed and liberating the methane, or maybe an uptick in precipitation was causing more water to leak through the outcrops into the coal seam,



Methane concentrations across the United States are low on the coasts (dark blues and purples) and higher in the country's midsection (light blue, green and yellow), with the Four Corners hot spot, the red area highlighted with a circle, above, highest in concentration.
NASA/JPL-CALTECH/UNIVERSITY OF MICHIGAN

Wells dot the landscape of the Permian Basin — the most prolific oil field in the nation — on the New Mexico-Texas border. ALAN LEVINE/CC VIA FLICKR

Tracking air quality, from above

THE FOUR-ENGINE TURBO-PROP PLANE, built for hurricane research and surveillance, dips low over the pancake-flat plains that sweep from southeastern New Mexico across the Texas border. Huge irrigation circles are tattooed across the land in varying shades of brown and green. Then the well pads appear. From 1,000 feet in the air, they look like hundreds of sandboxes, connected by a maze of dirt roads.

"That's a lot of wells," says Joost de Gouw, a scientist with the National Oceanic and Atmospheric Association and the Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder. As the lead researcher tracking the emissions over America's energy hot spots, de Gouw has flown over oil and gas fields from North Dakota to Pennsylvania. Nowhere, however, has he seen a greater density of drilling operations than here in the Permian Basin, a 250-mile-wide-by-300-mile-long stretch of Texas and New Mexico — the nation's most prolific oil field.

WEB EXTRA
Taku Ide has a vision: Mini power plants fueled by fugitive methane providing electricity for those without access to the grid. **hcn.org**

Joost de Gouw, left, Jessica Gilman of CIRES/NOAA and Drew Gentner of Yale University study readings aboard the CIRES research plane. DAVID OONK/CIRES

But De Gouw isn't interested in the energy being produced here; he's tracking the "fugitive emissions" leaking into the atmosphere. They include substances like methane, an odorless, colorless greenhouse gas far more potent than carbon dioxide, on a per-molecule basis, and volatile organic compounds, gases that produce a thick layer of pollution in the atmosphere linked to cancer and other health problems.

As part of NOAA's Shale Oil and Natural Gas Nexus, or SONGNEX, project, de Gouw and 40 other researchers are trying to quantify those emissions and their effects on everything from the quality of the air we breathe to how much and how fast the planet will warm. Little attention was paid to methane emissions in the past, but with the current energy boom, the amount that's being pulled from the earth and put into the air is rapidly increasing, and the need to understand emissions is becoming critical.

De Gouw earned his doctorate in atomic and molecular physics, but got into atmospheric science because he wanted to focus on something larger than the interactions of tiny particles no one could see. He has small wire-framed glasses and close-cropped sandy hair, and he speaks calmly, with a trace of a Dutch accent.

The inside of the plane is crammed with people and machinery. Scientists stare at monitors hooked up to air sensors outside the plane. The plane costs $5,000 an hour to operate, and today's flight will last seven hours. It crisscrosses back and forth across the basin in a grid pattern, to better enable researchers to pinpoint the sources of the emissions.

Methane can come from a variety of sources, from a leaking pipeline to a landfill to a feedlot. So in order to find the source, the researchers must analyze the emission's chemical signature: If the methane is accompanied by ethane and butane, it comes from oil and gas fields. If not, then it probably comes from somewhere else.

Getting these "top-down" readings from the air is crucial because it can

provide a snapshot of an entire region. Previously, most measurements were taken at ground level, directly at a potential emissions source, which meant that scientists had to estimate the full scope of methane leaks and VOC pollution. The lack of concrete data meant anti-drilling proponents could cite certain studies that found high leak rates, while industry proponents could point to studies that found the opposite.

"There was no way to get to rational policy discussion," says Drew Nelson, an expert on natural gas with the Environmental Defense Fund, which is sponsoring a series of studies to track down methane leaks and quantify them.

After more than 20 flights, de Gouw sees big differences between different basins. Over in Pennsylvania's Marcellus shale formation, for instance, the researchers found a leak rate of less than 1 percent, compared to parts of Utah, where it was as high as 11 percent. The discrepancy is partly due to the formation's composition: In Pennsylvania, it's almost entirely "dry gas," but out West, the gas is much wetter and requires a lot more processing before it's ready for market. The liquid hydrocarbons are separated from the natural gas at the wellhead, and that creates a greater potential for leaks.

But de Gouw suspects that regulations — or the lack of them — also play a role. In Utah's Uinta Basin, for instance, oil development was supposed to be a short-term project when it began back in the early 1980s. As a result, most pipelines were built aboveground, which is cheaper than burying them, but also leads to higher leak rates. Thirty years later, they're still in use.

Ahead of us, flames erupt in the Guadalupe Mountains. Oil is almost always accompanied by natural gas, and it's often not cost-effective for an oil company to build infrastructure to capture the natural gas released during the drilling. So most of the natural gas, along with other unwanted byproducts, is burned off, a process known as "flaring" that releases pollutants like benzene and VOCs into the atmosphere. De Gouw notes his data show that refiners in Utah are sending around 200,000 tons of VOCs into the air each year, double what producers have reported to the EPA.

Does de Gouw believe that methane leaks are cooking the planet faster than previously thought? The scientist won't say. "I like to keep my opinions out of it," he says. A moment later, the plane dips precipitously and de Gouw, unaffected by the stomach-churning turbulence, politely excuses himself. He turns toward where his computer sits at the back of the plane: "I'm going to go see what the data says." SARAH TORY

Eric Kort, an atmospheric scientist from the University of Michigan and one of the authors of last year's methane hot spot paper, explains how aerial efforts work with the ground campaign to map emissions in the San Juan Basin and elsewhere.

thus displacing methane and pushing it to the surface. They introduced enough uncertainty to obfuscate the official findings.

But even when Amoco's consultants acknowledged that the industry, as a whole, might be to blame for the increased leakage, there was no way to pin a particular seep's behavior on any particular well or company. And since no baseline data existed, there was really no way to know, for sure, that the leakage had increased, dying vegetation notwithstanding. The uncertainty was enough to help Amoco dodge litigation; when the homeowners sued the company, they lost. The company did purchase four contaminated homes and bulldoze them, and it has continued to help fund a multi-agency effort to map, model, monitor and mitigate the seeps. (When I asked BP representatives what they're doing to mitigate leaks in their systems, they told me no one was available to speak to me.) As time went by, and no more homes were contaminated and the price of natural gas crashed, the issue faded from the public consciousness.

Until now.

ERIC KORT, AN ATMOSPHERIC SCIENTIST with the University of Michigan, is the lead author of last year's hot-spot study, and on an April morning he is preparing to lead a forum on methane in Farmington, New Mexico. Kort, who is tall and lanky with a light beard, his hair pulled back into a little bun, is clearly amazed at the turnout. Some 200 people have crowded into a college lecture room to hear scientists talk for four hours about hyperspectral imaging, isotopes and teragrams.

