

big ideas
SPECIAL ISSUE

High Country News

For people who care about the West



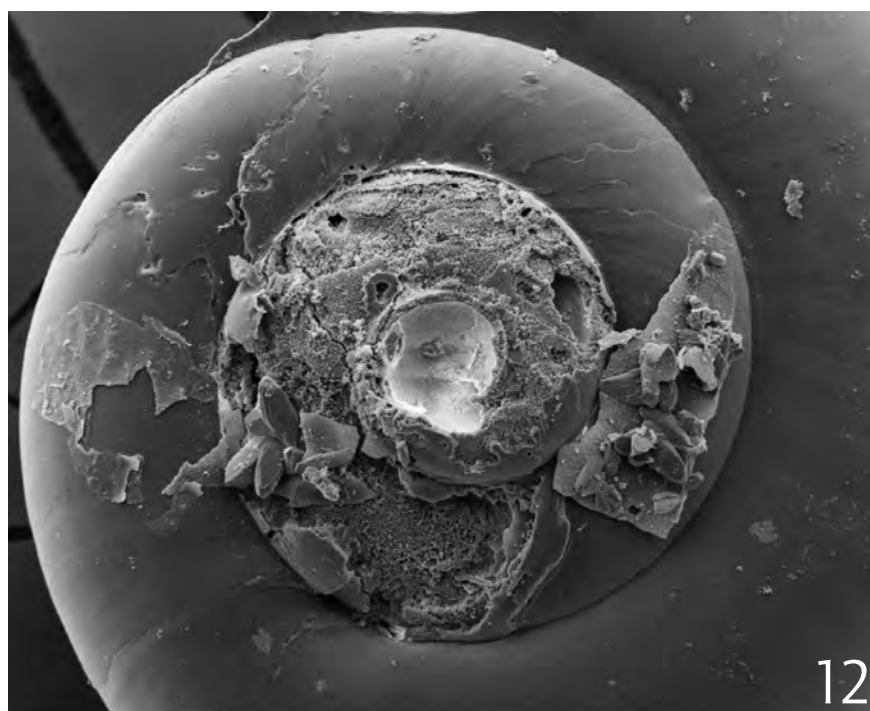
NO HOAX

How the West is confronting the reality of climate change

Left: A pinhead-sized pteropod, its shell corroded by ocean acidification, seen through a scanning electron microscope. Pteropods form the basis of a marine food web that includes everything from seabirds to Pacific salmon.

Center: A child from the Inupiaq village of Selawik walks near the shore in northwest Alaska. The community faces coastal erosion from climate change.

Right: Farmer Jenni Medley checks on seedlings beneath a grow light in Homer, Alaska. Along with climate change and concerns about food security, new technology is expanding the possibilities of what can be grown in the Far North.



COURTESY NATASHA R. CHRISTMAN/ WASHINGTON OCEAN ACIDIFICATION CENTER



NO HOAX

How the West is confronting the

Editor's note

This summer, we met our new reality

Climate change is no longer a hypothetical threat from some distant future. This summer, it showed up in force.

In Texas, Hurricane Harvey pummeled the Gulf Coast and inundated Houston, dumping many trillions of gallons of water in rain and causing so much damage it will take years for the state to recover. There is no definitive science saying that climate change causes specific hurricanes. But what we do know is that global warming has raised sea levels, which strengthens hurricane storm surges. It also increases precipitation, the real destructor in Texas. That's because warmer air holds more water, which falls as rain — in the case of Harvey, record-breaking rain that has caused perhaps \$180 billion in damage.

Montana, meanwhile, has a different problem. In the past century, the state has warmed by about 2 degrees Fahrenheit. Heat waves are more common than they once were, and drought has killed trees, dried soil and increased the risk of wildfires. The Environmental Protection Agency estimated in 2016 that the number of above-100-degree days that Montana experiences each year is likely to double. This summer, drought and dry weather have created a terrible fire season. At the time of this writing, 4,000 firefighters, 125 aircraft and 350 National Guard troops are



fighting more than 40 active wildfires in Montana alone. Well over 600,000 acres have already burned there, with no end in sight.

Hurricanes and wildfires are real threats to life and property. They cost lives and money, and while they cannot be prevented, they can be prepared for. But doing so requires acknowledging that these extreme weather events are bound to get worse, and that is something our current policymakers can't seem to do. The president insists that climate change is a "hoax" and won't allow government agencies to even mention it.

In this issue, we're asking a seemingly obvious question: What if — just what if — climate change is not a hoax? What if there is no global conspiracy of scientists (or the Chinese) manipulating data to trick people into reducing the use of fossil fuel? Who in the American West accepts the reality of climate change and is working to lessen its impact? We sent writers across the region, from the Pacific Coast to Alaska, Arizona to Wyoming, to see where and how climate change is affecting the West, its people and its politics. What we learned is that though the West is extremely vulnerable to a changing climate, it is also full of people who are determined to address it. If only that were true of our national leaders, flying over flood-stricken Texas or fire-ravaged Montana and wondering why in the heck things seem so out of control.

—Brian Calvert, editor-in-chief



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KRISTA LANGLOIS

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reality of climate change

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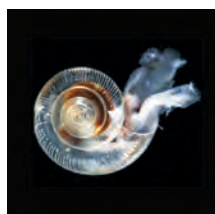
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On the cover

A pteropod, or sea butterfly, collected by scientists from waters off the West Coast, with a shell corroded by ocean acidification. Signs include white lines, white spots and pock marks. In extra-acidified water, the small snails don't die right away. Instead, they crumble, exhausting their resources trying to repair their shells.

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MORE ON DISTRIBUTED
GENERATION

I am a member of one of those California Sierra Club chapters that Jonathan Thompson mentions in his excellent feature, "The Bid for a Big Grid" (*HCN*, 8/21/17). Our concern has been more about the fact that up to 25 percent of the power transmitted long distances via high-voltage power lines is lost during transmission. Several California chapters have long argued for a Sierra Club policy that promotes distributed generation — local power generation for local needs.

Distributed generation has the advantage not only of cutting transmission losses; smaller targets are less appealing to terrorists, and the consequences of terrorist attacks on energy infrastructure would be much more limited.

Distributed generation has a long history and has been well studied. In fact, even the U.S. Department of Energy has a report on the subject, published in 2007: *The Potential Benefits of Distributed Generation and Rate-Related Issues That May Impede Their Expansion*.

I would have liked to see the distributed generation option discussed in Jonathan's article; it is compatible with a more integrated grid. Even better would be a follow-up feature that explores the advantages and disadvantages of big, centralized power generation as compared to decentralized generation.

Felice Pace
Klamath, California

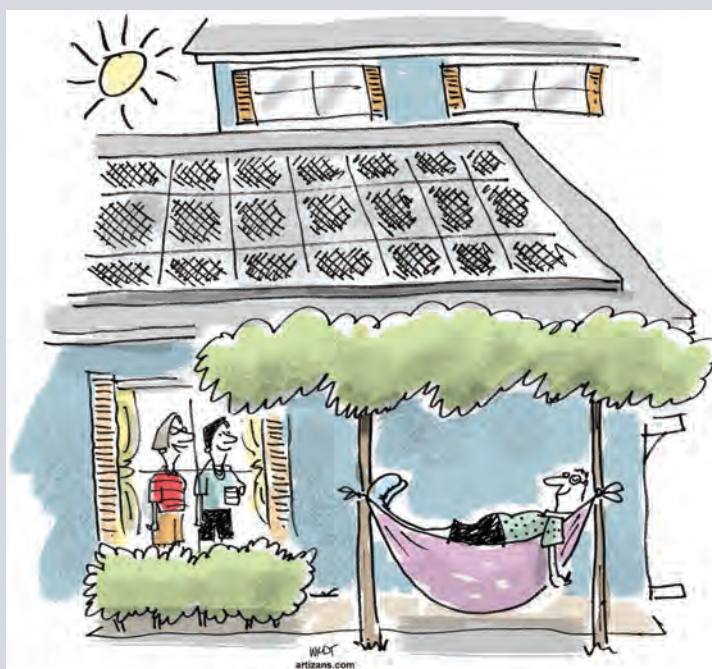
FOSSIL-FUEL-FREE FUTURE

Thank you for Jonathan Thompson's article on "The Bid for the Big Grid," as well as Elizabeth Shogren's on the Nevada power situation (*HCN*, 8/21/17). For the first time, perhaps, I am reading on the "how to" of switching to renewables instead of endless sorrow at what the United States seemed incapable of doing — a vision of moving forward without fossil fuels. I hope this gives others an inkling of vision as well, so that some of the despair around climate change, even for those who do not understand it much, dissipates.

High
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High Country News is a nonprofit 501(c)(3) independent media organization that covers the issues that define the American West. Its mission is to inform and inspire people to act on behalf of the region's diverse natural and human communities.



"Ned always naps more soundly when he's selling power back to the grid."

CHRIS WILDT/ARTIZANS

Like the brothers Nunn in Thompson's article, perhaps a whole new generation of "pinheads" will gain excitement, get the wheels turning, and keep on trucking to something sustainable. The Nevada article delightfully made it clear that many of these new pinheads are women.

Kate Niles
Durango, Colorado

TOO MANY MOTORS

The Alaska Quiet Rights Coalition (AQRC) was delighted to see Krista Langlois' very informative article "Trail Blazing" (*HCN*, 6/26/17). It deals with a topic that is dear to our hearts — providing high-quality opportunities for human-powered recreation on Alaska's public lands. We certainly agree that encouraging the development of more hiking, cross-country skiing and biking trails could create significant economic benefits for rural and other Alaskan communities. And the opportunities would seem to be boundless on Alaska's public lands — 224 million acres of federal and 104 million acres of state-owned land.

But there's an elephant in the room. The article never mentions one of Alaska's most basic and unyielding recreational problems: The vast majority of reasonably accessible (as well as

less accessible) public lands and trails, both federal and state, are managed for motorized recreation. There are very few refuges in the state for those who are seeking a quiet, natural, non-mechanized experience free of the immediate and/or lingering impacts and conflicts of motorized recreational vehicles like snowmobiles and ATVs. We'd be surprised if most *HCN* readers were aware, for example, that — due to what we firmly believe is a misinterpretation of a provision in the Alaska Lands Act — recreational snowmobiling is generally allowed, even in congressionally designated wildernesses, including those in national parks. Especially in winter, don't count on a wilderness experience — or even a fully

natural one — on Alaska's public lands.

Motorized recreation in the 21st century certainly has its place — but not seemingly everywhere. The adverse effects of poorly regulated motorized recreation are many. Natural sounds and natural quiet are of course degraded, as are clean air and water, soils and vegetation, wildlife, and intangible values like wilderness character. Even Alaska's spectacular scenery can be badly marred. Many otherwise beautiful snowscapes are a maze of snowmobile tracks as far as the eye can see, and in the non-snow seasons, innumerable landscapes are seriously scarred by ever-widening ATV trails — many, if not most, of those trails unplanned and virtually unregulated.

The Alaska Quiet Rights Coalition certainly supports efforts to provide more — in fact, many more — high-quality opportunities for human-powered recreation in Alaska. It's our mission. But until Alaska's state and federal public-land managers agree to allocate a more reasonable percentage of the public lands to non-motorized recreation, visitors seeking a quiet, natural experience hiking, skiing or biking in Alaska will be sorely disappointed.

Brian Okonek, president
Alaska Quiet Rights Coalition
Anchorage, Alaska

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Why the Bundy crew keeps winning in court

In late August, a Las Vegas jury acquitted Ricky Lovelien of Montana and Steven Stewart of Idaho for their parts in the 2014 armed standoff between the federal government and supporters of rancher Cliven Bundy. The jury found co-defendants Eric Parker and Scott Drexler not guilty of most charges, but deadlocked on some. When it comes to trying the Bundy family and their supporters, federal prosecutors have a terrible record, winning just two convictions after two trials of six defendants in Nevada this year. Last fall, Bundy's sons Ryan and Ammon Bundy and five others were acquitted of charges stemming from the armed takeover of Oregon's Malheur National Wildlife Refuge in early 2016.

The recent acquittals in the Nevada case raise big questions for prosecutors. Some legal experts say the nation's current political climate, characterized by distrust of federal authorities, may be one reason juries keep siding with the Bundy crew.

In 2014, a court ordered the federal government to round up Bundy's cattle, which were illegally grazing on public land near Bunkerville, Nevada. Bundy felt the feds were overreaching. In the tense face-off that ensued, hundreds of armed supporters forced Bureau of Land Management and National Park Service employees to end the roundup for fear of violence. The Bunkerville stand-off trials may have set off alarms for the average juror. Jurors are instructed to use their "common sense" when evaluating evidence. Today, an estimated 80 percent of Americans say they distrust the federal government at times. (That's up from 66 percent in 2000 and 27 percent in 1958.) The recent verdict was not a result of jurors' sympathy for the Bundys, Lovelien's attorney, Shawn Perez, concluded. "This is not a rogue jury. It is a failure of truth on the part of the government."

