Winter 2018 Issue 8

Western Confluence

NATURAL RESOURCE SCIENCE AND MANAGEMENT IN THE WEST

AVERTING EXTINCTION

Return of the Grizzly

Addressing Climate Change

Wyoming's Only Endangered Plant

When Tourism Works for Conservation

A publication of the William D. Ruckelshaus Institute at the University of Wyoming's Haub School of Environment and Natural Resources

Western Confluence

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Twice a year, Western Confluence magazine brings you on-the-ground, science-based stories about the interdisciplinary, collaborative solutions to our toughest natural resource challenges.

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Photo by Jenna VanHofe, Casper Star-Tribune

EDITOR'S NOTE

By Nicole Korfanta

Western Confluence has grappled with some controversial topics, but as the editorial crew planned this issue, a focus on endangered species felt especially fraught. Whether it's wolf management, grizzly bear delisting, or the diminutive but powerful Preble's meadow jumping mouse, everyone has a position and a team. It's hard to imagine a more contentious topic in Wyoming. But as I read through the stories in this issue, a different *c*-word kept popping up: collaboration.

Although we in the Ruckelshaus Institute believe in the power of collaboration, we did not charge the writers to explore endangered species through that lens. So it's significant that it's there nonetheless. The story of collaboration in bringing back black-footed ferrets from the brink is an exemplar. Sara Kirkpatrick writes about a ranch dog near Meeteetse, Wyoming, that delivered a dead ferret—a species thought to be extinct—to its owner's doorstep, revealing that private lands still harbored the creatures. Now, willing private landowners, protected from risk and engaged through collaboration, are key to growing the wild ferret population (and in Buffalo, Wyoming, sage grouse too, as Maria Anderson reports). Even in Oregon, where the northern-spotted-owl saga fractured communities for decades, writer Courtney Carlson found that stakeholders are collaborating to find irrigation solutions that sustain both fields and amphibians. From frogs to sage grouse to ferrets, collaboration is more than just the least worst option. Many of the stories in this issue reveal that collaboration may well produce the very best option, for people and imperiled species.

This issue also shows that, more than ever, society needs different approaches for endangered species conservation in a rapidly changing world. Climate change, disease, and small population sizes are straining bull trout, bat, and bighorn sheep populations. We stand to lose too much. As our guest creative writers Alec Osthoff and Charlotte Austin note, when we lose species, wildness, and even access to quiet, we lose part of our humanity. The well-worn model of lawsuits and more lawsuits abdicates our responsibility to figure it out together, leaving critical biological and economic decisions to the courts. Our growing human footprint, the need for economically prosperous communities, our innate desire for connection to each other and to wildness—all beg for radical solutions.

As Emilene Ostlind concludes in her story on efforts to improve the Endangered Species Act, collaboration is just such a radical proposition. In spite of decades of intractable conflict, or perhaps because of it, endangered species management has become a surprising crucible for the collaborative and creative approaches that society so desperately needs right now.

Above: A crowd follows ranchers Lenox Baker (left, blue shirt and green hat), Kris Hogg (center, black and flowered shirt), and Allen Hogg (right, plaid shirt and straw hat) onto the Pitchfork Ranch near Meeteetse, Wyoming, to release endangered, captive-raised black-footed ferrets to the wild as part of the species recovery effort.

On the cover: Through her paintings, Fort Collins, Colorado-based wildlife artist Jacquie Vaux says she aims to "immortalize the animals I have known by portraying their likenesses as realistically as possible while capturing their individual personalities." Learn more about her work at jacquievauxart.com.

CONTENTS

PATH TO RECOVERY MAP OF THE ENDANGERED SPECIES ACT

By Emilene Ostlind and Gary Beauvais

INNER WORKINGS OF THE ENDANGERED SPECIES ACT (ESA)

LISTING IN PROCESS

90 DAYS

PETITIONED

Any member of the public can petition a species to be added to the threatened or endangered species list. Petitioning entails writing up a justification for why the species deserves protection and including information and supporting documentation that gives evidence of the need to list the species. Species can be petitioned repeatedly. The US Fish and Wildlife Service (USFWS) has 90 days to respond, but some species linger as petitioned well beyond the 90-day limit.