There's a palpable tension in the room, hinting at what's at stake in this fossil fuel-heavy region. Shirley "Sug" McNall, a local who has been butting heads for years with the oil and gas industry over its impacts on air quality, is here, listening anxiously, as are members of regional environmental groups, such as the San Juan Citizens Alliance and Western Environmental Law Center. Officials from the two huge coal power plants west of town, which together with the accompanying coal mines employ hundreds of people, look on somberly. Most anxious, though, are the natural gas industry leaders present, recognizable in part by their uniform: jeans, button-up shirt, fleece vest with company logo.

For them, the hot spot is like a big bull's-eye, centered right over their heads, drawing unwanted attention to them and their industry. The San Juan Basin is one of the nation's most prolific natural gas fields, and the economy was built on the industry's shoulders. As goes national sentiment toward the fuel, so goes the financial fate of Farmington restaurants and Wal-Marts, schools and government. And for now, at least, it appears as if these scientists hold that fate in their hands.

The hot spot is like a big bull's-eye, centered right over their heads, drawing unwanted attention to the natural gas industry.

Beginning a decade or so ago, environmentalists and politicians of all stripes began hailing natural gas as the most potent weapon to dethrone King Coal and reduce carbon emissions. From 2007 to 2010, in fact, the Sierra Club's Beyond Coal campaign was largely funded by $26 million in donations from natural gas giant Chesapeake Energy. Not only does natural gas burn more cleanly than coal, emitting half the carbon and a fraction of the sulfur dioxide, particulates, mercury

and other pollutants; it's also more versatile. Like coal, gas can be used to produce steam to turn turbines that produce round-the-clock baseload power. But gas can also be used to power combustion turbines — similar to jet engines — that can be ramped up to produce juice in a matter of minutes to provide backup for variable solar and wind energy.

As the so-called shale revolution yielded a natural gas glut and decreased prices, the fuel became affordable enough to compete with coal. After chipping away at coal's supremacy for several years, this April, for the first time, natural gas generated more electricity in the U.S. than coal. That same month, carbon dioxide emissions from the electric power sector reached a 27-year low, after steadily declining for the last several years. It was a big win for the climate. Or was it?

In 2011, Cornell University's Robert Howarth dropped a bomb on the natural gas party when he published a study suggesting not only that natural gas wasn't as clean as hyped, but that it may ultimately have a larger greenhouse gas footprint than coal, thanks to methane leakage. Though the study's conclusions and methods remain in dispute, it woke people up to the fact that, in addition to the on-the-ground environmental impacts of drilling, the fuel has a tender Achilles' heel when it comes to saving the climate. Methane has 86 times more global warming potential than carbon dioxide over a 20-year span, and up to 30 times over a century. That means that for every 100 tons of carbon dioxide kept out of the atmosphere, it only takes three or four tons of methane leaking from a pipeline or other infrastructure to offset the gain. Howarth concluded that in order for natural gas to retain its greenhouse gas superiority over coal, leakage rates had to stay below 2.8 percent.

EPA greenhouse gas inventory data show that the national leakage rate is about 1.5 percent, which sounds pretty good. Unfortunately, several independent studies have found that actual emissions are often far higher than what gets reported to the agency. Petron and her colleagues, for example, found that oil and gas production in the Denver-Julesburg Basin in Colorado emitted three times more methane than the EPA inventory showed. And in 2014, Kort, Petron and others published a paper in *Science* documenting that, nationwide, measured emissions were 1.5 times higher than those in the inventory. Now they're trying to see if the same is true here in the Four Corners. To achieve concentrations like those found in this hot spot, says Kort, emissions would need to total about 590,000 metric tons per year. That's upwards of 150,000 metric tons more than the amount all the emitters in the region report to the EPA's greenhouse gas inventory.

Kort had speculated that the increase could result from fugitive emissions that the companies don't know about, like the apparent slow leak in the wellhead that showed up on Petron's monitor, or perhaps from known emissions from facilities that fall below the inventory's reporting threshold. Pipelines frequently rupture, releasing huge quantities of gas: A *High Country News* analysis of data from the Pipeline and Hazardous Materials Safety Administration revealed that ruptured pipes have leaked enough methane since 2010 to heat 170,000 homes for a year. Perhaps hundreds of abandoned gas and oil wells, leaking but unaccounted for, are to blame. If this is true, it could put the coalbed methane field's leakage rate as high as 8 percent.

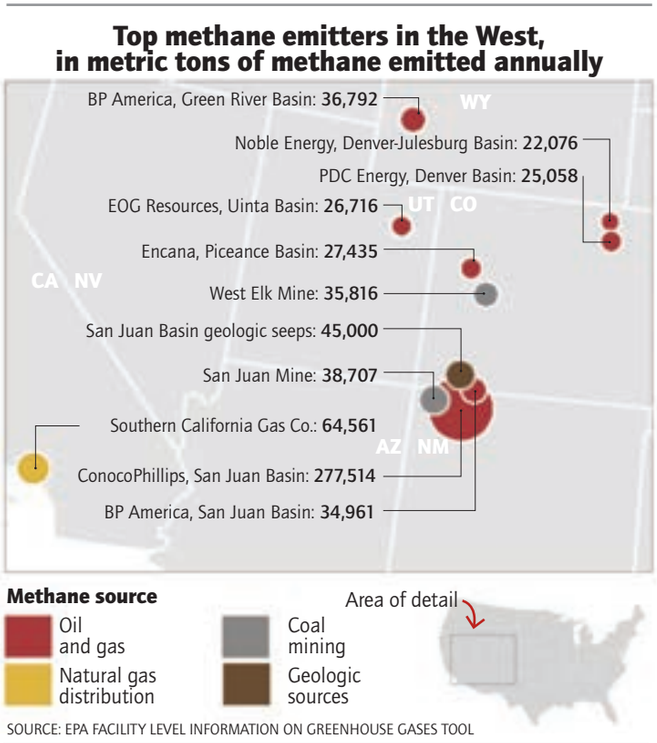
Industry flacks balk at such hypotheses, though. "The San Juan Basin is well-known as a large area of natural seepage — when methane emissions are naturally occurring and not the result of energy development," writes Katie Brown for *Energy In Depth*, a PR outlet for the Independent Petroleum Association of America. Such claims, however, are "little more than a bogus, rhetorical diversion to avoid responsibility and to undermine ongoing rule-making efforts," says Erik Schlenker-Goodrich, executive director of the Western Environmental Law Center.