The most recent trial, a retrial after the first jury deadlocked, was marked by a persistent push-and-pull dynamic between the defense team



Cory Chappell holds a sign during a rally outside the Nevada Federal Court in August after a judge cut short the testimony of defendant Eric Parker during the Bundy standoff retrial in Las Vegas.

© JOEL ANGEL JUAREZ VIA ZUMA WIRE

and U.S. District Court Judge Gloria Navarro. That conflict took its own form outside the courtroom, too: Bundy supporters observing the trial have called Navarro "biased" for months. "The public has become more and more aware of the power of the judiciary. As a result, there's been kind of a political arms over appointments, which has resulted in more distrust," said Ian Bartrum, constitutional law expert at the University of Nevada. "Couple that with recent conservative rhetoric and presidential rhetoric, and I guess you get the current climate."

Similar dynamics may come into play in the trial of Cliven Bundy himself, which is slated to begin Oct. 10. TAY WILES

MORE: hcne.ws/distrustful-acquittals

“You can get a lot of votes by being tough on illegal immigration, and Arpaio came to the conclusion that this was good politics.”

—David Berman, a political science professor at Arizona State University, who has studied the influence of Joe Arpaio's rhetoric on voters. More on how "America's toughest sheriff" galvanized a movement among Arizona Latinos: hcne.ws/arpaio-pardoned



Pete Seeger serenades the Snake River in Hells Canyon in August 1972. BOYD NORTON

A return to the Snake River

In the late 1960s, a ragtag group of outdoors people, including legendary musician Pete Seeger, took a trip on the undammed Snake River. Those photos helped persuade politicians to establish the present-day Snake River Wilderness. The personality of the river, captured in those old photographs, is juxtaposed with recent river trips in 2010 and 2017. The collection colorfully shows the then-and-now of the Snake River's Hells Canyon section.

CAMERON SCOTT MORE: hcne.ws/river-revisited

90,000 Number of cars it would take to create as much greenhouse gas as is emitted, in the form of methane, by western Colorado's West Elk coal mine each year.

8% to 5% Royalty rate reduction the mine's owner, Arch Coal, has requested from the Bureau of Land Management, which holds the leases.

\$4 million Loss in revenue, over five years, Colorado would face if the royalty rate is reduced, according to Gov. John Hickenlooper, who says he'll agree to the loss, if Arch agrees to capture the methane.

Arch Coal is struggling in a declining coal market and has asked the federal government to reduce coal royalties at the West Elk Mine in Colorado, the state's largest methane emitter. The state was willing to agree to the discount in exchange for methane capture. But the final decision by the Bureau of Land Management, expected this month, may not require it. ELIZABETH SHOGREN
MORE: hcne.ws/methane-discounts

Trending

Big blazes and politics

Montana has been hit hard by wildfires this year, which have caused evacuations and burned over half a million acres. Republican politicians have laid the blame on "environmental extremists," saying they are causing mismanagement through restrictive lawsuits that limit logging. Removing dead trees and thinning forests are common tools for helping to prevent wildfires. But scientists have shown climate change is increasing temperatures and triggering longer wildfire seasons. President Donald Trump's proposed 2018 budget calls for a \$300 million reduction to the U.S. Forest Service's wildfire-fighting programs. CHRIS D'ANGELA/HUFFPOST VIA CLIMATE DESK

You say

HATCHETT JIM: "Let it burn, that's part of the natural cycle of Western forests. The cost of fighting fires should be paid for by the people that build their houses in these obviously vulnerable areas."

RUSSELL WELCH: "Strange how the privately managed stands of timber in the Northwest never seem to suffer insect devastation or catastrophic fires."

STACY PHILBRICK KANDEL: "We try to manage our forests with selective logging and reduction of fuels. Nearly every time a harvest plan is submitted, 'environmental extremists' sue to stop it claiming logging 'may' hinder an animal that 'may or may not' live in the area. It's ridiculous."

MORE: hcnews/blaming-environmentalists and facebook.com/highcountrynews

Tribes commit to uphold Paris climate agreement

Western nations take action on climate change — and push for self-governance

BY LYNDSLEY GILPIN

The Swinomish Indian Tribal Community started planning for climate change a decade ago. Located on the southeastern peninsula of Fidalgo Island on Puget Sound in Washington, the reservation is surrounded by water and at high risk from sea-level rise. A destructive 100-year storm event in 2006 led tribal leaders to research and fund climate programs, and the Swinomish became the first tribal nation to adopt a climate adaptation plan.

So when President Donald Trump announced his decision to withdraw the U.S. from the United Nations' Paris climate agreement, the Swinomish reacted swiftly and — together with other tribes — publicly committed to uphold the accord.

In the West, where many tribal communities and reservations are on the frontlines of climate change, tribal leaders are determined to move forward and act as sovereign nations, despite budget cuts, climate denial and inaction. "We came together with one another to raise the level of environmental awareness," said Debra Lekanoff, governmental affairs director for the Swinomish. "We can't just pick up and move the places where we live."

Though Indigenous communities have a small carbon footprint, they are often the most severely impacted by climate change. There are 567 federally recognized tribes in the U.S. — 40 percent of them in Alaska — and climate change threatens many of them. In California and the Pacific Northwest, tribal nations are at increased risk of sea-level rise. Coastal communities like the Quinault Indian Nation in western Washington and at least 31 Alaska Native villages, including the Shishmaref village near the Bering Strait, face coastal erosion. Already, several have been forced to relocate.

Around the American Southwest, heat and drought are baking streams and shifting sand dunes, leaving the Navajo Nation and other tribes and pueblos with fewer resources, while wildfires endanger tribal nations from eastern California to the Rocky Mountains. Primary food sources, like salmon and other endangered fish, are dying from warming rivers and acidifying oceans.

On June 3, just two days after Trump made his announcement on the Paris Agreement, the Swinomish Indian Tribal

Community joined the Standing Rock Sioux Tribe, the Quinault Indian Nation, and the Central Council of the Tlingit and Haida Indian Tribes of Alaska in committing to support the agreement. The National Congress of American Indians and the Native American Rights Fund did so as well.

Their decision to publicly announce their support is more than symbolic, experts and leaders say: It tells the United Nations that tribal nations are climate leaders and intend to remain part of the global conversation about climate change.

"Tribes have already taken a lot of leadership in planning for the negative impacts of climate change," said Kyle Powys Whyte, a member of the Citizen Potawatomi Nation and professor of philosophy and Indigenous studies at Michigan State University. "It's really important that some tribes begin to take the lead on what it means to have the biggest possible energy-saving impact in the area they live, and to exercise self-governance."

Though tribes and states are sovereign entities within the U.S., they are not allowed to enter treaties or negotiate with foreign nations. Under United Nations policy, Indigenous people are treated as self-determining when it comes to cultural issues, but lack the political self-determination of member nations.

The 2008 United Nations Declaration on the Rights of Indigenous Peoples allows tribal communities to participate in U.N. matters. Signing an agreement like the 2015 Paris climate accord, however, would require changing policies at the

Quinault tribal member Sonny Curley canoes through Sea Breeze Field after seawater flooded the tribe's lower Taholah Village in March 2016 during a storm. In response to repeated flooding due to sea-level rise and anticipated tsunamis, the tribe is moving its lower village to higher land and rebuilding the sea wall.

LARRY WORKMAN/
QUINULT INDIAN NATION



U.N. and in the U.S. Tribal leaders say it's possible. "Just to have them recognize us was a step in the right direction," said Brian Cladoosby, president of the National Congress of American Indians.

But changing the law is an arduous process, so tribes in the U.S. are taking a short cut: working more closely with Indigenous populations from around the world through programs like the United League of Indigenous Nations, which has its own climate program, or the International Indigenous Peoples Forum on Climate Change.

"Tribes are really trying to get out there and represent themselves, and become stronger partners in agreements where U.S. representation isn't necessarily good for them, like the Paris Agreement," Whyte said. According to Whyte's research, more than 50 U.S. tribes have engaged in formal climate change planning, and many have had climate adaptation plans approved by their councils.

In addition to assessing larger climate goals, tribes are working on the ground to address the impacts. The Swinomish have partnered with the Skagit Climate Consortium to protect the region's salmon from pollution and warming waters. In Southeast Alaska, the Tlingit and Haida Indian Tribes are monitoring ocean acidification levels and harmful algae blooms while adapting buildings and infrastructure to cope with rising sea levels along rivers and the coasts.

Since 2008, the Pueblo of Jemez in New Mexico has been working on small and utility-scale solar projects, as well as biomass and geothermal energy projects. Last September, the Samish Indian Nation in Washington landed a grant from the Bureau of Indian Affairs for climate adaptation planning and education. But funding is increasingly uncertain: Another Department of Energy grant that arrived this summer was five months later than expected.

"What happens in the future is anyone's guess at this point," said Todd Woodard, director of natural resources for the Samish. "Tribal country funding has never been so murky as it is now."

Trump's federal budget proposal would cut tribal climate resilience award money by \$9.9 million, and in June, the Bureau of Indian Affairs had scrubbed all references to "climate change" from the agency's website about the Tribal Climate Resilience Program. Whyte noted that many tribes may not be able to start renewable energy projects alone; usually, an investment from the federal government is needed.

"It behooves tribes to find ways for their climate change plans to be part of discussion," Whyte said. "By publicizing them as much as they can and getting interactions with as many parties as possible, we can see if that begins to build traction, so parties at the U.N. begin to see them as what they are: sovereign entities that should be able to self-determine." □

Snapshot

Imported salmon

This year's fall chinook salmon return on the Klamath River in Northern California is the lowest ever, which means that the Yurok Tribe, whose reservation hugs the river on both sides, has received its lowest fish allocation ever, at 650 fish. In order to help the species, the tribe has voluntarily imposed

a moratorium on fishing for the season, as was evident at the annual Salmon Festival. Usually, the festival features a chinook meal; this year the salmon came from Alaska, parts of which have also cancelled their fishing seasons. The West Coast as a whole is seeing massive drops in salmon populations due to climate change and dams; 200 miles of coastline have been closed to commercial and recreational salmon fishing for the season. ANNA V. SMITH MORE: hcn.org/salmon-fest



Oscar Gensaw tends the fire as salmon cooks on redwood sticks — the Yurok Tribe's traditional way of cooking salmon — while his brother, James, readies more yew wood to feed the flames. The salmon was served for the Klamath Festival luncheon, at \$15 a plate. JOLENE NENIBAH YAZZIE



Cooked strips of salmon sit seasoned and ready to eat, left. Because of a shortage of salmon from the Klamath River, organizers had to purchase fish from Alaska. A pile of wooden skewers used to roast salmon near the fire pit, right. The word for salmon in Yurok is *ne po y'*, which means "that which is eaten." JOLENE NENIBAH YAZZIE

Going home again

A young climate change researcher fights invasive plants on her ancestral lands

BY PAIGE BLANKENBUEHLER

Uncommon Westerner

Name Ka-Voka Jackson

Age 25

Current position

Graduate student at the University of Nevada, Las Vegas

The work Restoration ecology research

She says "I'm out to protect the little guys – the vulnerable ones. Because those plants, the willows and the sage, have a tougher battle against climate change than the invasive grasses do."

The work Valley of Fire State Park

Favorite non-work activity Mountain biking in the desert

Most rad battle scar An artificial incisor that replaced a tooth that was lost in a biking accident last year.

Inside a lab on the fourth floor of the Science and Engineering Building at the University of Nevada, Las Vegas, Ka-Voka Jackson pulled from a brown sack a dried seed head of the invasive plant called ravnagrass. She slowly maneuvered the brittle branch out, and from its wispy ventricles tiny seeds poofed into the air, across the counter and onto the floor. A couple of them latched onto her long black hair. "Each of the seed stock plumes can produce thousands per plant," she said, as she shimmied it back into the bag. "It's a prolific seed bearer. They are very light, and they can travel by wind, float on the water. And it seems to spread very efficiently in this area."

Jackson, a graduate student in the School of Life Sciences, was raised on the Hualapai Indian Reservation in Arizona. Her ancestral lands span 1 million square miles along the Colorado River. Since 2016, after completing a degree in Salt Lake City and moving to Las Vegas, she's been studying how to eradicate *Saccharum ravennae*. The bushy plant, sometimes called elephant grass, grows up to 14 feet tall, in bunches nearly half as wide. It was introduced as a decorative landscaping plant in Ohio in the 20th century, and by 2001 had reached the Southwest. While its beauty and resilience make it a popular accent amid rock gardens and succulents, ravnagrass can push out native plants, like white sagebrush and willow baccharis, that play a role in the ceremonial and medicinal practices of the Hualapai and other Southwestern tribal nations.