HUNDREDS US **10 WY**

# of species at this stage in US (including WY) and in WY

12 MONTHS

SUBSTANTIAL

The USFWS looks at each petition to decide whether it provides "substantial information" that a listing may be needed.

NOT LISTED

NOT SUBSTANTIAL

If a petition doesn't make a strong case for further investigation, the USFWS deems it "not substantial" meaning they won't consider the petition's case any further.

>50 WY IN THE LAST 20 YEARS

NOT WARRANTED

After further investigation, the USFWS may decide that the species is in good shape and protection is not warranted.

CANDIDATE (WARRANTED BUT PRECLUDED)

Some species deserve protection under the Endangered Species Act, but the USFWS just doesn't have the time or money to protect them right now. Candidate species get a review every two years, and can hang in limbo for years or decades.

28 US **2 WY**

ESA SPECIES IN WYOMING

Sturgeon chub *(Macrhybopsis gelida)*

Little brown myotis bat *(Myotis lucifugus)*

Tricolored bat *(Perimyotis subflavus)*

Plains spotted skunk *(Spilogale putorius interrupta)*

Regal fritillary *(Speyeria idalia)*

Western bumblebee *(Bombus occidentalis)*

Yellow-banded bumblebee *(Bombus terricola)*

Monarch butterfly *(Danaus plexippus plexippus)*

Narrow-foot diving beetle *(Hygrotus diversipes)*

Yellowstone bison *(Bos bison)*

For decades, groups have petitioned the bison for protection under the ESA. Each time, the USFWS has found the petitions "not substantial" or "not warranted." That doesn't stop petitioners from tweaking and resubmitting their pitches to protect the species. Most recently two environmental groups argued Yellowstone bison are different from other plains bison and are threatened by disease and "impairment of genetic and population structure due to ongoing management activities."

Over the last 20 years or so, more than 50 petitioned species that live in Wyoming have been found "not warranted." On average, around two thirds of petitioned species are determined not to warrant the high level of protection provided by the ESA. Just last autumn, the USFWS determined four Wyoming species—the eastern subset of the western toad, the Black Hills black-backed woodpecker, the fisher, and the white-tailed prairie dog—were not in enough trouble to warrant listing.

Small rockcress *(Boechera pusilla)*

Whitebark pine *(Pinus albicaulis)*

In 2011 the USFWS announced the whitebark pine warranted listing due to threats from blister rust and pine beetles, but other, higher priority species would be protected first. The tree has remained a candidate ever since.

LISTED

ENDANGERED OR THREATENED (WARRANTED)

If a species really is in serious trouble, the USFWS will first publish a "Proposal to List" in the Federal Register and open a 60-day public comment period. Proposed species usually move to being actual listed species within a month or two. Endangered species are those in danger of extinction. Threatened species are likely to become in danger of extinction in the foreseeable future.

Once a species is listed, there are all kinds of ways it is protected. It becomes illegal to kill or harm the species or damage its habitat (anywhere for animals, only on federal lands for plants). The USFWS often writes a recovery plan, which designates critical habitat, sets recovery goals for the species, and details recovery actions like captive breeding, reintroduction, monitoring, and more.

ENDANGERED
~1,850 US
4 WY

THREATENED
~450 US
8 WY

Black-footed ferret
(Mustela nigripes)

Kendall Warm Springs dace
(Rhinichthys osculus thermalis)

Blowout penstemon
(Penstemon haydenii)

Wyoming toad
(Anaxyrus baxteri)

The Wyoming toad once teetered near extinction. Captive breeding and reintroduction to the wild is bringing it back.

Canada lynx
(Lynx canadensis)

Northern long-eared myotis bat
(Myotis septentrionalis)

North American wolverine
(Gulo gulo luscus) [proposed]

Preble's meadow jumping mouse
(Zapus hudsonius preblei)

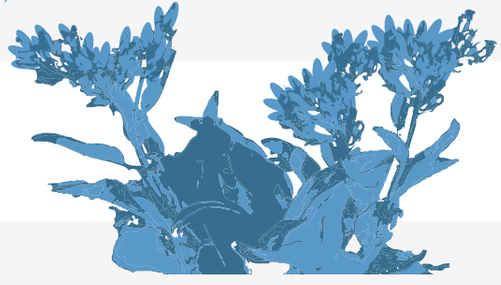
Colorado butterfly plant
(Gaura neomexicana var. coloradensis)

Ute ladies' tresses
(Spiranthes diluvialis)

Western glacier stonefly
(Zapada glacier) [proposed]

Desert yellowhead
(Yermo xanthocephalus)

The desert yellowhead, which lives only in a few acres southeast of Riverton, Wyoming, was listed as a threatened species in 2004.