At the forum, Kort, Petron and other scientists assure the audience that they have no ax to grind, and that they will look at all potential sources, including geologic seeps. This, along with Kort's Zen-like demeanor, seems to ease the earlier tension. The scientists' analysis of what Kort calls a "fire hose of data" won't be published until next year, but ongoing research hints at what they might find. Monitored seeps along the Colorado side of the coal outcrop have leaked more than 45,000 metric tons of methane per year, which has the same warming potential as the carbon dioxide emitted from more than 200,000 cars annually. And still more methane is leaking from other parts of the outcrop that aren't monitored, in New Mexico, or on the Southern Ute Reservation, where data about the seeps has not been made public. The seeps are a significant source. But by its own count, ConocoPhillips' San Juan Basin operations collectively released six times that amount — 277,000 tons — in 2013, making it the largest such emitter in the nation.

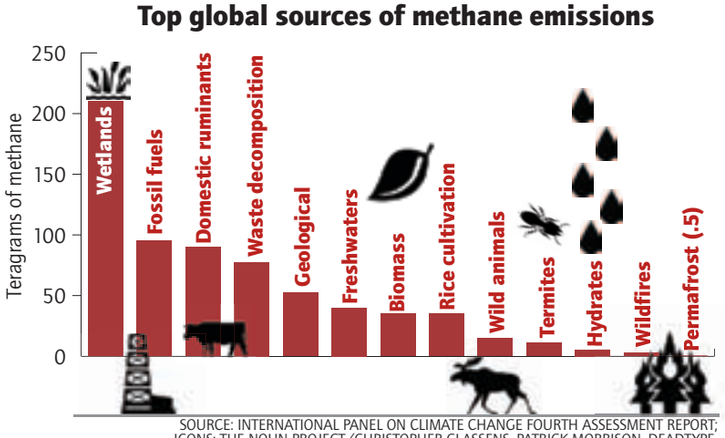
Also lingering is the question of how much, if any, of the seeps' emissions can or should be attributed to the coalbed methane industry. A report published in 2000 as part of the multi-agency project to map, model and monitor the coal outcrop again established a link between drilling and the seeps, but some mystery remains. "How much is natural and how much is exacerbated," Petron says, "it's not something we understand yet." And we probably won't understand it anytime soon. While Hencmann and his colleagues continue to collect reams of data, the stats mostly fall into an analytic void. The researchers have found, for example, that the total emissions from the seeps in their monitoring zone has increased each year since 2007, yet no one is currently trying to determine why. It could be drought, it could be changes in the gas field, or it could be something else entirely. Hencmann hopes the attention on the hot spot will revive flagging efforts to decipher the seeps.

Without understanding the connection between the anthropogenic and the natural seeps, there's no real mechanism for encouraging or requiring companies to mitigate those seeps. Unless we know how much the industry is responsible for, we can't truly calculate the leakage rate of the region's natural gas systems and therefore can't ever really know how big its greenhouse gas footprint is.

A new round of research could have global implications. Similar basins, with similar geologies and seeps, exist all over the world, says Taku Ide, a petroleum engineer who studied methane-fueled fires in the coal outcrop on Southern Ute land. The Intergovernmental Panel on Climate Change estimates that, worldwide,



SOURCE: EPA FACILITY LEVEL INFORMATION ON GREENHOUSE GASES TOOL



SOURCE: INTERNATIONAL PANEL ON CLIMATE CHANGE FOURTH ASSESSMENT REPORT; ICONS: THE NOUN PROJECT/CHRISTOPHER CLASSENS, PATRICK MORRISON, DEADTYPE, HEBERTE ALMEIDA, MEGAN MITCHELL, RICHARD CORDERO

geologic seeps could be emitting as much as 40 to 60 million metric tons of methane per year, putting them on par with landfills or coal mines. "The San Juan Basin is the most advanced in terms of work that's been done to serve as a model, to drive the conversation across the U.S.," says Ide. "It could be a model child." If, that is, the national conversation sparked by the hot spot kicks new studies into gear.

JUST SOUTH OF FARMINGTON, white sandstone cliffs rise from the swatch of green along the San Juan River. From atop these cliffs, you can look out over a landscape that is beautiful and battered, sacred and sacrificed. You can see the nation's energy past, and perhaps its future, from here.

To the west, two massive coal-burning power plants stand in the high desert. Each kicks out more than 11 million tons of carbon dioxide each year, along with a soup of particulates, sulfur dioxide and mercury. When the wind rises, as it does frequently, a fine gray dust lifts up into the air from the multimillion-ton piles of coal-combustion waste piled near the Four Corners plant, its sooty gray stacks juxtaposed against the beige backside of the Hogback monocline.

Environmentalists and Navajo activists have struggled for years to shut down the plants, protesting and filing lawsuits, and recently their efforts have had some success. Four Corners recently shut down three of its five generators to comply with regional haze rules, and San Juan Generating Station plans to shut down two of four units and replace one with a natural gas-fired "peaker" plant — if opponents don't succeed in retiring the plant altogether.

The victories have come in part with the help of an unexpected ally, also visible from this cliff-top vantage point: The coalbed methane and conventional natural gas fields that pockmark thousands of square miles here. Much of this gas is piped to California, where utilities buy it at a relatively cheap price to run power plants, thereby helping to wean themselves from the two coal plants here. President Obama's Clean Power Plan, released this summer, will likely tilt the nation's energy balance further away from coal and toward natural gas, at least until more renewables take hold. That could do more to clean up this area's coal-sullied air and landscape.

But it would also increase demand on, and activity in, the natural gas fields. More wells would be drilled and more pipelines built, providing more avenues for methane to escape, adding to the hot spot and further diminishing natural gas' green cred in the battle to curb climate change. Unless, that is, the gas companies can get a handle on all those leaks.

This summer, the EPA announced an overhauled program designed to get companies to voluntarily clean up their act, and industry officials have promised to comply, since it's in their best interest to keep their cash crop from slipping away. A spokesperson with ConocoPhillips says that the company has already reduced overall emissions by 48 percent on its own, mostly by using "off-the-shelf" solutions. But just 10 of New Mexico's 475 natural gas producers participate in the EPA's current EnergySTAR program, and with natural gas prices so low, there's little incentive to invest much into leak prevention. That's why activists are pressing for strong regulations that will push the entire industry to tighten up.

In August, the EPA released its new rules requiring operators to plug leaks of methane, ozone-forming volatile organic compounds and other toxics on new and modified facilities. They'll also require drillers to capture the methane that burps out of any newly fractured oil or gas well. Since the rules don't apply to existing infrastructure, they will do little to reduce the methane cloud already hovering over the San Juan Basin. But the BLM will hand down its own rules in coming months, and they are expected to apply to these existing facilities. The majority of the wells in the San Juan Basin are under BLM jurisdiction, so the new rules should have an effect on the hot spot. Indeed, Interior Secretary Sally Jewell invoked the Four Corners hot spot when announcing the need for such rules in March. The BLM regulations may resemble Colorado's, implemented last year, which require companies to install leak-detection and prevention equipment and take other measures to reduce emissions. Chris Colclasure of the Colorado Air Pollution Control Division says it's too soon to quantify the effects of the rules, but he believes they work and are not too onerous for the companies. In fact, several energy firms have endorsed the regulations, saying they're good for business.