When we met at the University of Nevada's plant seed control room in August, it was nearing 100 degrees, and Jackson was dressed entirely in black, including canvas Toms shoes and rounded black glasses. Half a dozen tattoos decorated her calves and forearms. With the Southwest's climate on a trajectory for prolonged drought and weather extremes, Jackson navigates the deep backcountry near Glen Canyon, around the Arizona-Utah border. Here, back home, she is working to eradicate prolific and climate-change-resistant invasives and restore native vegetation.

Growing up in the early 1990s, Jackson took an early interest in the natural world. Her mother, the head of the



Ka-Voka Jackson monitors plots of ravnagrass that have been treated with herbicide. Part of Jackson's research is testing to see how manual removal compares to spraying herbicide in stopping the plant's spread throughout Glen Canyon Recreation Area. BRAD JORGENSEN

Hualapai's cultural resources department, took her on river trips down the Colorado. The year she was 5, she spent a total of seven months sleeping outdoors. She graduated from the University of Utah and went to graduate school at the University of Nevada, Las Vegas. As part of her graduate research, in collaboration with the National Park Service and Glen Canyon National Recreation Area, Jackson is now assessing dozens of plots, 100 square meters each, in five different canyons.

In April, she took a team of technicians into the canyons to kill or pull up ravnagrass and replant native plants. Jackson is also investigating whether passive re-vegetation — allowing the native plants to come back on their own — can work. Over the course of her program, she will return to monitor her plots, recording details from each to give land managers insight into which methods could work best for Glen Canyon National Recreation Area. "Given that the climate is dry and this is truly a desert, finding even one or a few techniques that restore native ecosystems would be a huge success in this type of difficult environment," said Scott Abella, an associate professor who is overseeing the research.

While Jackson's research will help land agencies, she hopes the project can

create a bridge between tribal nations and federal agencies, so that tribes can develop their own long-term ecological restoration plans. Eradicating ravnagrass completely will be difficult, but Jackson thinks a paradigm shift in land management is imminent. "Tribes still use these plants ceremonially, to build certain objects, medicine and food sources. We're not dependent on them now; we have modern society and can go to Home Depot instead of building from thatch. But it's more about keeping the culture alive."

The challenge is mighty. Climate change is increasing the harshness of the Southwest. Recently, Jackson and a technician from the Park Service revisited her plots that had been treated this spring. They entered a canyon where a park technician had sprayed herbicide a few years earlier. As they wended their way through thickets of brush and shrub oak, Jackson saw a delicate hanging garden of native flora — in view of a bunch of encroaching ravnagrass. "We were both just like 'NOOOOOO!'" she said. "It was really upsetting to see that even after the Park Service had thought it eradicated some of the ravnagrass in the canyon, it came back." Still, she remains hopeful. "I myself am not going to eliminate all of the ravnagrass in Glen Canyon," she said. "But I can figure out the best way to get rid of it." □

Wyoming's coal conundrum

As cheaper, cleaner fuels overtake the electricity market, can coal remain a linchpin of Wyoming's economy?

BY JOSHUA ZAFFOS

Wearing a blue construction helmet, Dennis Thorfinnson stands in the shadow of a 500-foot-high chimney, and stares up at a sharp blue sky filled with puffy summer clouds. "What do you see?" he asks me. It seems like a trick question; I see nothing.

Thorfinnson grins proudly. Not a single visible trace of pollution floats from the stack of Gillette, Wyoming's Dry Fork power plant, even as it burns coal. This is one of the country's newest — and cleanest — coal plants. The engineers who built it in 2011 tailored its pollution controls to the particular chemical composition of coal from the neighboring Dry Fork Mine. That means it releases less sulfur dioxide, nitrogen dioxide and even carbon dioxide than older coal plants do.

But it still releases invisible carbon dioxide, which contributes to climate change. And Wyoming's leaders know that's a problem. Forty-two percent of the domestic coal supply is mined in the state, much of it from large mines around Gillette. In recent years, the coal industry has employed one in every 10 workers in Gillette and surrounding Campbell County. But coal is declining as a power source. It can't compete with cheaper, cleaner natural gas, and eventually, climate change regulations are expected to worsen its prospects.

Yet with roughly 6.6 billion tons of recoverable coal still in the ground, and an economy hooked on mining and burning it, Wyoming can't seem to quit it. Instead, state leaders are trying to clean it up and find new uses for it.

Near where Thorfinnson and I stand, a construction crew is setting beams for the Wyoming Integrated Test Center, where researchers hope to capture carbon dioxide emissions and eventually turn those emissions into plastic, carbon-fiber materials, concrete or fuels. Wyoming has put \$15 million into its construction. A private utility company will test new carbon-capture technologies and pursue uses for the carbon, while five smaller research teams compete for \$20 million in industry prize money, offered to commercialize "advanced coal" products.

During a 30-year career, Thorfinnson has seen technological advances reduce power plants' output of mercury, sulfur dioxide and nitrogen dioxide, virtually eliminating problems like acid rain. Capturing and using carbon emissions is the natural next step, he says. Capable, confident and affable, Thorfinnson has me believing, too.

So far, though, most "clean coal" initiatives have failed. Carbon-based rubbers, asphalts and chemicals have never

achieved large-scale commercial success, partly because it's easier and cheaper to just use petroleum. Highly touted efforts to capture and store emissions from coal plants have also fizzled because costs spiraled out of control. Even in Wyoming, it's hard not to wonder: Is it smart to keep betting on coal?

On the last day of March 2016, Gillette miners traded anxious phone calls, trying to figure out who still had a job. Following months of declining coal prices, mining companies laid off more than 500 Wyoming workers. By the end of the year, another 500 had lost their jobs.

The bust hurt more than Gillette and other mining towns; it hammered the whole state. Taxes on the minerals dug from the earth, along with property taxes paid by the energy industry, account for 50 to 65 percent of Wyoming's total tax revenue, bankrolling schools, roads, hospitals, police and emergency services. Coal mining, specifically, has recently contributed more than \$1 billion annually to state and local budgets.

When production crashes, so does the state's budget. The decline of coal was a major factor in lawmakers' 2016 decision to drastically cut funding for public schools, suicide-prevention programs, health-care services, and fish and wildlife management. And this time, few are banking on coal's full comeback.

So last November, Gov. Matt Mead, R, launched ENDOW, an economic diversity initiative designed to attract new manufacturing and technology businesses and create work for young Wyomingites.

Please see Coal tech, page 29



Train cars to be filled with coal move through a loading area at Peabody Energy's Rawhide Mine, outside Gillette, Wyoming. The Dry Fork power plant, where researchers will soon begin experimenting with turning the plant's emissions into useful products, operates in the background.

KRISTINA BARKER

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SPOKEN THROUGH CLAY: NATIVE POTTERY OF THE SOUTHWEST

By Charles S. King. 352 pages, hardcover: \$125. Museum of New Mexico Press, 2017.

Spoken Through Clay features the artwork and stories of more than three dozen Native American potters from the American Southwest. Photographs of clay vessels — their sides painted or carved with designs ranging from abstract motifs to realistic depictions of people, butterflies, fish and other creatures — form the heart of this gathering of contemporary clay art, carefully chosen by author Charles S. King.

Vignettes describing the meaning and inspiration behind the pieces accompany the images. Each selection of vessels, grouped by artist, begins with a portrait of the potter by Diné photographer Will Wilson. Narrative accounts of each artist's personal experience and creative process, written by the potters themselves, add depth and nuance to the collection of vessels and their histories. As one Pueblo artist writes, "You can look at pottery — and see there's a story there." **EMILY BENSON**



LES NAMINGHA



Matthew and Joan Symonds use their eclipse glasses to stare at the sun while visiting *HCN* after their road trip to see the total solar eclipse.

BROOKE WARREN

Solar sojourners and print 're-leafing'

Mornings are getting chillier as August fades into September, and we've started to spy the first changing leaves dotting the aspens in the mountains above Paonia, home of *High Country News*. Happily for us, the sun and the moon conspired to bring plenty of visitors to our door. In the days after the solar eclipse in August, which was 87 percent total here, several folks stopped by on their way home after watching the celestial spectacle.

Joan and Matthew Symonds from Farmington, New Mexico, visited after viewing the eclipse in Riverton, Wyoming. The experience, they said, was indescribable; Joan noted that she saw the moss roses shut when the sky went dark. Matthew has been an *HCN* subscriber for 30 years, and he appreciates that we cover a lot of stories "otherwise missed by everyone."

Subscriber **Dan Groth** of Durango, Colorado, also dropped in on his way home; he watched the eclipse with his brother and his family in Laramie Peak, Wyoming. **Robi Mulford** and **Ian Swift** from Los Alamos, New Mexico, came in post-eclipse after finding a nice quiet spot down a farm road — also in Wyoming. Robi works at a medical clinic where *HCN* is the "only coffee-table reading," so she reads it at work quite happily! She renewed her own subscription while she was here, so now she'll be able to read us at home, too.

Three-year subscriber **Jane**

Mahon and her friend **Abby Dix** also stopped by for a visit. Jane, from Corrales, New Mexico, is considering moving to Paonia after some prodding from Abby, who lives nearby in the Telluride area. **Wilbur Flachman**, from Westminster, Colorado, toured the office in late August. As a veteran of the industry — 50 years in publishing — Wilbur wanted to see what the inside of our operation looks like. We hope it meets your standards, Wilbur!

Tim and Kate Willink visited the Western Slope from Denver for the hiking, the peaches and the local gin. Our staff enjoyed a nerdy chat with Tim and Kate about net metering, which we covered in a feature story in our Aug. 21 issue. **Janna Treisman**, a retired teacher from Washington and a longtime subscriber, came by for her second visit in two years. She thanked the staff for "keeping her sane." Thanks for coming back by, Janna! It's visitors like you who keep us sane.

We're clearly big fans of the pages you're currently holding, but we also hold dear the trees they came from. That's why, starting in October, we'll be participating in "PrintReleaf," a program that plants trees to offset the paper we use to print *HCN*. About 80 trees will be planted for each issue, totaling about 1,760 trees per year. Now that's a forest we'd like to see!

—Emily Benson,
for the staff

BUYING T

How the Pacific Northwest is confronting the threat of ocean acidification

FEATURE BY
MAYA L. KAPOOR

Taylor Shellfish Farm's Quilcene hatchery perches on a narrow peninsula that juts into the sinuous waterways of Washington's Puget Sound. On the July day I visited, the hatchery and everything surrounding it seemed to drip with fecundity. Clouds banked over darkly forested hills on the opposite shore, and a tangy breeze blew in from across the bay. But the lushness hid an ecosystem's unraveling.

Climate change is altering the very chemistry of surface seawater, causing ocean acidification, a chemical process that is lowering the amount of calcium marine organisms can access. Acidification is a relative term; the oceans are not actually turning into acid and will not melt surfboards or sea turtles anytime soon. Still, with enough acidification, seawater becomes corrosive to some organisms. Hardest hit are calcifiers, which use aragonite, a form of the mineral calcium carbonate, to make shells, skeletons and other important body parts. Examples of calcifiers include crabs, sea urchins, sea stars, some seaweeds, reef-forming corals, and a type of tiny floating marine snail, or pteropod, called a sea butterfly. Shell-

fish, including oysters and clams, are also seriously affected. With the disappearance of many of these sea creatures, oceanic food webs will be irrevocably altered by century's end.

People have harvested shellfish in the Pacific Northwest for thousands of years. Today, the industry generates more than \$270 million annually in the state of Washington alone. A decade ago, the region's shellfish growers were already reeling from harmful effects of climate change, so they have been in some ways at the forefront of climate adaptation. I'd driven to Taylor Shellfish Farm to learn how they were working, with scientists and others, to save their livelihoods and the coastal ecosystems they're built on.

Dave Pederson, the hatchery manager, met me in a bright building full of burbling saltwater tanks of assorted mollusks. A tall, fit man with a graying beard, Pederson led me outside behind the hatchery. Two hundred feet below us, glittering blue water splashed against the steep cliffside, while inside the hatchery, tiny oysters, mussels and geoducks — pronounced "goeey ducks" — filtered algae soups, carefully concocted by hatch-

ery staff. Yesterday, workers had spawned Pacific oysters, which within hours built their first shells from seawater calcium. Throughout the hatchery, millions of baby bivalves grew from mere specks to identifiable mollusks, fated to gleam on half shells in trendy Seattle oyster bars, or be whisked off to Asia by FedEx flight.

"Oysters are our number-one product, then geoducks, then Mediterranean mussels," Pederson said, guiding me between shaded storage tanks. "We've also done some research work with scallops."