EXTINCT

Though many more species have gone extinct through history, only 10 have been delisted because they went extinct, for example, the dusky seaside sparrow.

10 US
0 WY

Requires a petition and 90-day substantial finding

DELISTED

TAXONOMIC REVISION/ NEW INFORMATION DISCOVERED

Defining a species can be difficult. New genetic testing capabilities are revealing all kinds of things about species we never knew before. What were once thought to be unique species may turn out to be genetically identical to one another. In other cases, similar-looking organisms are found to be genetically distinct. Sometimes new information like this changes previous listing decisions, even leading to some species being delisted.

6 US
NEW INFO
8 US
REVISION

Although there have been no taxa listed and then delisted due to a taxonomic revision in Wyoming, the state has come close to this situation with some rare invertebrates. For example, the USFWS listed the Idaho springsnail as endangered in 1992. In 2004 three more species—the Jackson Lake (in Wyoming), Harney Lake, and Columbia springsnails—were petitioned for listing. Further investigation determined, however, that the four species are all the same and more widespread than previously thought. In 2007, the USFWS delisted the Idaho springsnail.

RECOVERED

The whole point of the Endangered Species Act is to recover species that are in danger of extinction. Once a species reaches the numbers laid forth in its recovery plan, it can be petitioned for delisting. Recovery is evidence of the act's success, and a testament to our nation's ability to correct a wrong in the natural world. When a species is recovered and removed from the threatened and endangered species list, the USFWS continues to monitor it for a few years to make sure its numbers don't plummet again, while management authority for the plant or animal returns to the state(s) in which it lives.

42 US
4 WY

Grizzly bear
(Ursus arctos)

Gray wolf
(Canis lupus)

Peregrine falcon
(Falco peregrinus)

Bald eagle
(Haliaeetus leucocephalus)

With fewer than 500 breeding pairs in the 1960s, the bald eagle was one of the first species listed under the ESA. Reduction of the pesticide DDT and other protections helped the species recover to nearly 10,000 breeding pairs by 2007, when it was delisted.

Source: US Fish and Wildlife Service Environmental Conservation Online System, ecos.fws.gov
Numbers current as of December 2017 | Design by Jessica Perry/Creative Blue Yonder

AVOIDING EXTINCTION

Can the Endangered Species Act protect

By Sarah Jane Keller

On a summer day in 2011, a group of US Geological Survey researchers hiked through the wildflowers high above Glacier National Park's tree line, sloshed into the icy stream flowing out of Grinnell Glacier, and began flipping over rocks. They scraped muck from the rocks into nets, hoping to capture the hard-to-see nymphs of an insect that survives only in the cold runoff within 500 meters of year-round snowfields or glaciers.

Scientists first described the extremely rare western glacier stonefly (*Zapada glacier*) in the 1970s, after they collected the insects in six of the park's high mountain streams. But glaciers feeding those mountain streams have shrunk by 39 percent on average since 1966, according to USGS data released last year. After surveying the original streams for three summers beginning in 2011, researchers concluded that only one of the original insect populations remained. Meanwhile, two new populations showed up in higher elevation waters. With Glacier National Park's 25 largest glaciers projected to disappear by 2030, soon the stoneflies won't be able to climb any higher.

Glacier National Park's stoneflies aren't simply obscure victims of climate change. "They're indicative of an entire ecosystem, and complex food webs that we know little about," says Clint Muhlfeld, an aquatic ecologist for the USGS Northern Rocky Mountain Science Center, and one of the scientists involved in the stonefly study. And they are one of thousands of species declining globally.

Glacier's stoneflies are indicative of global declines for climate-sensitive species. According to a 2012 study in the journal *Nature Climate Change*, melting glaciers in the Ecuador, the Alps, and Alaska could lead to the loss of 11 to 38 percent of alpine invertebrate species in those regions. In 2016, a small Australian rodent called the Bramble Cay melomys was the world's first mammal known to go extinct because of climate change. Sea level rise inundated its island habitat. Local extinctions due to climate change are much more common. In a 2016 *PLOS* study, 47 percent of 976 plants and animals surveyed worldwide had gone extinct locally.