While some oil and gas lobbyists have portrayed the new rules as an attack on the industry, the Environmental Defense Fund's Mark Brownstein says that compliance won't require that much from operators, many of whom say they're already doing what the regulations require. Whereas the administration's limits on carbon dioxide emissions make it virtually impossible to build a new coal-fired power plant, and are thus aimed at phasing out coal in the long run, the methane rules seem intended to sharpen up the natural gas industry's green credentials, making it more appealing in the future.

The scientists working to decipher the methane mystery remain mum when it comes to specific regulations, but they have discussed what they think needs to be done. "If natural gas is to be a 'bridge' to a more sustainable energy future," wrote Kort, Petron and several other researchers in a paper published by *Science* last fall, "it is a bridge that must be traversed carefully: Diligence will be required to ensure that leakage rates are low enough to achieve sustainability goals."

Back at the gas well behind the high school, Petron lets me flip the little switch that snatches an air sample from the breeze for later analysis. It will tell Petron and Thorley precisely what isotopes of methane are here, and, just as importantly, what other compounds may be seeping out of the well. Methane's not going to hurt anyone in the short term unless it builds up enough to explode, but benzene, another pollutant emitted by oil and gas wells, has both short- and long-term health effects and is a known carcinogen — certainly not something you want your high-schoolers inhaling every day.

As we pull back onto the road and head toward another sample site, Petron reminds me of one simple, enduring fact of life here in oil and gas country: "Your air is being impacted," she says bluntly. "You live on the edge of the gas field." □

Coal from the nearby San Juan Mine is piled up at the San Juan Generating Station in northwestern New Mexico. The power plant emits huge amounts of carbon dioxide, but relatively little methane. The mine, however, is one of the biggest single methane emitters in the region.

Senior editor Jonathan Thompson writes from Durango, Colorado. @jonnypeace

This story was funded by a grant from the McCune Charitable Foundation.

BUSINESS OPPORTUNITIES

Conservationist? Irrigable Land? Stellar seed-saving NGO is available to serious partner. Package must include financial support. Details: http://seeds.ojaidigital.net.

CONFERENCES AND EVENTS

Oct. 7-10, 2015, SHIFT Festival, Jackson, Wyo. An in-depth exploration of outdoor access, responsible recreation, conservation leadership and youth engagement for communities striving to live in balance with nature. Tickets at www.shiftjh.org.

The Public Land and Resources Law Review will host the 36th Public Land Law Conference on Oct. 1-2, 2015. This year's Conference focuses on "Transcending Boundaries: Achieving Success in Cooperative Management of Natural Resources." The opening Keynote Address will be presented by Hilary Tompkins, solicitor, U.S. Department of the Interior.

Sixth Annual Roundtable on the Crown of the Continent Conference, Missoula, Mont., Sept. 16-18, 2015. Please visit www.crownroundtable.org/6thconference2015.html.

EMPLOYMENT

WorkInFarming.com — Where job seekers and farmers connect. Facebook, Twitter, LinkedIn, Google+.

Rocky Mountain Youth Corps, a Taos, N.M.-based Youth Conservation Corps, is hiring a Development Director. Qualified applicants will have experience in grant writing and management, fundraising experience and donor relations expertise. More information at www.youthcorps.org.

The Nature Conservancy is hiring a Verde River Groundwater Projects Manager to oversee projects that improve flows in the Verde River through implementation of groundwater focused strategies that offset the impacts of prior, ongoing and future groundwater withdrawals. Works with a range of partners to create enabling conditions for the implementation of groundwater projects to enhance river flows in the Verde River Basin and along other rivers in Arizona as requested, in coordination with various municipal agencies, contractors, and other partners and staff. Responsibilities include negotiation of complex agreements, project management, fundraising, and monitoring of specific recharge infrastructure projects. Provides strategic guidance for these projects to achieve river flow goals, and stewards community relations, especially with municipal partners, and outreach for the projects with local communities. Reports to the Arizona Water Projects Director, and provides local leadership for TNC's integrated water management strategies in the Verde Watershed, working alongside the Verde River water transactions manager and Arizona hydrologist. May occasionally also support groundwater project implementation at other Colorado River Basin locations as requested. Supervises no other staff, but helps lead internal and external teams of interdisciplinary professionals, including external contractors. Job location is within the Verde River Watershed — Flagstaff Region (Yavapai and Coconino Counties, Ariz.). For more info and to apply, go to: nature.org/careers. Deadline to apply is Sept. 4, 2015 (prior to 11:59 p.m. ET). The Nature Conservancy is an equal opportunity employer. Women, minorities, people with disabilities and veterans are encouraged to apply.

Director of Development — Located in Crested Butte, Colo., the Rocky Mountain Biological Laboratory is hiring a Director of Development. This individual will help drive revenue growth to support scientific field research and education. For more information, visit: http://www.rmbl.org/about-us-2/jobs/.

Seeking Executive Director — The Gila Watershed Partnership, a nonprofit Arizona corporation, is seeking an Executive Director. Requirements are: Person must reside in Graham or Greenlee counties during employment; have nonprofit administrative experience; write or assist in writing grants for projects and programs; have experience in public communications; and excel in verbal and written communication skills. Details regarding the position may be found at www.gwpaz.org. Please email a letter of interest with résumé to Steve Eady, Executive Director, steve@gwpaz.org, due Sept. 11, 2015, or until position is filled. Applications will be reviewed as received.