For more than 250 years, since the Industrial Revolution's beginnings, the ocean has absorbed approximately a third of the carbon dioxide that humans have produced, slowing the impacts of climate change on land. But since 1750, the average acidity of its surface water has increased by almost 30 percent. The ocean is acidifying 10 times faster now than it has in the past 50 million years. Scientists don't yet understand what this means for sea life, but ocean acidification already affects Pederson and others who rely on the ocean. He and other farmers, along with researchers and policymakers, are searching for lasting solutions to the



I M E

regional climate change impacts they are witnessing. Meanwhile, worries about the planetary implications of ocean acidification keep growing.

HUMANS HAVE LIVED along North America's West Coast for millennia, in part because of a maritime phenomenon that occurs in only a few places on Earth: seasonal coastal upwelling. First, surface seawater near Japan sinks into a deep-water current well below sunlight. That current carries the water to North America, a trip that takes between 30 and 50 years. Decaying pieces of marine plants and animals come along for the ride, providing a feast for carbon dioxide-releasing bacteria that naturally acidify the surrounding water. Eventually, this deep current reaches the West Coast, where a southerly wind blows the surface water out to sea. Then the nutrient-rich water from the North Pacific rises, nourishing the seaweed and phytoplankton that thrive in sunlit surface waters. That growth is the foundation for the West Coast's incredibly diverse food web, which supports some of the most productive fisheries in the world.

Even before human-caused climate

change, the organisms of the Pacific Northwest lived at the edge of their tolerance for acidity. Now, though, surface water absorbs so much atmospheric carbon dioxide that by the time it upwells again, its acidification will reach problematic levels.

"This is something that's roaring up on us that can't be stopped and is really kind of freaky-scary," Skyli McAfee, director of The Nature Conservancy's North American Oceans Program, told me. "We know that we already had an unusual and acidified system, and to pile all this on top of it — we're not certain what kind of impacts we can expect to see."

Because of the long voyage that Pacific seawater takes, this problem won't stop anytime soon, McAfee added. "Even if we stopped all carbon emissions tomorrow, we'd be getting the signals that have already been entrained in the water, over the next several decades," she said. "Twenty years from now, we're going to see waters that contain a signal from the atmosphere 20 years ago. So we kind of bought the cow."

The study of ocean acidification is still a young field, and scientists don't yet know how the phenomenon is going to

affect most sea life. But in coastal areas, it's clearly compounding other threats, such as farming pollution and city sewage. To McAfee, this introduces a paradoxical sliver of hope: If regional actions exacerbate a globally produced problem, perhaps regional responses can help assuage it. McAfee acknowledged that there is no returning to an ocean untouched by human-caused acidification. Instead, she focuses on resilience. As more people move into coastal communities, more and more nutrients flush into coastal systems. Extra municipal and agricultural runoff create the potential for more "dead zones," such as in the Gulf of Mexico. "It sets off a chemical reaction that is analogous to ocean acidification," McAfee said. McAfee believes that coastal communities can protect themselves by keeping their marine ecosystems as healthy and diverse as possible, helping to prepare for ever-more-acidic upwellings. This will require working with farms and cities to cut back on runoff, for example, and preserving as many coastal protected areas as possible to give marine life safe places to grow from vulnerable babies into adults. Ultimately, if coastal ecosystems

A worker tends the tanks outside the Taylor Shellfish Farm hatchery in Quilcene, Washington. The tanks hold various types of algae that help the bivalves bred at the hatchery grow to a size at which they can survive the increasingly acidified coastal waters into which they'll be seeded.

CAMERON KARSTEN



get help with regional stressors, they will be in the best possible shape for surviving global stressors. McAfee calls this “managing for resilience.”

“It’s not all doom and gloom,” she assured me. “At the end of the day, what the story is, is: We have the tools, we have the science, we have the fortitude. We just need to do it.”

A DECADE AGO, most people — including scientists and shellfish growers — had never heard of ocean acidification. But in 2007, following a hunch, National Oceanic and Atmospheric Administration oceanographer Richard Feely put to sea

cruise, shellfish farms throughout the Pacific Northwest were failing. About two days after hatching, all 2 million oysters in a set would die. Whiskey Creek hatchery — one of the industry’s largest suppliers of shellfish larvae to farms — produced only 2.5 billion “eyed” larvae in 2008, just 25 percent of what it normally produced in a season. As one bad season stretched into two, farmers focused on the usual suspects. Thinking a bacterium called *Vibrio tubiashii* was to blame, growers would halt operations, clean out their tanks, and add new water and new stock, only for their oysters to die again. The growers were mystified. Then, in 2008,

years, though, Dale’s oyster seeds died before they ever left their tanks. In some cases, their tiny shells seemed to dissolve.

Feely’s keynote presentation explained what Dale and the other growers were witnessing at their hatcheries: Before the Industrial Revolution, the upper ocean’s average pH was 8.2. The pH scale, which measures acidity, goes down as acidity goes up. It’s now 8.1, a deceptively small-sounding difference: The ocean is actually 30 percent more acidified. And in the summer of 2008, because of seasonal upwelling, hatcheries recorded seawater pH levels as low as 7.6, which explained the havoc shellfish farms were experiencing. If carbon dioxide emissions continue increasing as predicted, by the end of this century the ocean’s surface may become on average 150 times more acidified than it was before the Industrial Revolution, with a pH of about 7.8. This would be disastrous for a lot of marine life, especially in areas such as the Pacific Northwest.

Word of the researchers’ findings spread. Pacific shellfish growers quickly went to work with state and federal biologists to adapt, so their stock could survive in a changing ocean. They tried filling their water tanks in the afternoon, rather than the morning; this improved the baby oysters’ chances of survival because photosynthesizing plants took up some of the seawater’s carbon dioxide. Shellfish continued to die, but there was enough improvement to suggest that things were headed in the right direction. Next, researchers put the same pH and carbon dioxide sensors they had had on their ship into hatcheries. Scientists also taught farmers how to add calcium carbonate — soda ash — to seawater coming into their hatcheries, raising the pH in tanks. Hatcheries even shortened their spawning season to avoid the acidified late-summer conditions of the sound.

Scientists and farmers were able to work together because Sen. Maria Cantwell, a Democrat from Washington, supported their collaboration. “She secured \$500,000 of stimulus money to buy pH sensors and put them into the hatcheries,” Feely said. “So for that \$500,000 investment, we saved that industry from dying off. We saved that industry \$35 million in one year’s time. That’s a clear example of how science and government can work together to save an industry, and that felt pretty good.”

Which is not to say that the tools they used were pretty. Tracking the measurements that shellfish growers rely on — such as carbon dioxide levels and aragonite saturation levels — in real time is complicated. Burke Hales, an oceanographer with Oregon State University, constructed a device, resembling a plastic travel trunk sprouting machinery and colored wires, that hatcheries could install to monitor conditions. Now, when conditions are bad, growers don’t spawn oysters. The co-owner of another hatchery named the contraption, which has since been trademarked, the Burke-o-lator.



Dave Pederson, hatchery manager at Taylor Shellfish Farm in Quilcene, Washington, holds a geoduck — the hatchery’s second biggest seller, after oysters — grown mostly for export to Asia.

DAVID RYDER/BLOOMBERG VIA GETTY IMAGES

on a research trip off the West Coast of North America. Feely had found dissolved carbon dioxide levels in surface waters of the continental shelf off Northern California that were much higher than he’d expected. While Feely thought those high recordings hinted that an upwelling event was happening, he had no idea of the magnitude or extent of the acidification he was about to discover.

Feely assembled a group of marine researchers who sailed from Canada to Mexico, collecting and analyzing water samples along the way. They had a bet going about when they would see ocean acidification. All of them turned out to be wrong, because it was everywhere: Corrosive waters registered from Vancouver Island all the way to Baja California. Feely and his colleagues estimated that by the end of the century, marine creatures throughout the entire ocean would have access to dramatically less calcium carbonate because of ocean acidification, with regions of coastal upwelling hit especially hard.

Even as Feely conducted his 2007

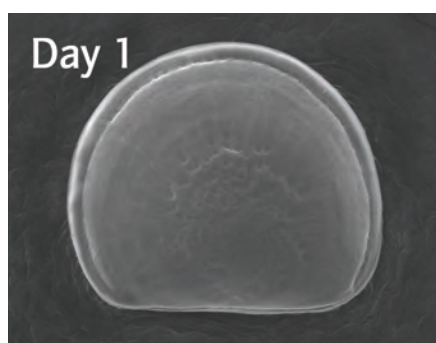
Feely and the other researchers published their findings. Later that year, the Pacific Shellfish Growers Association invited Feely to present his research at its annual meeting. The reality, the growers learned, was much worse than a common bacterium: Essentially, as their baby oysters struggled to pull enough calcium from acidified seawater to form shells, they ran out of energy and starved to death.

Greg Dale, southwest operations manager at Coast Seafoods Company in Northern California, watched Feely’s presentation. Raised in a fishing family from Alaska, Dale began working at an oyster farm as a student at Humboldt State University. At first, it was just a job, but he ended up loving the work. At Coast Seafoods, Dale raised oysters both to sell as baby “seeds” and as ready-to-eat adults. The adults were transferred to tidal mudflats, where they grew individually in baskets of powdered shell, or on pieces of shell stuck in braids of rope that trail up from the bottom of the ocean like underwater vineyards. For two terrible

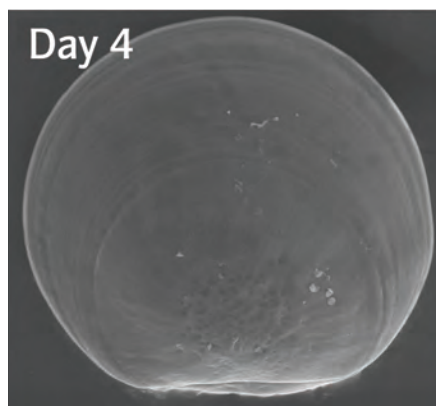
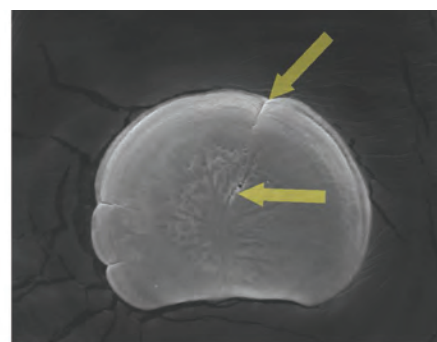


The economic calamity caused by ocean acidification in 2007 and 2008 caught the attention of many people, including then-Washington Gov. Christine Gregoire. Washington's seafood industry generates more than 42,000 jobs and \$1.7 billion a year, from industry profits and employment at neighborhood seafood restaurants, distributors and retailers. What's more, shellfish have significant and growing cultural and resource value for the region's tribal communities, especially as salmon stocks plummet. Gregoire created the Washington State Blue Ribbon Panel on Ocean Acidification in 2011. Five years later, the panel would become the springboard for the International Alliance to Combat Ocean Acidification, which has united local, tribal and national governments from around the world, though the U.S. government has yet to join.

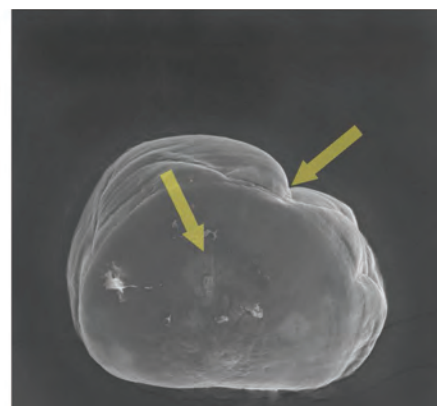
Today, the Pacific shellfish industry is at 50 to 70 percent of historic production levels. "We're all really freaked out about ocean acidification," Dale said. "What we realized is that it's not going to change in our lifetime — the causes of acidifica-



Day 1



Day 4



▲ Oceanographer Richard Feely stands on the deck of the research vessel *Wecoma* during a 2007 research cruise. Using canisters and sensors lowered by winch into the sea, scientists recorded corrosive waters from Vancouver Island to Baja California.

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◀ Pacific oyster larvae from Taylor Shellfish Farms. Shellfish develop normally in low dissolved carbon dioxide levels, left. In high dissolved carbon dioxide levels, right, seawater becomes acidified. Shellfish struggling to pull enough calcium from seawater for shell formation run out of energy and starve to death.

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tion — so what we want is tools to manage around it.” For the past decade, NOAA provided many of those tools through its Integrated Ocean Observing System, or IOOS. But research and management programs depend on the political climate as well as the physical one. As NOAA funding has decreased, Pederson told me, scientists have come to rely more on industry data. A graduate student conducting research at the Quilcene hatchery showed me a Burke-o-lator in a cramped plastic shed. The device was broken, and hatchery personnel had neither the time nor expertise to fix it. Hales, I was told, was working to create a new version that was more mobile, user-friendly and affordable.