In 2016, the US Fish and Wildlife Service proposed protecting the western glacier stonefly under the Endangered Species Act. In the United States, the ESA is the last line of defense against extinction for many creatures. But when animals or plants are at risk of extinction because climate change is altering the ecosystem around them, it puts scientists and managers in a tough spot. "It's a paradox for ecosystem managers," says Muhlfeld. The USFWS, "is going to list the species, but what can we do to slow or stop the effects of climate change on those species?"

That's a big question that managers and scientists charged with protecting species are now striving to answer. In the process, they've developed a range of innovative strategies to cushion species from climate change. They've improved ecological and climate models to forecast where future habitat will meet species' needs, while using those predictions to strategically restore habitat or even relocate animals. Meanwhile, policy-makers have gradually applied the Endangered Species Act to better account for ever-changing ecosystems. But the stoneflies' extreme plight is just one example of how difficult it is to keep species around when the most managers can do is address climate change's symptoms, rather than remove its root cause.

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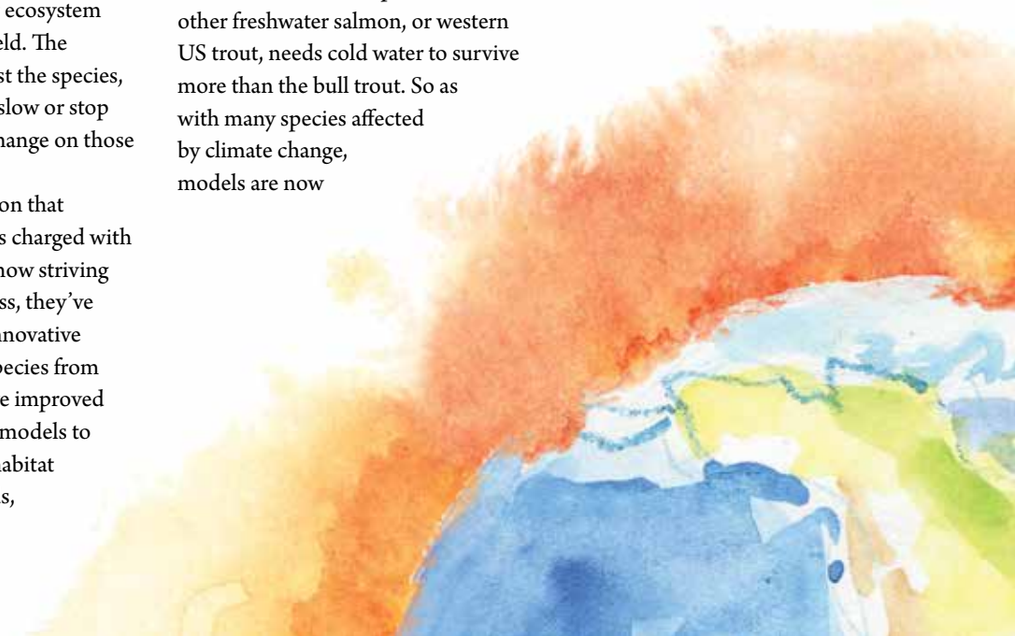
Bull trout, a steely, pink-spotted relative of the salmon, once dominated the cold waters of Pacific Northwest lakes and streams. These stout-headed fish have special habitat requirements: cold, clean water, and connected migratory corridors. In short, they thrive in the kind of wild, undisrupted habitat that is now rare. That loss of habitat, along with threats from non-native fish species, is why the USFWS listed them as threatened in 1999.

In the years since the trout's listing, scientists have paid more attention to how warming waters harm cold-water fish species. No other freshwater salmon, or western US trout, needs cold water to survive more than the bull trout. So as with many species affected by climate change, models are now indispensable when managers have to make decisions about how to help the cold-dependent fish find refuge in the future. It's something Dan Isaak, a fish biology researcher at the US Forest Service Rocky Mountain Research Station in Boise, started thinking about in the early 2000s. At that time, a slew of studies about shrinking snowpack in the West's mountains gave fish biologists another reason to worry about trout species' future.