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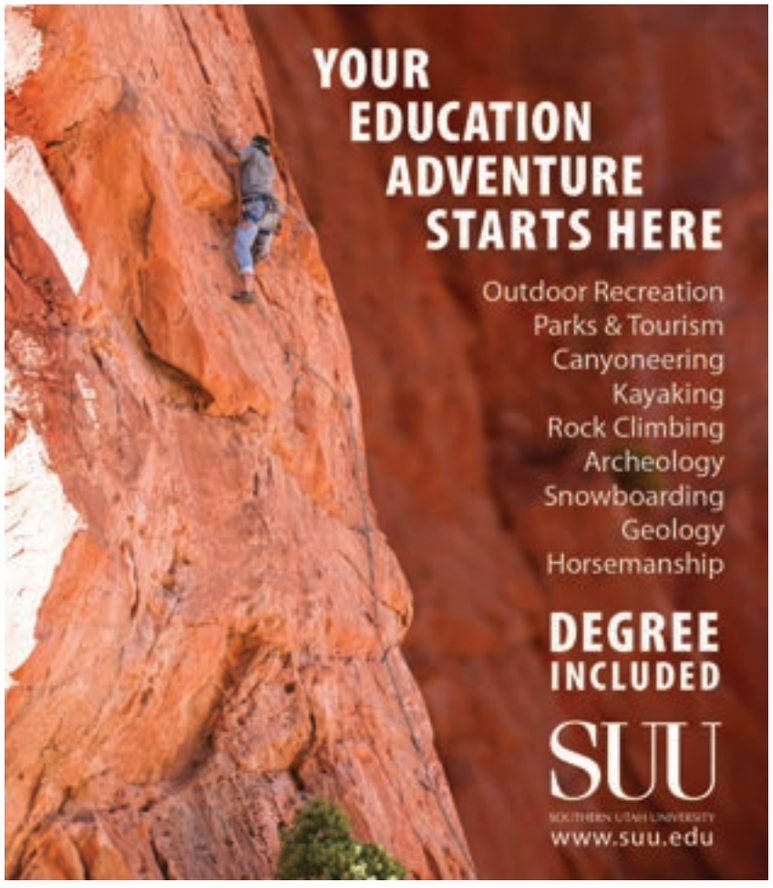
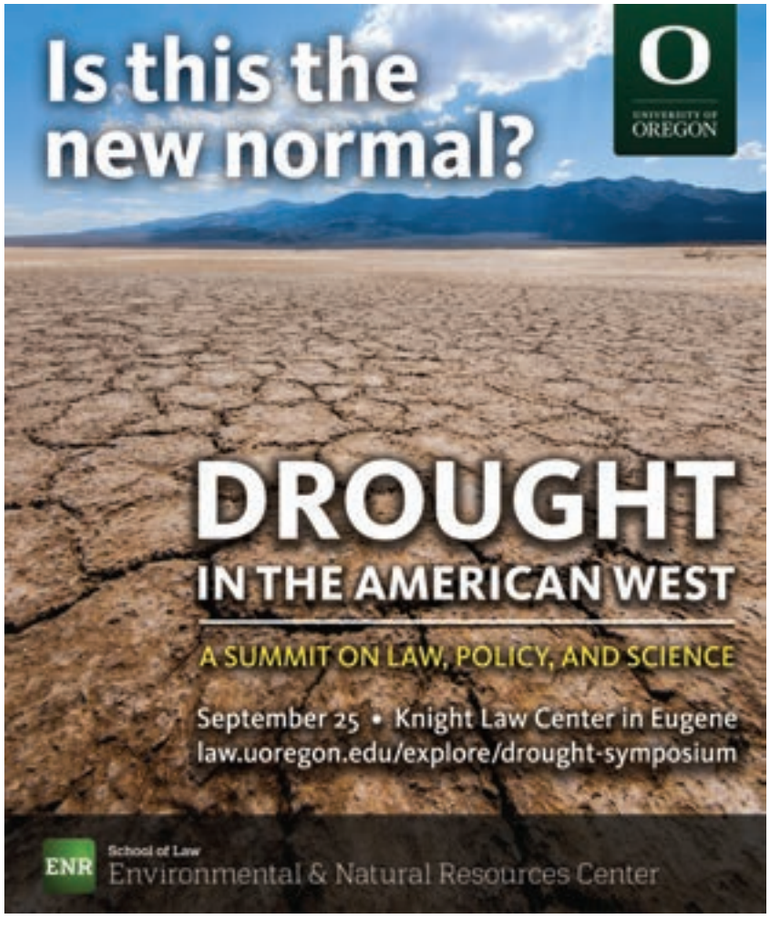




FEMA *continued from page 9*

area where the feds are spending money to build things," says Jeffrey Thomas, a Louisiana lawyer and former FEMA contractor. "Are they compatible with the high aims we are articulating for our cities to be more resilient to climate change?"

A White House task force recently called for reforms, and Obama responded with an executive order in January. He directed federal agencies to create a new standard, one that requires that projects constructed with federal funds be built on higher ground or elevated to withstand the floods expected with rising sea levels, greater deluges and other consequences of climate change. Obama also encouraged FEMA to support green infrastructure projects, such as moving buildings out of floodplains and planting trees and shrubs instead, to soak up floodwaters and make communities more resilient.

It's too early to judge the effectiveness of the executive order, which FEMA has yet to implement. But it wouldn't even address the dilemma faced by mountain communities like Manitou Springs. The necessary fixes, experts say, won't come from FEMA or the White House alone. Lawmakers need to act, but, as Steve Adams, director of strategic initiatives for the Institute for Sustainable Communities, says: "Nobody thinks you could successfully amend statutes at this time because of the Congress."

There are other possible sources of federal assistance for vulnerable communities. The Federal Agriculture Department's Natural Resources Conservation Service can fund projects, even if the destruction doesn't warrant a federal disaster declaration.

There's not enough money, though, to do very much. For example, the program helped buy concrete jersey barriers and sandbags to protect rural developments near Flagstaff, Arizona, against anticipated flooding after the 2010 Shultz Fire. But "what did come was orders of magnitude worse than anyone predicted" and quickly overwhelmed those barriers, says Dustin Woodman, engineering division manager for Coconino County, Arizona. The torrential rain washed soil, trees and other debris down steep slopes into two rural neighborhoods, killing a 12-year-old girl and filling dozens of homes with several feet of mud.

Woodman has spent the last five years designing and funding $30 million in projects to handle floodwaters to protect the Timberline and Doney Park subdivisions outside Flagstaff. He quickly learned that FEMA would fund projects that used concrete or metal pipes to direct floodwaters, but not the green infrastructure favored by many scientists and communities. He sought funding elsewhere for such remedies, like meandering channels planted with grasses and shrubs to absorb and direct floodwaters. "FEMA is focused more on traditionally engineered flood-mitigation structures — levees and retention basins," Woodman says. "Rather than fight that fight, we focused the FEMA funds we had on projects where we wanted to do more traditional projects."

FEMA also resisted when Woodman wanted to use its money to replace a 2-by-4-foot roadside ditch with a channel 10 times larger. "Those public assistance funds are only able to be used for replacement in-kind," Woodman says. That makes it difficult for communities to upgrade drainage ditches, bridges or other structures when risks increase. But since the flooding had already carved a ditch the size Woodman wanted, he was eventually able to get a waiver for that project.

Other towns haven't been as lucky. In Williamstown, near Vermont's Green Mountains, for instance, FEMA paid to replace a pair of culverts four times — after they washed out — in 2004, 2007, 2011 and 2013. Each time, the agency refused to pay to upgrade the corrugated metal culverts, but it spent a total of about $1 million to repeatedly repair the stretch of road destroyed by flooding. Town manager Jackie Higgins remembers telling a FEMA representative in 2013: "You're still only going to put back what was there? You're wasting money." Late that year, Williamstown finally replaced one of the culverts with a much larger concrete structure. The project was funded by the state.

For years, counties have been asking FEMA and Congress to acknowledge that major fires often cause flooding and should be treated as one disaster. Currently, unless each flood is declared a federal disaster, victims likely won't qualify for FEMA's help.