Because of ocean acidification, mul-

everything — the whole food web, our weather, clouds.” Neither is acidification the only climate-change-related concern; rising sea levels, warming ocean temperatures and hypoxia complicate life for coastal communities even more. Dale mentioned the “Blob,” a huge, persistent patch of unusually warm water that lingered off the West Coast from 2013 until 2016. “That really just drove everything into the ground,” he said. “Our salmon, harmful algal blooms, birds starving. The ocean is just goofy right now.”

IT WAS AN OVERCAST Thursday dawn when I boarded the *Clifford A. Barnes*, a 65-foot research vessel anchored in a Puget Sound marina. “*Cliffy*,” as the ship

side; two dolphins swam in our wake. The water that *Cliffy* nosed through turned teal blue, provoking excited speculations about a “coccolithophore” — a one-celled phytoplankton — bloom. “I haven’t seen this in 40 years of sampling here,” one researcher told the others.

Much of the collecting was on behalf of researchers not present; the boat bunked only six, with two spots reserved for undergraduate volunteers. The scramble to collect everything at each stop didn’t let up, even when a cold, steady rain began. For lunch, researchers slipped into the galley briefly in ones and twos and slapped together thin sandwiches, then ducked back into the lab built on the deck. Washington Ocean Acidification Center, or WOAC, research cruises ply Puget Sound three times a year, collecting water chemistry data and dragging plankton tows, a combined effort to study chemical cause and biological effects of ocean acidification.

On this cruise, postdoctoral student Ramón Gallego collected floating DNA samples, or eDNA, from the water to find out what had passed by recently for a new collaboration combining that data with ocean acidification research. “We think that areas with less ocean acidification will have more species richness,” he said. Gallego used a preservative to kill any living organism in the water sample, so that small microscopic bits of life didn’t eat the even smaller bits before he’d had a chance to analyze them. Originally from the Canary Islands, Gallego spent several years in Madrid in mainland Spain during his 20s. “I don’t want to live away from the ocean anymore,” he said.

The biology of ocean acidification is a new field, though it’s growing quickly. Laboratory studies of ocean acidification reveal direct and negative consequences on larval mollusks and juvenile fish, but things get complicated in the field. Terrie Klinger, co-director of WOAC, focuses on the biological consequences of ocean acidification. “The chemical evidence of acidification is unequivocal,” she told me by phone from her Seattle office. Still, “it’s very difficult to do lab studies on multiple species at one time and then have them bear any resemblance to what happens in nature.” Some of the most surprising discoveries have come from observing juvenile fish. A research group in Australia first noticed that juvenile fish behave strangely in acidified water. Ocean acidification affects a particular neuroreceptor in the fish that is sensitive to carbon dioxide levels — a receptor that’s found in virtually all vertebrate species. With increased acidification, “fish are less able to smell their predators,” Klinger said. “They are sometimes less able to smell food; they don’t eat as well. In coral reef habitats where they have very strong homing behaviors to crevices, they can lose their homing behavior.”

Funding limitations hamper biological monitoring, even though researchers must study complicated factors in combination:

“The ocean drives everything — the whole food web, our weather, clouds.”

—Greg Dale, southwest operations manager at Coast Seafoods Company in Northern California



Geoducks by the millions grow in specially formulated algae mix and protected from acidified ocean water at the Taylor Shellfish Farm hatchery in Quilcene, Washington. NAOMI TOMKY

tiple Pacific Coast hatcheries have tried relocating their operations to Hawaii, though they’ve struggled there as well. Some hatcheries are researching another approach: selectively breeding oysters that are more tolerant of lower pH levels. It’s possible, too, that growing shellfish near seaweeds and seagrasses — which take up carbon dioxide — could help. I spoke with two senior scientists — one in California, one in Washington — who have experimented with growing kelp and are now analyzing their results. But it may take years before researchers know whether planting kelp in coastal waters helps. There are no easy solutions to ocean acidification for the shellfish industry. In the meantime, as acidity levels increase, shellfish become ever more vulnerable. Right now, only baby shellfish struggle in the Eastern Pacific’s acidifying waters, but eventually, adult shellfish may, too.

Of course, the ocean holds much more than shellfish. Oysters, however fascinating, tasty or economically important, comprise a very small part of the sea’s life at the end of the day. “It’s honestly quite scary,” Dale said. “The ocean drives

is affectionately called, belongs to the National Science Foundation. As I stumbled onboard, most of the crew, led by Chief Scientist Marine Lebrech, who wore green waterproof boots and a sky-blue down jacket against the chill morning air, were hustling to cast off or hunched silently in the small galley over phone screens and steaming mugs. Under the captain’s watchful eye, *Cliffy* quietly motored out of the dock and into the mist rising from the slate-colored waters.

Later, when we were underway and caffeinated, the researchers — who were living onboard in cramped bunk beds — began their grueling routine of hauling in sampling gear and nets at mapped locations, rushing to preserve and process samples, and resetting the gear for the next stop. In between, they showed me what they’d gathered from the sea: assemblages of tiny crustaceans to be sorted, pteropods to be checked for corrosion, water to be analyzed for everything from dissolved oxygen content to chlorophyll levels, crabs for dinner. A pair of bald eagles gripping the bare branches of a snagged tree passed on our starboard

marine species reacting to changes in pH and temperature and hypoxia together, for example, or looking at more than one organism at a time in the field, which is tricky. WOAC funds laboratory experiments on the effects of ocean acidification on salmon, black cod, crab, copepods, euphausiids, oysters and other Washington species. Still, “we’re limited in what we can do at this time,” Klinger admitted. Because it’s very difficult to do lab studies that resemble the natural world, some of the best studies from the field come from underwater seeps. Just by chance, the natural carbon dioxide leaking from underwater volcanoes into seawater mimics the expected change in pH due to ocean acidification. When carbon dioxide levels cause enough acidification at a seep, the area becomes overgrown by seaweeds, and animals disappear.

BACK ON CLIFFY, as the sun broke through, crewmembers stripped off their rainclothes. Expensive vacation homes began to dot woodsy hillsides, glowing in the late afternoon light. Everyone looked forward to the end of the workday, when *Cliffy* would dock at the only place the researchers would be able to shower for the entire voyage: an extremely expensive resort, some of whose guests arrived by seaplane and private yacht. I wondered how much the guests in that idyllic setting understood about the biogeochemical processes happening around them — *because* of them. Because of all of us: Perhaps a small quantity of the carbon dioxide that acidified these waters emerged from the tailpipe of the moving truck that my parents drove from New York City to my New Mexico birthplace some 40 years ago.

The fate of the oceans can’t easily be predicted, but ominous signs are floating all around us. You could scoop up some of the most telling into your hands, but they are so small they would drip through your fingers without your noticing. In a rare moment of downtime toward the end of the cruise, scientist Natasha Christman showed me image after image taken by scanning electron microscope of tiny coiled shells in different stages of dissolution. Microscopic planktonic snails with body parts like wings, pteropods — or sea butterflies — are as delicate and beautiful as their name suggests. Pteropods are exceedingly sensitive to acidification, so researchers use them as indicators. In extra-acidified water, the small snails don’t die right away. Instead, they crumble, exhausting their resources trying to repair their shells. By 2050, as much as 70 percent of the pteropods on the outer continental shelf may be destroyed by upwelling events, up from about 50 percent currently. Before the Industrial Revolution, upwelling events harmed only about 11 percent of pteropods, which form the basis of a marine food web that includes everything from seabirds to Pacific salmon.

The day before the cruise, I’d met with Jan Newton, the other co-director of



WOAC, at her University of Washington office, a fifth-story room warmed by the late sun angling through a bank of windows. Tall, with clear frameless glasses on an open face, Newton had her long gray hair pulled loosely into a ponytail. At the start of the interview, she paused to scan her smartphone for photos of her new grandchild. “What I love about oceanography is that large system,” she said. “I’m thinking about global atmospheric processes as well as down on a cellular level, and integrating all of that. I just love that.” Though the walls of Newton’s office were plastered with research posters and she had two desktop computer monitors in addition to a laptop, the many freckles on her arms testified to long hours spent on the water. “There’s a real joy, I think, to studying natural systems,” she said. “Now ocean acidification is just this really horrible situation, but what’s interesting about studying ocean acidification is you have to understand everything to understand it.”

Because ecological knowledge about ocean acidification is in its infancy, solutions-based endeavors are, too. But there’s a growing enthusiasm for finding those solutions. Newton also focuses on refining the information that WOAC provides to shellfish growers. She wants them to be able to look up acidification predictions for their localities on their smartphones as easily as they do weather predictions. “Knowledge is enabling,” she said.

I wondered, at this point, what she hoped this knowledge would enable people to do. I felt personally overwhelmed by ocean acidification, and we’d only been discussing it for about an hour; it was

her life’s work. “I carry a responsibility to make sure people understand it more, because it does have implications for generations on down,” she responded. “The more that people see what the response of what we’re doing is, the more they can make decisions. I feel like when I give a talk on (acidification), it’s just so depressing, and people go, ‘Well it’s just going to happen, and we’re screwed.’ But which world would you rather live in? We are actively making that choice every day as a global community.”

Regional solutions necessary require triage. The ocean might recover on its own from ocean acidification through slow planetary processes: the weathering of rocks and dissolving of calcium carbonate in marine sediments, mixed into sea water by ocean circulation patterns but this would take up to hundreds of millennia.

After we docked *Cliffy* and ate freshly boiled crabs — cracked open with pliers from a toolkit, so sweet we skipped the butter — I joined the crew in walking to the resort, where they would shower and have a drink and I could text a cab for the long drive back up Puget Sound. On the way to the resort’s outdoor bar, we passed a wedding party gathered on a green lawn that stretched to the water’s edge. The adults chatted and laughed together over drinks in the setting sun. A few small children clambered over a stone walkway to the beach, where they crouched in the fading light, picking through the rocks in search of shells. □

This story was funded with reader donations to the High Country News Research Fund.

Aboard the research vessel affectionately known as *Cliffy*, researchers haul in the canisters and sensors that take readings as they collect samples in Puget Sound, Washington.

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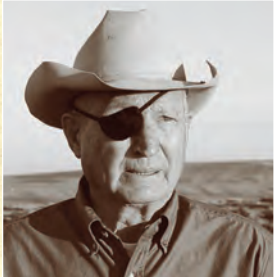
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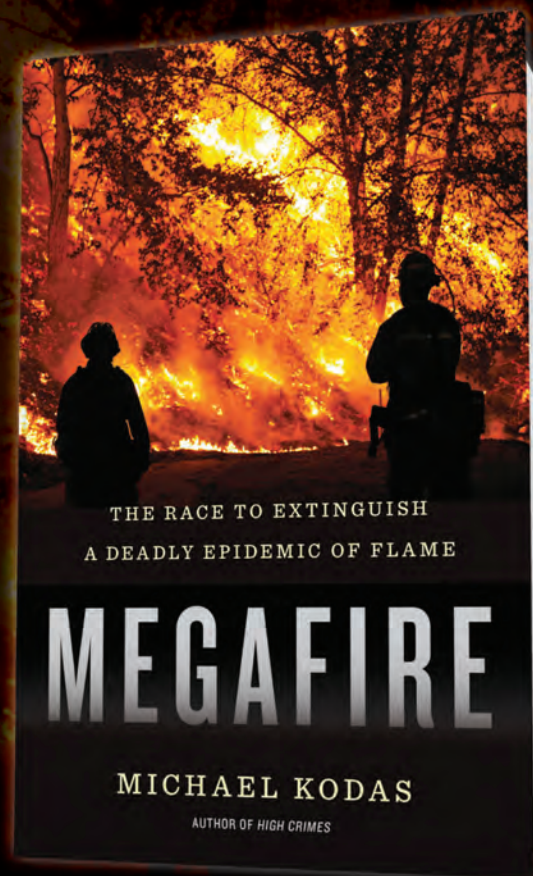
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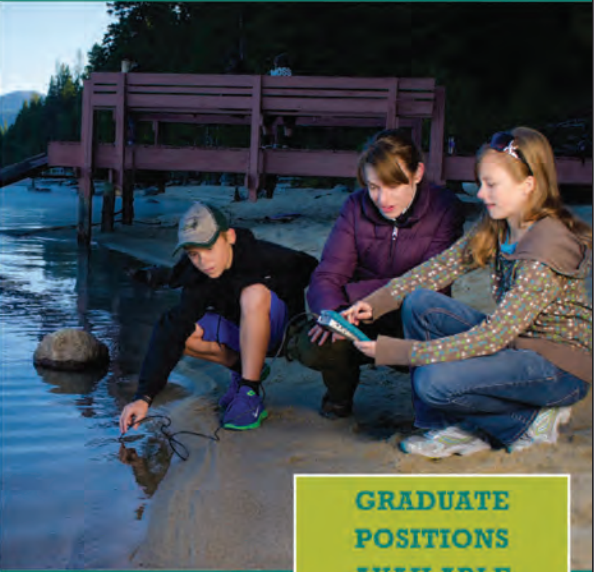
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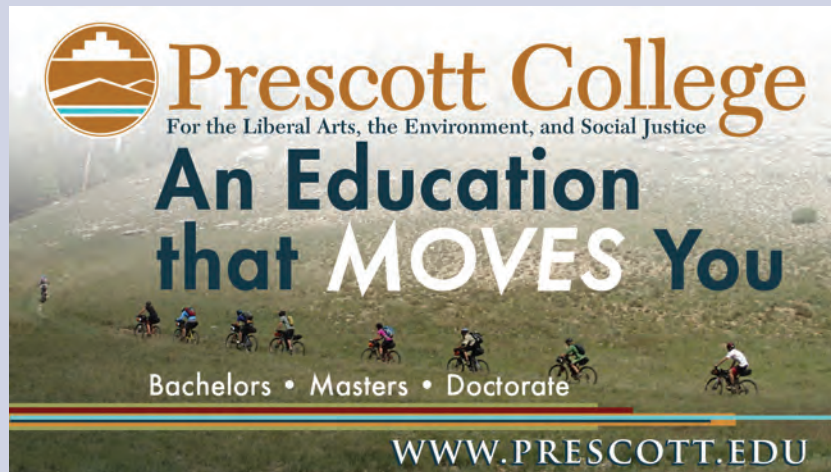
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Environmental Affinity Group grantee Big City Mountaineers. Photo by Devin Pool.