To get a better idea of what those studies meant in a practical sense, Isaak and his collaborators started mapping where bull trout and cutthroat trout occur today, along with stream temperature data, and projections of future stream temperatures. They named their model the Cold Water Climate Shield because it helps identify where cold water is most likely to protect fish from future warming.

Scientists have been building coarse temperature models to predict trout species' futures for 25 years, and the results mostly looked grim. But while older models were air



ON A WARMING PLANET

wildlife in a changing climate?

temperature-based, Isaak's model incorporates millions of stream temperature records with bull trout habitat data collected by biologists all over the fish's range. The more detailed model that represents habitats where bull trout live today, and where they are likely to live in the future, told a more optimistic story.

"It seems to be suggesting that these cold-water trout populations, at least the ones that live up in the headwaters of these river networks, are a lot more resistant to climate change than what we've been hearing for the last 20 years," says Isaak. "So as it warms up it's certainly not going to help them, but they're certainly not going to go extinct the way people thought."

For managers, that means there's no need to write bull trout off. Instead, they can use the models to give bull trout a boost as the future becomes more stressful for them. That may mean taking a more targeted look at where agencies do restoration work, or planning for more extreme actions like moving fish populations out of harm's way.

> When animals or plants are at risk of extinction because climate change is altering the ecosystem around them, it puts scientists and managers in a tough spot.

In recent years, managers have been translating modeling and habitat studies into conservation actions to help bull trout adapt to climate change. "Are bull trout going to disappear from the planet in the next 50 years?" says Wade Fredenberg, the Fish and Wildlife Service's bull trout recovery coordinator for western Montana. "Even under the most extreme scenarios the answer's no. But they already have disappeared and will disappear from some places. The key for us is to try to figure out where the refugia are, and where to put our efforts into those places so that we can maintain and if possible expand those habitats."

The US Forest Service is using the Cold Water Climate Shield to figure out where to reclaim roads that damage trout habitat. Those projects are expensive and can be controversial with the public, so it's important to invest in restoration that will remain relevant as climate changes.

State wildlife managers, along with the Forest Service, are also using the model to assess if they should establish new, higher elevation bull trout in Montana's Scapegoat Wilderness. Putting animals where they've never been found before is an uncommon approach to helping threatened and endangered species weather climate change. But with guidance from sophisticated models, and increasing pressure from climate and invasive species, helping fish reach higher waters is starting to look like a sound conservation strategy.

Managers are already moving fish in Glacier National Park, where in 2014, the National Park Service started a project to rescue bull trout populations from both invasive species and climate change. Muhlfeld and his colleagues at the USGS used climate and habitat data, and models, to identify a high-elevation lake that will continue providing cold habitat for bull trout spawning. It's also important that the lake sits above a cliff that keeps invasive trout out. Managers have captured over 100 bull trout, placed them in special backpacks full of oxygenated water, and hiked them several miles up the mountain to release them in a lake where bull trout haven't lived before.

Trout translocations, as they are called, are an example of how climate change has forced managers and researchers to be more forward-looking when it comes to endangered species. "You've got to go out on the limb in the face of uncertainty sometimes," says Muhlfeld. "I think climate [change] kind of changed the way we're looking at systems and species. We're transitioning from a reactionary mode to a proactive mode in terms of trying to identify opportunities for climate adaptation."

As managers on the ground have made headway with proactive conservation that accounts for climate change, federal policy makers have also applied a forward-looking perspective to the Endangered Species Act. Similar to bull trout, the USFWS expects climate change will cause lower elevation and lower latitude populations of southern California's Quino checkerspot butterfly to disappear. The tiny orange and white-flecked butterfly was once one of Southern California's most common, but development ate away at its grassland, shrub, and chaparral habitat. It landed on the endangered species list in 1997. Now that its populations are small, they are at risk of extinction from drought, above average temperatures, and extreme weather events.

To protect the Quino checkerspot butterfly from climate change, federal wildlife agencies have adapted the critical habitat provision of the ESA to consider how habitat will change along with the climate. The main point of critical habitat is to identify areas essential for a species' survival and ensure that the federal government's activities don't

harm protected plants or animals. In the butterfly's case, the USFWS used critical habitat designation to set aside a migration corridor where the butterfly doesn't live today, in case the at-risk core population needs to move to a higher elevation part of its range.