Kayle Higinbotham, 68, lives in an 1880 Victorian ranch house five miles west of Manitou Springs, at the base of Pike's Peak. Her home flooded this spring when a 12-foot-deep gulch next to her house filled up with debris, and sediment washed down from the slopes. But even though three feet of muddy water filled her family room, her house isn't in a mapped floodplain, so Higinbotham doesn't qualify to have it bought out or moved to a safer location. Before the fire, her house and the 60 acres she inherited were valued at $1.7 million. Now, her real estate agent tells her she couldn't find a buyer.

The risk of a dangerous flood is so great that the fire department advised her to leave home during the summer monsoon. When Higinbotham is home, she anxiously monitors the weather and listens for a flood warning on her radio. All this has left her with post-traumatic stress disorder. "You get on your feet from the fire, and then comes the flood," Higinbotham says. "And then you get on your feet from the flood, and here comes the next flood. There's just no end in sight."

The plight of people like Higinbotham has inspired community leaders to compete for federal grants, call for changes in federal policy and even levy new taxes. Other communities, however, have yet to awaken to their increased vulnerability to the bigger fires and bigger storms that are likely on the way. □

Chris Wareham, left, and Andrew O'Banion, of Flagstaff, Arizona, survey damage in Wareham's living room after a wall of water pushed mud and other debris into his house during a 2010 flood caused by erosion from the Schultz Fire.
JOSH BIGGS/AP PHOTO/THE ARIZONA DAILY SUN

This story was funded in part by the New England Center for Investigative Reporting and the Fund for Investigative Reporting.

An even bigger threat to rivers

OPINION BY
GARY WOCKNER

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

If there's any good news to be gained from the toxic spill of mine wastes into the Animas River upstream of Durango, Colorado, it's that public attention has suddenly shifted to the health of rivers in the West.

The 3-million-gallon accident riveted the media, even rating a story in England's *The Guardian* newspaper. Here at home, officials took action almost immediately: Biologists put out fish cages to see if the sludge was killing fish, and chemists began testing the murky water for acidity and heavy metal concentrations. Within a few days, the governor of Colorado, both Colorado U.S. senators, and the administrator of the Environmental Protection Agency — whose contractors triggered the spill — showed up in Durango to express their regret, outrage, support, etc. They promised that it would never happen again.

But of course a disaster is sure to occur again, because there are thousands of century-old abandoned mines in the region that have never been thoroughly cleaned up. And as the saying goes: Acid mine drainage is forever.

Yet while an orange plume of heavy metals moving through a river system toward a major reservoir like Lake Powell is certainly a serious problem, there's another danger targeting rivers in the West. It's the kind of disaster that sometimes kills every living creature in a river, imperils the river's health for weeks and months, causes extensive contaminations of *E. coli* and heavy metals, and destroys the recreational economy — rafting, tubing, fishing — for months at a time.

This disaster is caused by dams. Whether they are large or small, they block a river so that water can be diverted for farms, ranches or domestic use. From its beginnings high on the Continental Divide, for example, the Colorado River loses 90 percent of its flow to diversion in the first 40 miles.

Once the Arkansas River leaves the mountains and heads for Kansas, it becomes a dribble of its former self. The dammed and diverted South Platte River through Denver is often a putrid, algae-ridden and depleted mess, and when it exits town, most of its flow is made up of discharge from Denver's sewage treatment plant.

The Cache la Poudre, near my home in northern Colorado, is sometimes drained bone-dry as it moves through downtown Fort Collins, and when it does have water in it, its native flow is diminished over 50 percent by dams and diversions.

Colorado is just the tip of the iceberg of river destruction. Rivers across New Mexico and Utah are in a similar desperate condition. And in Southern California and Arizona, most rivers are drained completely dry every single year. The Gila River in Arizona, once a large and beautiful tributary of the Colorado River, is now completely dead except during rare monsoon rains that fall perhaps once every 20 years.

But there's worse to come. The states of Colorado, Wyoming, New Mexico and Utah have all just gone through official water-planning processes and are proposing even more dams and river-draining activity. The governor of Wyoming has called for "10 new dams in 10 years." The state of Utah wants to put "a dam on every river in the state," and water agencies in Colorado are proposing large new diversions out of the Colorado River.

In addition, Colorado yearns to retain every legal drop before its rivers cross the state's boundaries.

As you watch the media focus for a while on river health, consider this trivia question: Where was the last major dam and river-destroying project in Colorado?

If you guessed it was on the Animas River, southwest of Durango, you're right. The controversial Animas-La Plata Project erected a huge dam and reservoir, a pumping station to divert water out of the Animas River, and the federal government did it all with virtually no mitigation to offset the impacts to the river.

Were elected officials outraged at this project? No, they celebrated it and named the reservoir Lake Nighthorse after former Colorado Sen. Ben Nighthorse Campbell.

If this plume of poisoned water moving downstream teaches us anything, maybe it ought to be this: All of our rivers are at risk so long as we continue to prevent them from running free. □

Gary Wockner directs Save The Poudre and Save The Colorado, and lives in Fort Collins, Colorado.

Lake Nighthorse, the reservoir filled with water from the Animas River.
SHAUN STANLEY

Writers on the Range is a syndicated service of *High Country News*, providing three opinion columns each week to more than 70 newspapers around the West. For more information, contact Betsy Marston, betsym@hcn.org, 970-527-4898.

Renewal through exploration in Greater Yellowstone

The Wild Excellence: Notes from Untamed America
Leslie Patten
256 pages, softcover: $20.
Wordsworth Publishing, 2014.

It's not that uncommon for weary Californians to uproot from the chaotic coast and replant in the big-skied wilds of the Interior West. Few transplants, however, re-root as deeply or earnestly as Leslie Patten, author of the new collection of essays, *The Wild Excellence*.