The Seri return to their roots

Climate change threatens traditional ecological knowledge

BY SARAH AMANDOLARE

In September 2014, Hurricane Odile barreled across the Baja California Peninsula, sending 30,000 tourists to evacuation shelters and killing 11 people. Odile weakened as it swept into Sonora, Mexico, but its torrential rains still washed out the dirt road connecting the tiny coastal village of El Desemboque to the highway. Local residents, all members of the Seri Indigenous group, were stranded for three days without food or water. Finally, someone managed to charge a computer with a car battery and posted a plea for help to Facebook.

That message reached Laura Monti, a research associate in arid lands cultural ecology with Prescott College and the University of Arizona. It brought the Seri's vulnerability to extreme weather sharply into focus, and also gave new urgency to the native and medicinal plants research that Monti has been doing in Sonora for two decades.

The Seri, who also live farther south in Punta Chueca, have endured harsh Sonoran Desert and Gulf of California conditions for 2,000 years, harvesting plants for food, hydration and medicine, and hunting on land and at sea. Their lives may become even harder in the years ahead, as intensifying tropical storms, rising sea levels and ocean warming and acidification ravage plant habitats as well

as the coastal wetlands that help support the fish that Seri fishermen rely on.

And time may be running out to pass down the traditional ecological knowledge that could help the Seri and other regional Indigenous communities, such as the Yaqui, become more resilient in the face of climate change. With such knowledge, said Rodrigo Renteria-Valencia, an environmental anthropologist who's worked with the Seri for more than a decade, "better science is possible, better programs for sustainability are possible, and a better understanding of what the Sonoran Desert is, is possible."

In June, at a parched arroyo just outside of El Desemboque, Monti joined a handful of Seri women representing three generations for a morning of collecting plants and sharing knowledge about their qualities and uses. Diabetes has become a major problem in this increasingly sedentary, former hunter-gatherer community, for example, and the red inner bark of *Krameria* roots contains chemical compounds that may lower blood sugar, while its taproot stabilizes sand dunes, preventing coastal erosion. The group meets monthly and practices sustainable harvesting — carefully replacing soil after digging up roots, for example. Monti has also led trainings in the conservation

of the ironwood tree, a keystone species and important "nurse plant" for many other desert plants. The women study desert ecology and botany and document the environmental changes that they see.

Maria Luisa Astorga Flores, an elderly woman dressed in a long skirt and colorful shawl, gestured out across the sparse, sandy expanse of the arroyo. "There used to be many more plants here," she said, peering over her wire-frame glasses. Because of the site's location near running water, mesquite trees and plants once flourished here, including broomrape, which has an edible lower stem, and lantana, used to relieve dizziness, Astorga Flores explained. But Odile battered the arroyo, and some plants have not yet recovered.

At least 20 percent of Mexico's plant species are found in Sonora, whose two annual rainy seasons contribute to North America's richest desert ecosystem. But the hotter, drier conditions of recent years have thwarted the growth of perennial grasses, flowering plants and mesquite trees in some areas. Meanwhile, Pacific Ocean storms arrive earlier and with greater frequency and strength, washing away crucial habitats. Marine life is also vulnerable to climate shifts. Ocean warming and acidification pose risks to the shelled organisms, like saltwater clams and blue crab, that Seri fishermen depend on, as well as to the entire Gulf of California ecosystem — home to nearly 900 fish species and the source of about half the production volume of Mexico's national fisheries.

Seri villages are especially vulnerable compared with more socioeconomically diverse Northern Gulf locations, such as Puerto Libertad and Puerto Peñasco. Mexico's National Commission of Natural Protected Areas has assigned Indigenous women to be climate change educators in their communities, including El Desemboque, and sent four Seri women to India's Barefoot College for solar engineering training in 2016. To Renteria-Valencia, these examples show the community's capacity to adapt, whether by rearranging social hierarchies, learning new technologies or incorporating traditional plants back into their diets. "They remain by means of changing," he says. "The Seri are not disappearing any time soon."

Well beyond the arroyo, Monti maneuvered past prickly cholla cactus to join the women standing around a *Krameria* bush. Crouched underneath the branches was 28-year-old Vilma Morales Astorga, expertly scooping away soil with a palm-sized seashell to reach the prized roots. The women explained that the tool had been left behind by a previous harvester — a gift for the next collector to come along. Monti beamed. "It's really special that she found that," she said. □

Seri artisan Carolina Félix harvests the fruit of the senita cactus in El Desemboque, Sonora, Mexico. The fruit can be eaten fresh, and the Seri have used the cactus wood to build shelters.

DEBORAH SMALL

BY THE NUMBERS: HOW ALASKANS EAT
The economics behind food security
in the far-flung 49th state

95 Percentage of store-bought food Alaska imports.

60 hours Length of drive from California's Central Valley, where much of the nation's fresh produce is grown, to Anchorage, Alaska.

7 Number of days it takes to take fresh produce to travel from Anchorage to some outlying villages.

742,000 Population of Alaska, as of 2016.

50 million Pounds of wild foods harvested by Alaskans in 2012.

\$400 million Estimated economic value of Alaska's annual wild food harvest.

\$2 billion Total cost of food eaten by Alaskans each year, including wild-harvested food.

\$7 Price of a gallon of gas in Savoonga, Alaska, on St. Lawrence Island, as of 2014.

\$10 Price of a half-gallon of milk in Savoonga.

1,200 Number of walrus that residents of Savoonga and the neighboring village of Gambell typically harvest for food in a year.

34 Number of walrus harvested by the villages in 2013.

30 Number of walrus harvested in Gambell in 2016.

3 Number of years in a row the walrus harvest has fallen short.

6 Degrees on average that Alaska winters have warmed over the last 60 years.

790,000 Fewer square miles of ice covering the polar seas in 2017, compared to the average global minimum between 1981 and 2010.

45 percent Length by which interior Alaska's growing season has increased over the past century, on average.

\$4 million Dollars the U.S. Department of Agriculture has spent subsidizing high tunnels, greenhouses and other growing equipment in Alaska, as of 2014.

62 percent Increase in the number of Alaska farms selling directly to consumers between 2007 and 2014.

— KRISTA LANGLOIS

Farming the Last Frontier

As climate change strains food security and lengthens the growing season, more Alaskans are taking up farming

BY KRISTA LANGLOIS

"All right," announces Jenni Medley, wiping her hands on her faded black Carhartts and consulting a clipboard. "The birds are bagged. Total number is 70."

It's 3 in the afternoon, and just outside a small commercial processing facility in Homer, Alaska, Beau Burgess, one of Medley's farming partners, stands in a miasma of blood, chicken guts and swirling snow as another farmer sprays him with a garden hose. The temperature is 30 degrees Fahrenheit. Medley, Burgess and three other employee-owners of Blood Sweat & Food Farm have been butchering chickens for seven hours, and they still need to freeze the birds, process their hearts and livers, clear some land for garden beds, and then feed the cows, rabbits and pigs, all in sloppy mud and weather that one local calls "blustery as all get-out." Welcome to farming in Alaska.

Medley believes the 12-hour days are worth it. Thanks to built-up organic matter and ash from nearby volcanoes, locals say that Homer has some of the best soil in the Northern Hemisphere. Water is plentiful, and land is so affordable that after three years in business, Blood Sweat & Food recently bought a new 10-acre parcel. Combined with the milder winters Alaska has experienced lately, this makes farming irresistible — especially for the Blood Sweat & Food crew, who hail from dry, overworked places like Texas, Colorado and New Mexico. "I love the high desert of New Mexico," Medley says. "But there's no water. If I think about what I want to be doing, I just can't do it there."

Alaskans are also hungry for local food. Wild game, fish and shellfish are staples of the Alaskan diet, but vegetables, perishables and store-bought meat are usually imported from far away, at tremendous cost. In many villages and small towns, the produce at the local store is limited to a few stalks of wilted celery or a bin of mealy apples — if there's any produce at all. Even shelf-stable food isn't readily available, since bad weather can delay shipments to remote communities.

For decades, Alaskans accepted this as the cost of living on the Last Frontier. But as cheaper technology and a changing climate make growing food easier, more Alaskans are turning to farming. The United States has lost more

than 131,000 farms over the last three decades, with a 4 percent drop between 2007 and 2012 alone. The number of small farms in Alaska, however, jumped by 67 percent from 2002 to 2012. Direct sales from farmers to local consumers are growing here at a rate 13 times the national average.

The reasons for this trend vary, but among the farmers I talked to, climate change came up frequently. Alaska is warming twice as fast as the rest of the country, with winters some 6 degrees warmer than they were 60 years ago. The warming climate has brought new insect infestations and wreaked havoc on some wild game, but it also means apple trees and other plants that were once unable to survive here are now thriving.

"Some people are total climate deniers," says Kyra Wagner, manager of the Homer Soil and Water Conservation District. "But they're still seeing unprecedented aphid infestations or imbalances in the fish harvest. They may not blame it on climate, but there's an awareness that something's changing. Everybody is a little weirded out."

Alaska's history is littered with failed agricultural enterprises. Around 1883, explorers noted that seeds planted in Arctic Alaska could be harvested in just 27 days because of the 'round-the-clock sunlight. In 1912, industrious farmers in the state's interior produced the equivalent of \$2.4 million worth of produce. The following year, it snowed in August, ruining crops.

During the Great Depression, the U.S. government tried to establish a utopian farming colony in south-central Alaska by relocating dozens of families from the Midwest. The experiment fell apart after seven years, largely due to the short growing season and the difficulty in getting produce to market. In the 1970s, Alaska tried yet again, spending \$200 million to develop a dairy industry. It, too, fell into financial ruin.

Today, 95 percent of the food purchased in Alaska is imported — a figure on par with other states, but one that's nonetheless worrisome in such a remote place. "After Hurricane Katrina, it took two weeks to get food into parts of New Orleans," says Arthur Keyes, director of the Alaska Division of Agriculture. "And they're connected to the rest of the country. We're over 2,000 driving miles from



Washington state. If we have a major crisis like an earthquake or fire or we lose a port, can you imagine how long it'll take food to get here?"

Add to this a changing climate that's occasionally decimated wild berry harvests, impacted salmon runs and altered the migration patterns of caribou and walrus — important food sources for many Alaskans — and the state has some of the highest rates of food insecurity in the nation.

That's one reason why born-and-raised Alaskan Emily Garrity started Twitter Creek Gardens in Homer nine years ago. "I do feel at times like our food security is threatened," she tells me over tea in her cabin, which on this April day is reachable only by foot or snow machine. "That's a big deal, and I'd like to be part of the solution."

Outside, the only sign of spring is the lengthening daylight. The clouds are dark and low, spitting flurries. Four feet of heavy snow still blankets the ground. But Garrity revels in the bad weather: After several warm, soggy years, she says, it finally feels like a real Alaskan winter.