By focusing on unoccupied critical habitat designations, the USFWS acknowledged that the ESA is now trying to hit an ever-moving target. "Designating critical habitat outside the [butterfly's] historic range is a pioneering response to climate change," researchers wrote in a 2014 paper about the Quino checkerspot butterfly. "This politically challenging, non-traditional, climate change-oriented conservation effort exemplifies flexible thinking needed for species vulnerable to climate change."

In the future, it's likely that more critical habitat designations will include places where species do not live today, but which will become important as the climate changes. That could mean securing higher, colder mountain habitat, future beach front, or wetlands as sea level rises, or migratory corridors that species may need to move from place to place. In February 2016, the USFWS amended its critical habitat regulations that make it easier to designate habitat unoccupied by a species at the time of listing. Eighteen states are challenging the rules, saying they unlawfully expand federal control over state lands and waters. The lawsuit is indicative of the political challenge of accounting for climate change while applying the ESA.

Recovery plans are another area of the ESA where the USFWS and National Marine Fisheries Service are gradually integrating flexible thinking about climate change. The law's ultimate goal is ensuring a species' long-term survival, and recovery plans provide the roadmap for how managers can get there. The USFWS finalized its bull trout recovery plan in 2015. While climate change was not a factor in the fish's 1999 listing, the recovery plan acknowledges the problem multiple times. The plan states that important bull trout habitat may shift or disappear over time due to climate change, so managers should use the best available research to focus on areas most likely to have cold-water fish habitat in the future. This idea is consistent with how managers are already using models to manage bull trout.

In addition to the plan for bull trout, hundreds of other recovery plans mention climate change, according to Shaye Wolf, the Center for Biological Diversity's climate science director. Some call for actions to help species adapt, or note that they require a cooler habitat to recover. For instance, the recovery plan for West Coast salmon calls for restoring streamside vegetation to shade rivers and reduce temperature stress on the fish. Others point out that greenhouse gas reductions are ultimately needed to save a species.

When recovery plans acknowledge the cause of climate change, they brush up against an ultimate question about the ESA's role in a shifting climate: Can the act address the root of the problem? Can it, and should it, regulate greenhouse gas emissions?

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With some species already in peril from climate change, it appears that the ESA alone won't be enough to hold the line against extinction. Even if the federal government wanted to claim that greenhouse gas emissions that modify a species' habitat are a "taking"—meaning something that kills, bothers, or otherwise harms endangered animals—it's not clear how such a policy would work in practice, argues Vanderbilt University Law School professor and ESA expert J. B. Ruhl.

"Are you going to regulate the entire greenhouse-gas-emitting economy?" Ruhl asks. Since every molecule of carbon dioxide is equally responsible for climate change, it's impossible to pinpoint who is liable for harming bull trout, or western glacier stoneflies, he argues. "That's why the agency through both Republican and Democratic administrations has said, 'We're not going there.'"

For example, the USFWS clearly spells out this position in its bull trout recovery plan when it states that "addressing the root causes of greenhouse gas emissions and climate change is not within our jurisdiction." The plan does go on to note that managers should "proactively protect those habitats that are expected to best maintain cold water conditions suitable for bull trout."

Some environmental groups do see ways the ESA could support reducing greenhouse gas emissions. When federal agencies plan projects like dams or roads, the ESA requires them to consult with the USFWS or the National Marine Fisheries Service to make sure a project won't harm listed species. The Center for Biological Diversity, and other groups, argue that this consultation process should also be done for federal projects that emit significant greenhouse gases.

In theory, the ESA's provisions preventing "taking" could also be used to regulate greenhouse gas emissions. The law against taking also bans "any significant habitat modification that leads to the death or injury of the species."

"I think that the ESA has played a very positive role when species are protected due to climate change threats, but the ESA can be used more fully to protect climate-imperiled species," says Wolf. "There's more work to be done in fully using the law and the benefits that it provides."

While astute management can still help species like bull trout persevere despite rising temperatures, there is little that can be done for others besides reducing greenhouse gas emissions. For instance, managers are already wracking their brains about how to help the western glacier stonefly, now proposed for addition to the endangered species list. Perhaps it will need to be raised in captivity, or moved somewhere colder. But since it is already as high as it can go in its ecosystem, and already in a protected area, it's not clear where that would be.