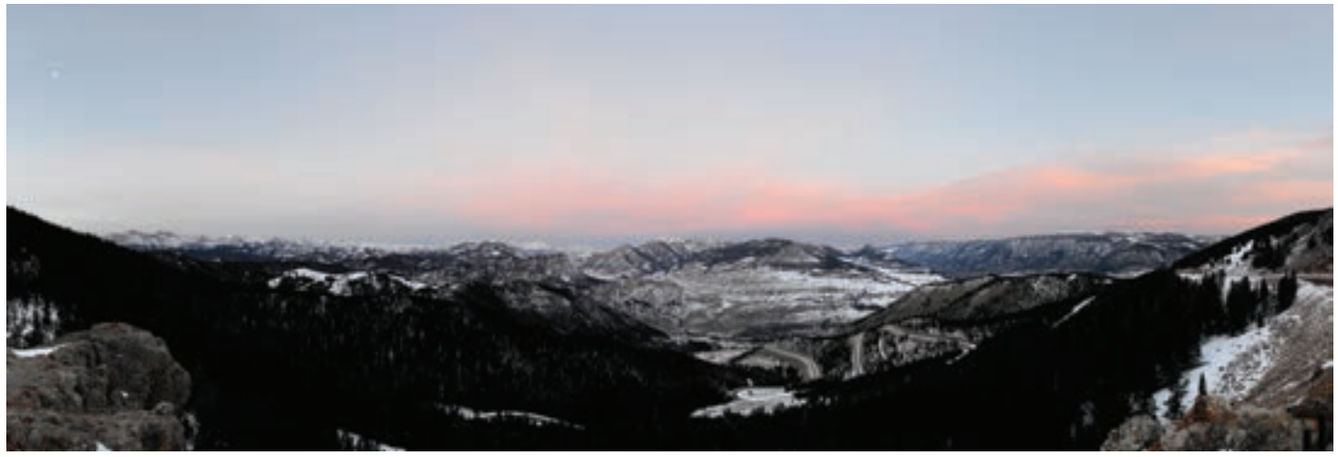
In 2005, the Bay Area landscape designer — fueled by memories of summers spent in Wyoming and a needling urge to cut through emotional unrest with the "sharp edge" of backcountry living — bought a leaky, ragged cabin in Sunlight Basin, 50 miles from Cody. A few years (and cabin repairs) later, Patten, in her early 50s, moved alone to northwestern Wyoming for good. Armed with a rare curiosity and fearlessness, she began exploring her surroundings: the richly forested and glacier-hewed heart of the Greater Yellowstone ecosystem.

Patten's investigation of this landscape, and her place within it, forms the basis of *The Wild Excellence*, which chronicles her "day to day, season by season" integration into habitat as rich in beasts as it is in beauty.

But *The Wild Excellence* is more than a personal meditation on place. From her humble six-acre patch among the pines, Patten has experienced more land-use and wildlife issues than most Westerners encounter in a lifetime. Patten digs into everything, from archaeological preservation to trapping to wolf and grizzly management, probing the bones of each with a thoughtful calm born of research and experience. Her prose is fresh, clean and occasionally profound, as when she describes her approach to the basin's grizzlies: "To walk with the Great Bear," she writes, "one must be alert, fully awake and aware. ... You cannot walk lost in thought, or conversation. You must be present. This alone is a gift that only another top predator can bring to man."

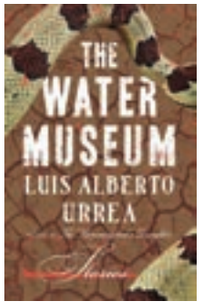
As Patten shares her adventures, from her initially awkward attempts to fence her property and camera-trap local wildlife to her later exploration of her neighbor's — and the area's — homesteading history, it becomes clear that she didn't move to the mountains to idle in a scenery-soaked stupor. Rather, Patten writes, the Greater Yellowstone Ecosystem is an elemental place that seems "to hold the essence of what (is) required to be a human being ... a landscape demanding vigilance and clear-eyed thinking."

BY MARIAN LYMAN KIRST



Sunrise over Sunlight Basin from the summit of Chief Joseph Scenic Highway. SCOTT COPELAND

The lonesome, crowded West



The Water Museum
Luis Alberto Urrea
272 pages, hardcover: $25.
Little, Brown and Company, 2015.

In "Mountains Without Numbers," the first short story in Luis Alberto Urrea's latest collection, *The Water Museum*, a middle-aged woman pages through her high school yearbook before heading into work. Frankie, as the locals call her, owns the only diner left in her washed-up uranium town. "The sky feels like it's on fire as she drives into town," the Pulitzer Prize finalist writes. "Her morning clients are always there before she is. Waiting for her. Feels like the last six people in the West." When she can, she keeps her back to the butte where, for decades, the most daring seniors had scaled the cliffs to paint their graduation date. The dates, the stories — all serve as *memento mori*, painful reminders of better times. "Is a town dead," she wonders, "when the old men die, or when the children leave?"

The stories in *The Water Museum* stretch from South Dakota to California — from divorced Ivy League professors to illegal immigrants — but all of them share a peculiar loneliness. And though in many cases that isolation is buttressed by a stark Western landscape, it is rooted in the insecurities and restless minds of the stories' protagonists. A Chicano graffiti artist slips into reverie after finding strands of long blonde hair stuck to the windshield of a scrapyard vehicle. An Oglala Sioux encounters a white man passed out on the hood of his Volvo on a country road in Wyoming. A widower struggles to follow his minister's advice and "bend like a reed in the wind," even as he finds himself deeply agitated by the influx of immigrants in his community. All of these characters are cut off from the world, lost in their own psychic territory, stumbling in their search for a way back home.

Throughout the collection, Urrea uses both Chicano slang and a rural Midwest vernacular with unassailable authority. These pages are filled with language so electric that you'll want to reread the sentences, relishing Urrea's sharp eye for description. ("Dexter watched her bottom work the bright blue skirt like a couple of tractor motors under a tarp.") But the rich language is simply a bonus; it's the subtle revelations hidden in the stories that satisfy the reader. They reveal themselves in the barest details: "The old motor court sits across the street. And a couple of white houses and two trailers," Urrea writes. "Frankie thinks about how each of those little places is a story."

BY CARSON VAUGHAN

False expectations

Yesterday, an hour before dusk, a black bear padded across my front porch and meandered up the Rocky Mountain hillside through a mix of conifers. It was a mid-sized male with a scruffy coat, disproportionately tiny eyes, and thick haunches that it lifted with every step to accommodate the long claws on its back feet. The bear paused a couple of times, once to sniff the compost pile and once to rub its scent against a tree trunk. Nothing spectacular or particularly personal happened. Yet the encounter still gave me a thrill: A 250-pound wild animal had wandered freely into and then out of my day.

Over the last century or so, as our world population has grown by 600 percent — to more than 7 billion people — wildlife has become ghettoized, cinched into increasingly limited zones. The Wilderness Act, signed into law 51 years ago this September, states that people should remain "visitors" in certain "untrammeled" U.S. landscapes. Yet even in wilderness areas, animals are managed, tracked, counted, collared and culled, lending a surrealistic, *Truman Show*-like quality to the pretense of isolation and free will.

Our encounters with the natural world are increasingly mediated, too, particularly by the moving image. Our experiences of nature on film have led us to expect the same from reality: We demand to see the whale spout, the Komodo dragon spit, the booby dance, the monkey swoop, the African lion make the kill — even though those moments never look quite as good as they did on TV in HD, in the 10-second "money shot" that took a cadre of cinematographers four years of frostbite and celibacy to obtain.