But the volatile weather underscores the challenges that Alaskan farmers still face. Climate change isn't a simple trajectory toward warmer weather and longer growing seasons. The weather is also becoming more erratic and unpredictable. Garrity doubts that anyone starts a farm in Alaska because of climate change alone; rather, the increased affordability of high-tunnel greenhouses, hydroponics and other season-extending infrastructure are expanding the possibilities of what crops can be grown. Four of the five top counties receiving discounted high tunnels from the Natural Resources Conservation Service are in Alaska.

Alaska is still unlikely to overtake California as the nation's salad bowl anytime soon. Alaskans have tried commercial-scale agriculture in the past, and learned that growing food to export makes little sense in a state where transportation costs are high and shipping routes limited. As the Alaska Food Policy Council and others concluded in a 2014 report, one reason Alaska's past farming experiments failed was because

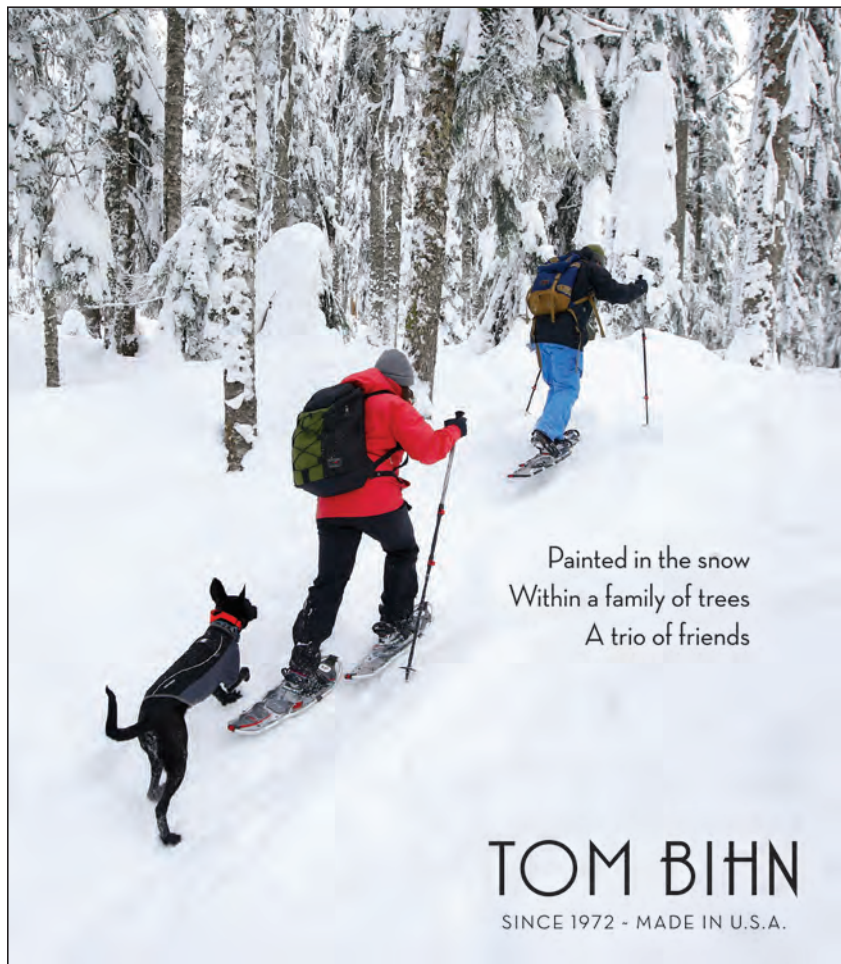
they assumed that the only way to grow a food economy was to export to the Lower 48.

Today, the new wave of farmers may have shed those assumptions, but they face their own challenges. In the rainy archipelago of Southeast Alaska, for instance, the owners of Farragut Farm have to wait for a tide high enough to float their skiff so they can row their produce out to a sailboat, then sail four hours to the nearest town to sell it. In Homer, when Blood Sweat & Food wanted to raise a type of pig that could cope with cold, damp weather, the farmers had to fly the piglets in by airplane. And at Garrity's farm in April, the garden beds are still covered in snow at a time when farmers elsewhere have already planted.

Nonetheless, Garrity receives some 15 applications a year from young farmers who are drawn to Alaska's untapped agricultural potential. "The first time I set foot on this land, I stuck a spade in the soil," Garrity says. "It was pure black, and I knew: We can grow food on this land." □

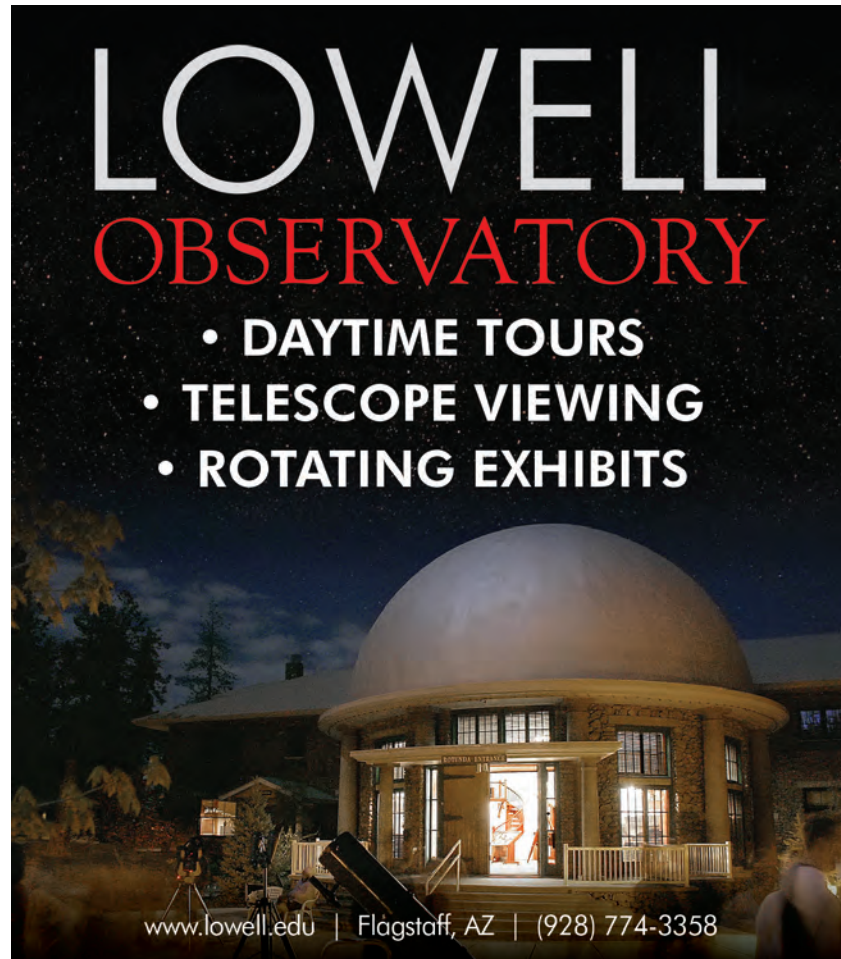
Farmer Jenni Medley waters the pigs on a chilly April day at Blood Sweat & Food Farm in Homer, Alaska.

KRISTA LANGLOIS



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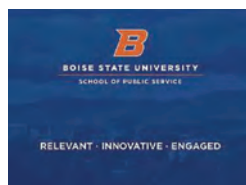


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Coal tech *continued from page 9*

Business and community leaders began meeting this May to develop a 20-year economic vision, discussing the possibilities of tourism, the state's super-fast internet connectivity, outdoor recreation and tax breaks for targeted industries.

But so far, even forward-looking projects like the Integrated Test Center still rely on fossil fuels. In some ways, that makes sense. With so much coal here, why not use it?

"If we can develop advanced coal industries, they could be using amounts equal to power plants in 20 or more years," says Phil Christopherson, CEO of the Gillette nonprofit Energy Capital Economic Development. Christopherson envisions a future bustling manufacturing sector, anchored by a Boeing or Ford plant that uses coal-derived carbon-fiber in its planes or cars.

"Three years ago, the coal companies wouldn't talk about advanced coal," Christopherson says. But in the wake of bankruptcies and with market conditions still looking gloomy, they've warmed to the idea. "Now we're working closely with some because they see small markets can become big markets."

Not everyone is convinced, however. "Some of these technologies are way out in the future and expensive, and others are small and not going to employ thousands of people," says Jill Morrison, director of the Powder Basin Resource Council, an environmentally minded landowners' group in the heart of Wyoming's coal country. She says carbon capture research is a poor use of taxpayer dollars; the money would be better spent developing renewable energy and more efficient electricity grids. "They are trying to spin gold out of coal."

W Wyoming is as rich in wind as it is in coal, with some of the country's stiffest, most reliable winds. But harnessing that wind into energy is politically fraught.

One July morning, a couple dozen people filled a classroom at Gillette College to learn about careers in wind energy. The session was organized by Goldwind Americas, a subsidiary of a Chinese company that is helping to build a large wind farm near Medicine Bow. University of Wyoming economist Robert Godby says the state could quintuple its wind generation, adding a load of technician jobs. Goldwind was offering free training and job-placement for prospective turbine techs — and targeting miners.

I sat next to a coal miner, who smiled and asked if I am part of the "biased media." A former Army aviator, he was one of the lucky workers to survive the layoffs, and he asked that I not use his name. He worried that his comments — and even his attendance here — might get him fired.

He was interested in Goldwind's offer: Coal mining is tough, dangerous work



Instructors set up a wind turbine hub trainer in the Wind Lab at Laramie County Community College. As wind energy production crops up around Wyoming, more workers are being trained for jobs in wind turbine maintenance.

COURTESY LARAMIE COUNTY COMMUNITY COLLEGE

with brutal hours and a precarious future. But wind has downsides, too. The starting salary for a tech is \$40,000, half his current salary, and he'd have to move. Others echoed his reservations: Few miners want to uproot their families, and many have doubts about the prospects of a real wind-energy boom.

That's partly because Wyoming lawmakers have long resisted renewables as unwelcome competition for fossil fuels. Last winter, legislators tried — unsuccessfully — to prohibit utilities from providing electricity generated by wind and solar. Wyoming is also the only state that taxes wind production, at a rate of \$1 per megawatt-hour. Some lawmakers have suggested increasing the tax three- or fivefold, partly to offset declining fossil fuel revenues. The tax hasn't deterred the industry from pursuing projects here, but hiking it, says Godby, could certainly discourage future development, including among tech companies looking for clean-energy sources when considering new locations.

There are other ways the state could fill its budget gaps — fairly simple ones, even. Wyoming has no individual or corporate income tax, and its sales tax, property tax and beer tax are all among the lowest in the country. The average Wyomingite pays about \$3,000 in taxes each year, but gets back \$15,000 or more in public services.

"Being a conservative state, the battle cry should be 'we're going to pay our own way,'" Christopherson says. Yet few lawmakers want anything to do with tax increases.

Most economists agree that taxes on energy production should be directed into special funds rather than used as a state's primary revenue stream. States need to provide public services during booms and busts, but when production slows, lawmakers tend to focus more on helping industry than on shoring up public services.

Unfortunately, good policy doesn't always make for good politics. Michael Van Flatern, a Republican state senator from Gillette who is on the ENDOW panel, is one of the few legislators who openly advocates raising some taxes rather than continuing to cut services. "Income tax," he says, "is about the dirtiest word you can say in this state."

Despite the layoffs and uncertainty, I encountered a lot of optimism in Gillette and found it contagious. "Obviously, in the future, we will not use coal for energy, but we're not at the point where we can shut it off," Lora Dilley told me over happy-hour beers at Applebee's. Dilley, the safety coordinator at the Dry Fork Mine, held onto her coal job last year. Her husband lost his, so he got his commercial driver's license. "He saw the opportunity to get out of mining," and he took it, Dilley explained pragmatically. Their family, you might say, has diversified.

Still, Dilley believes advanced coal will buoy Wyoming in the future, and after a few days in town, I, too, began thinking, "Wouldn't it be great if some mix of innovation, investment and gumption saved Wyoming — and the climate?"

That kind of optimism is necessary for innovation, but it can also be a trap. It's what kept Pacific Northwest logging towns from diversifying before the bottom fell out of the timber industry, says Mark Haggerty with the Headwaters Institute, a Montana-based economic think tank. Those towns are still struggling to regain their footing. For Wyoming, which is so uniquely reliant on fossil fuels, the task could be even tougher.