Such dramatic expectations of nature date back at least 75 years, when Walt Disney began to "let nature write the screenplays." (The actual cinematic lineage goes back even further to early nature filmmakers such as Percy Smith, who pioneered time-lapse photography, and Jean Painlevé, who built the first underwater housing for a camera.) As the story goes, Walt was ambling through his animation studios during the production of *Bambi* when he noticed the live footage of a fawn that his animators were using as a model. Walt found the "factual" footage as enticing as the fictional version; he had been striving for the utmost realism in *Bambi*, which was arguably a prescient animal-rights piece about human incursions in the forest. (The film lost money when it was released in 1942, partly due to the vocal outcry of gun-owners and deer hunters steamed about the portrayal of the heartless doe-killing hunter.) By 1945, Walt had hired a couple, Edna and Alfred Milotte, to make a Disney "True-Life Adventure" film, *Seal Island*, in the Alaskan wilderness. It was the first non-animated Disney film, and it went on to win an Academy Award in 1949 — as did seven subsequent others in the series, including *The Living Desert* in 1953 and *The Vanishing Prairie* in 1954.

The films were technically groundbreaking, and they still look stunning today. Their voice-of-God narration, *Fantasia*-like music, and outdoor choreography make them the clear progenitors of every PBS, National Geographic, IMAX and Discovery Channel nature show. Early viewers in the 1940s supposedly asked Disney how he got the animals to "perform" in sync with the sound. While there were no performing animals, the filmmakers did manipulate nature, most notoriously by slinging lemmings off a Canadian cliff during the making of the film *White Wilderness*: It was there that the myth of lemming mass suicide was born.

Last year, a new Disney "True-Life Adventure" film was released, called *Bears*. It begins not in the wilds of Alaska, as the narrator suggests, but on a controlled set with a captive bear giving birth. A quick cut to the exterior of a den elides the switcheroo, and we embark on the perilous mission of a female Alaskan brown bear, dubbed Sky, who is attempting to feed and protect her two anthropomorphic cubs, a "curious" male named Scout and a drowsy "mama's girl" named Amber. The trio must battle a "mischievous, scheming" wolf, Tikaani (the only "character" with an Inuit name) and more. Clearly, mainstream media still has a long way to go in how it portrays wildlife.

It all makes for theatrical viewing, yet could the contrast between that kind of colorful drama and real life trivialize, or even sour, our actual outdoor experiences? Me, I'd rather keep an eye out on my porch for another chance sighting of a live bear, even if I only catch a glimpse of its anonymous haunches. □

Filmmaker and writer Erin Espelie is editor in chief of *Natural History* magazine. She recently joined the faculty in film studies and critical media practices at the University of Colorado Boulder.

ANIEL J. COX/NATURALEXPOSURES.COM

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HEARD AROUND THE WEST | BY BETSY MARSTON

CALIFORNIA

The people-magnet at the botanical garden of the University of California, Berkeley, recently was a bilious yellow-green "corpse flower" dubbed "Trudy." Locals always have to wait a long time before the six-foot-tall Sumatran plant decides to open its purple petals, and the wait this time was unusually long — seven years. About 1,000 admirers — the most in more than a decade — lined up, not so much to see the plant, as to smell it. "Dirty socks wrapped around a rotting steak" was one of the more poetic descriptions of the plant's odor, reports KPIX-TV. Another visitor said the plant smelled like a "rotting fish carcass." Carrion beetles or flies are believed to come flying when the Sumatran titan aran prepares to flower, but pollinators have to be quick: The come-hither halitosis lasts only for a day.

WYOMING

Nobody had ever persuaded imperiled sage grouse to relocate their mating grounds until two eight-graders did so this spring, by creating impostor birds out of papier-mâché near Pinedale, reports Angus Thuermer in *Wyofile.com*. Maggie Majhanovich and Nora Legerski worked with state biologist Therese Hartman, who says that studies showed that leks — traditional places where the birds strut, court and mate — lose birds if they're within a mile of oil and gas drilling. In some places, the decline has been catastrophic. "The oilfield is real loud, and it's hard for (the grouse) to hear," explains Maggie. The students used carpentry shims to imitate the birds' splayed back feathers, and faux fur for the white, vest-like chest feathers; they even carefully painted the skin above the birds' eyes a gaudy gold. Because studies show that artificial leks that are too far away failed, they planted their 16 fake male birds slightly closer, wiring them to the ground. A final touch involved playing a recording of the booming chest sounds real males make as dawn arose. Surprise: For the first time ever, decoys worked, luring the birds into the quieter lek. Perhaps best of all for the real birds, the dummies offered no romantic competition. Hartman said that another way to help grouse survive in industrialized areas might be the erection of sound barriers around rigs. The birds are used to a natural background noise of 16 to 20 decibels, but drilling rigs can be as loud as 62 decibels, even from 100 yards away. For the students, the experiment was eye-opening: "If (the birds) were gone, who knows what might happen," asks Maggie. "It would affect other things — everything's balanced." The work isn't over yet; the girls' project will be entered in a science fair next year, so, as Nora says: "Now that we have our data, we have to type everything out."

WASHINGTON **Life skills.** KATHERINE DARROW

ARIZONA

Acting on a social media "tip," 11 armed, self-proclaimed bounty hunters recently swarmed the house of the Phoenix police chief, demanding that he release a fugitive allegedly hiding inside, reports *The Associated Press*. The tip was bogus, and the chief called his office, which sent police out to the standoff. They arrested the leader, Brent Farley, for criminal trespassing and disorderly conduct, and discovered that he was not even a registered bail recovery agent. It turns out, though, that *anybody* can become a bounty hunter in Arizona. Just register yourself with the state, and you can "walk out, go to the local gun shop, buy a gun, handcuffs, and 'Now, I'm a bounty hunter,' " says Joe Burns, former president of the Arizona Bail Bondsmen Association. Burns has been lobbying the Legislature unsuccessfully for years, he explains sadly, trying to mandate training and continuing education in the bail bonds industry.

SOUTH DAKOTA

Too shy? Motorcyclists at the annual Sturgis Motorcycle Rally lacked the necessary get-up-and-go-mostly-nude spirit to beat the world record for "most people assembled in one spot wearing only their underwear," reports the *Jackson Hole News&Guide*. Only 182 people showed up for the photo; the record remains untouched — 2,270 people.

NEVADA

In the last 17 years, Lake Mead has fallen 951 feet, reports the *Los Angeles Times*, and this summer it has sunk to its lowest level in 80 years. So come September, the lake's third and deepest intake pipe will be opened to ensure that Las Vegas stays watered. The reservoir's depletion has meant an upside for boaters: The once-submerged Mormon ghost town of St. Thomas is open for nostalgic sightseers, and a B-29 bomber that sank during a 1948 accident has become visible. The Lake Mead National Recreation Area remains the sixth most popular of the nation's 407 national parks, attracting 7 million visitors a year. But as the reservoir falls and the shoreline expands, there is a downside: Officials have spent $36 million extending boat launches — sometimes more than once.

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 or tag photos #heardaroundthewest on Instagram.

"Small rural radio stations are just as important in their communities as the big stations are in theirs — perhaps more so, since the **smaller communities lack the cultural and educational resources of urban areas.**"

Marty Durlin, in her essay, "CPB pulls the plug on Moab community radio," from Writers on the Range, hcn.org/wotr