"The Integrated Test Center is our future in many aspects, but we need to find other products," says Van Flatern. "We'll see how things shape up." Then he sighs. So far, on low-hanging fruit, like taxes, "they're not listening to me." □

Greening the Gospel

Why religious communities are taking on climate change

BY SARAH TORY

Before Pastor Jim Therrien, 49, moved to New Mexico, he rarely thought about environmental issues. Back in Kansas, where he was born and raised, the grass outside his home was always green, and though the state had an active oil industry, companies fenced off well sites properly and promptly cleaned up spills. But then he and his family saw the impacts of energy development on the Southwestern landscape and their new church community. Therrien began to think about the connection between the local environment and the broader issue of climate change.

Every day, Therrien, a blond, ruddy and tattooed man of Irish descent, looked out his window and saw a dry land getting drier. Residents told him that winters used to be much colder and snowier. The hotter temperatures thickened the methane haze, and oil and gas traffic tore up the dirt roads. Therrien started to see these problems as injustices that conflicted with Christian values. So he decided to take a stand. Churches have long played a crucial role in social movements, from the civil rights era to immigration reform. Why not environmental activism?

"I don't ever consider myself an environmentalist," he told me one afternoon at the Lybrook Community Ministries, on a remote stretch of Highway 550, between the Navajo Nation and the Jicarilla Apache Reservation. "I'm more of a people person."

Therrien's congregation, mostly Navajo, had spent years living with the San Juan Basin's drilling boom, and the last thing they needed was a sermon about climate change. So instead of lecturing, he created a garden to reduce the church's use of fossil fuels to transport food. Then he began fundraising for solar installations on homes around the mission and urging lawmakers to tighten regulations on methane, a powerful greenhouse gas released by oil and gas drilling.

Last year, he joined the Interfaith Power & Light campaign, "a religious response to global warming" composed of churches and faith communities across the U.S. Since 2001, the network had expanded its membership from 14 congregations in California to some 20,000 in over 40 states. The group provides resources to churches and other faith communities for cutting carbon emissions —

helping install solar panels, for instance, and sharing sermons on the importance of addressing climate change.

Therrien says he is merely "following the Scripture." In the process, however, he has joined a growing environmental movement that brings a religious dimension to the problem of climate change.

The green religious movement is gaining momentum. In May, nine Catholic organizations announced plans to divest from fossil fuel corporations, a move inspired by Pope Francis' 2015 encyclical, *Laudato Si': On Care for Our Common Home*.

In June, President Donald Trump announced plans to withdraw from the Paris climate accord, a decision that Catholic Bishop Oscar Cantú, of Las Cruces, New Mexico, called "deeply troubling." "The Scriptures affirm the value of caring for creation and caring for each other in solidarity," said Cantú, who is the chairman of the U.S. Bishops' Committee on International Justice and Peace. "The Paris agreement is an international accord that promotes these values."

In July, the United Church of Christ delivered a similar message, urging the clergy to preach on "the moral obligation of our generation to protect God's creation" and exhorting individuals to take political action.

For these churches, climate change connects a long list of social and economic injustices they care deeply about, from food insecurity to the global refugee crisis.

"Climate change is the biggest ethical, moral and spiritual challenge of our day," Joan Brown, the executive director of New Mexico Interfaith Power & Light, told me.

She pointed to St. Francis of Assisi, the patron saint of animals and ecology, a medieval Italian monk who spent much of each year living in hermitages, caves and on mountainsides, praying in the wilderness. "St. Francis speaks of everything being connected," she said, "of there being no separation between the human and natural world." When Jorge Mario Bergoglio was elected pope, he chose his name in honor of St. Francis. Brown credited Pope Francis with helping reframe climate change as a moral concern.

Laudato Si' describes the relationship between global poverty, inequality and



environmental destruction, and issues a call to action. When Francis visited the White House in 2015, he declared: "Climate change is a problem which can no longer be left to a future generation. I would like all men and women of goodwill in this great nation to support the efforts of the international community to protect the vulnerable in our world."

Among non-Catholics, too, the pontiff's message has had an effect: Polling from the Yale Project on Climate Change Communication shows that the number of Americans who say they think global warming will harm the world's poor rose from 49 to 61 percent; the percent who say the issue has become "very" or "extremely important" to them personally jumped from 19 to 26 percent.

A little over a year later, during the Paris climate negotiations, Brown recalled how during a breakout session for faith leaders, one of the Paris organizers praised *Laudato Si'* and the similar documents released by Muslim, Jewish and Buddhist leaders. It was the first time, Brown said, quoting the organizer, "that ethical and moral imperatives are front and center with delegates."

Here at his hardscrabble New Mexico parish, Therrien continues to practice what he preaches. On a hot day in July, he herded 28 visitors into the mission's two white vans for a drive out onto

Earth is a mess, God's not amused. ... do something about it.

—A quote on a T-shirt worn by David Radcliff, director of the New Community Project.



Members of the New Community Project tour the Navajo Nation near now-dry Washington Lake to learn how oil and gas extraction is affecting the Navajo people who live nearby, far left. Pope Francis stands in front of a statue of St. Francis of Assisi, left. The pope, who takes his name from St. Francis, the patron saint of animals and ecosystems, has led a call to action on climate change for the Catholic community.

SARAH TORY,
CNS/PAUL HARING

the Navajo Nation. The group, mostly Easterners, ranged in age from 8 to over 60 and had traveled to the Lybrook mission as part of a weeklong fact-finding trip. Like Therrien, many were members of the Church of the Brethren, a Protestant denomination with a history of activism. More recently, their focus had shifted to environmental issues — especially climate change.

“It’s concerning that our government is pulling back from what we should be focusing on,” one of them, Jim Dodd, told me. Recently, the giant Larsen Ice Shelf had broken off from Antarctica, and Dodd was worried. “Villages already at sea level are going to get flooded,” he said.

Leading the group was David Radcliff, director of the New Community Project, a Vermont-based organization. “It’s a fairness issue for the rest of God’s creatures,” he told me. Radcliff has led “learning tours” around social and environmental justice issues for church groups, most recently, to the Ecuadorian Amazon.

Radcliff, a small, wiry man with an intense blue gaze, wore a white T-shirt with a very long slogan on the back. “Earth is a mess,” it said, and “God’s not amused.” If you aren’t satisfied, it added, “do something about it.”

For Radcliff, discussing the facts of climate change isn’t enough. That’s where religion comes in. “At a certain point, you have to talk about the con-

sequences, and past that it becomes a conversation about morality,” he said. Take moose in the Northeast: They are dying from tick infestations exacerbated by a warming climate, caused by humans taking more from the Earth than they need, he said. “We are stealing from other living things.”

As we drove over bumpy dirt roads west of the mission, the Easterners stared in awe at the crumpled mesas and the vast New Mexican landscape. Navajo homesteads peeked out of the sagebrush. Every so often, a large semi-truck carrying pipes and other equipment roared past in a cloud of dust, heading for one of the scattered well pads or towering rigs marking fracking operations.

Therrien stopped the van at one of the well sites and ushered everyone out, gesturing toward a row of high metal storage tanks. Under federal and state regulations, the company should have built fencing around it, but out here on Navajo land, Therrien noted, the rules weren’t always enforced. Last year, several oil storage tanks north of Lybrook exploded, forcing Navajo families living nearby to evacuate their homes. Since moving to the mission, he often thought about how much easier it was to ignore the consequences of oil and gas development — and of climate change — if people weren’t involved.

Back in Kansas, Therrien had re-

cycled cans and kept a compost pile, but when it came to climate change, he felt mostly resigned. “I used to think, ‘What can one person do?’ ” he told me. Now, as a pastor on the Navajo Nation, he felt a new sense of urgency and purpose.

Last January, he spoke at a rally outside the Bureau of Land Management’s office in Santa Fe, New Mexico, protesting the agency’s decision to lease 844 acres of land for drilling. The rally brought together Navajo activists, environmental groups and religious leaders from the state chapter of Interfaith Power & Light. Although they failed to stop the sale, Therrien remained hopeful. “Through the church, I realized there was this network of people fighting for the same things,” he said.

Therrien stopped the van at a low rise overlooking what was once Washington Lake. Families once gathered water here for themselves and their livestock. Four years ago, it dried up.

Everyone piled out, while Radcliff explained how aquifers were losing water. “They’re dropping all over the world,” including in the West, he said. He paused and knelt to pick up a can that was left on the side of the road and brandished it above him. “No other creature makes trash,” he said. “So what’s progress?” The people gazed past him, staring at the dusty lakebed, where patches of dry grass swayed in the heat. □



HEARD AROUND THE WEST | BY BETSY MARSTON

THE WEST

"Lions and tigers and bears, oh, my!"

exclaimed Dorothy in *The Wizard of Oz*. Recently, some Westerners unfamiliar with wild animals have been calling the police to report scary-looking critters loitering in a suspicious fashion. In Newport, Oregon, the police department discussed the utter weirdness of a photograph of a tabby cat that had gone viral (*see photo, right*). Weird, because the black-and-white cat seemed to be holding a semi-automatic assault rifle while perched insouciantly high in a tree, reported the *tiphero.com*. The cat was definitely loitering, but the "rifle" that alarmed so many people was just an angled twig that resembled a weapon. No charges were filed.

On the Boulder, Colorado, campus of the University of Colorado, college officials confirmed that an "extremely dangerous" animal was on campus and walking down some stairs. As the *Boulder Daily Camera* put it, the four-legged creature with the black mask and claws was "likely in search of food — and possibly an education." The university tweeted a photo of the interloper — a badger — and warned everyone not to go near it. But badgers have no interest in cultivating humans, said Jennifer Churchill, spokeswoman for Colorado Parks and Wildlife. "It's not rare, and it's not a dangerous animal." Nervous students may have been reassured by a tweet from one of the University of Wisconsin's diehard Badger fans: "We're not so bad once you get to know us."

In Helena, Montana, the suspicious creature "prowling" a backyard was not a mountain lion but a hybrid breed called a Savannah, a cross between a domestic cat and a serval, a pointy-eared wildcat from Africa. Local police said lion sightings remain rare in town, although calls about housecats looking like lions happen "quite often."

Housecats would never be mistaken for wildcats if they just stayed indoors. But Ashley Gramza, who is getting her doctorate at Colo-



THE INTERNETS Meow-heur Occupation. NEWPORT, OREGON, POLICE DEPARTMENT

rado State University by studying how people think about wildlife, says many cat owners in the Boulder area told her they let their pets out because they believe they are "happier outdoors." Although cats may enjoy exercising their fierce predator instincts in the backyard, songbirds fall to their claws and teeth at a prodigious rate — up to 4 billion birds killed each year in this country, according to a 2013 Nature Communications study. Gramza realized that arguing about whether or not it's OK to let cats outdoors may be fruitless. Meanwhile, it would help if owners kept their cats inside until the afternoon, when birds aren't as active, or let the cats out inside an enclosure. Gramza told *Colorado Outdoors* that cat owners might think twice about letting their pets roam once they become aware of the issues, though that could take generations. She reminds us that unleashed dogs once enjoyed freedom on the streets of cities not so long ago, until attitudes changed: "I really want us to start working together."

But Richard Conniff, writing in *The New York Times*, is a stone-cold hard-liner when it comes to subsidized predators. Allowing a housecat outdoors, he says, should "be as socially unacceptable as smoking cigarettes in the office, or leaving dog droppings on the sidewalk." He's also against the spay and neuter campaigns sponsored by animal welfare organizations,

because "feral or stray cats do most of the killing (of birds)." Conniff's cat now lives indoors after his last outdoor pet met an untimely end in 2008. The wandering outdoor housecat was snatched and eaten by a much bigger relative — a bobcat.

THE NATION

One of the green initiatives the Obama administration could point to with justifiable pride was its 2011 Green Parks Plan, which changed the behavior of millions of visitors to 23 national parks. Instead of selling water to tourists in plastic bottles that were then thrown

away by the hundreds of thousands every day, the plan proposed filling water bottles with tap water at free filling stations. It didn't take long for Grand Canyon, Zion and 21 other national parks to adopt the ban on selling water, but this August, the Trump administration rescinded the ban. Park Service Director Michael T. Reynolds explained that visitors could "decide how best to keep themselves and their families hydrated during a visit to a national park." Perhaps there was another reason. As the *San Francisco Chronicle* put it, "the water bottle ban was opposed by the beverage industry that had long lobbied to change the policy." Watchdog groups were outraged: "Plastic water bottles have a tremendous environmental impact," said Lauren DeRusha Florez of the group Corporate Accountability International. And that wasn't the last anti-green swipe that's been taken at the Obama administration: The nine-slot Capital Bikeshare station, used routinely by White House staffers, was also removed in August. Why be green when you can be mean?

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.



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“It has failed to provoke urgency and been easy to pooh-pooh. It’s probably not a coincidence that a Republican political strategist recommended using the term ‘climate change’ because he said ‘it is less frightening than “global warming.”’”

Alex Lee, in his essay, "The term 'climate change' isn't working anymore," from *Writers on the Range*, hcn.org/wotr