In 2016, scientists found a couple new populations of western glacier stoneflies further south in Montana and Wyoming. But Muhlfeld still thinks they are at high risk because they remain rare and will continue to be squeezed out of a narrow band of habitat. The year-round snow the insects need is no more secure south of Glacier National Park. Even with the potential for ESA protections there seems to be little hope for helping the rare stoneflies adapt.

"[They] could be the first species that we're aware of here in the US that could potentially go extinct due to climate change," says Muhlfeld.

Sarah Jane Keller *is a freelance science and environmental journalist based in Bozeman, Montana. Find more of her work at sjanekeller.com.*

COPING, NOT OVERCOMING

Scientist discovers pikas' strategies for dealing with heat

By Alanna Elder

Just like the creature she studies, Embere Hall spends much of the winter beneath the snow. Her office is tucked in a network of hallways beneath the University of Wyoming's older science buildings. The floorplan seems parallel to the "subnivean," a tunnel system between the earth and the snowpack, where the American pika stays active even during the coldest months.

This past winter, while the animals at her field sites hid from the frigid alpine air, Hall was toiling behind a wall of computer monitors, finishing her dissertation. Because pikas are impossible to study in person until their hiding places melt out in the spring, much of their life history is still mysterious. The elusive details of pikas' lives beneath the snowpack fascinated Hall, but the question driving her research is a broader one. Hall wants to know how species like the pika are trying to adjust to "Human Induced Rapid Environmental Change," or HIREC. Scientists use the term to describe shifts in an ecosystem that have been brought on or accelerated by human activities, such as the spread of invasive species, deforestation, and climate change.

Photo by Embere Hall

Photo by Melia DeVivo

Embere Hall weighs a vegetation sample at one of her study sites.

Hall defended her PhD last March, opening the presentation with a well-known image: a polar bear drifting on a tiny block of ice. Like polar bears, pikas have adapted to survive in a cold environment. With HIREC, "we are exposing species to conditions very different from those that shaped their evolution," Hall told the audience. "Climate change is one of the most pervasive examples of this." Scientists know that mountain ecosystems are particularly vulnerable, and that that the Northern Rockies have experienced temperature increases three times more drastic than global averages. What they still do not know, Hall said, is what species like the American pika are doing to survive this transformation.

Sometimes called "rock-rabbits," pikas are quick moving and can be hard to spot. But they make their presence known with stacks of dry leaves poking out of the talus rock, and a raspy "bleat" that has long startled hikers. One special characteristic of pikas is that they are some of the only mammals that spend their entire lives at high altitudes without hibernating. To pull this off, pikas spend the warmer seasons building networks of hay piles from the flowers, grasses, and shrubs that cushion the alpine landscape. By the time big snows fall, these heaps can be as large as a bathtub. During the winter, pikas keep warm in snow tunnels, restoring their energy reserves with food from the piles. Their thick coats and compact shapes also help protect them from bitter cold, but with a catch—they do not cope well with heat. Scientists have been studying the species' unique physiology for decades, but with climate change in the picture, it is all the more urgent that they learn how the animals respond to heat stress.

"We have a pretty good sense for what their upper lethal temperature is," Hall said. "All animals have those temperatures above which our proteins denature." For pikas, just a few hours in conditions consistently hotter than 77 degrees can be deadly.

The evolutionary story of pikas is a story of climate, although the changes that drove the American pik'as distribution across the Mountain West were more gradual than those we are seeing today. Researchers have found pika fossils at relatively low elevations, places that are now sagebrush and prairie domain. They suppose that the species followed retracting glaciers off the plains and into the mountains. This hypothesis explains why pika populations now freckle high elevation regions of the western United States and Canada, completely separated from one another. This isolation makes the species more vulnerable to extinction, because it prevents populations from sharing genes that would help them resist or adapt to threats. The populations at lower elevations are in the most trouble, with areas in the Great Basin and Southern Utah emptying of pikas as temperatures have gotten hotter. Scientists worry that the species' only option to escape the heat is to move to higher elevations until they have nowhere left to climb.

Hall said this picture is right for many places, but it is a broad stroke to describe what distinct populations of pikas are experiencing. She and her advisor, Anna Chalfoun, have uncovered a more complex story of how elevation determines where pikas can live. The splotchy temperature maps that we often use to visualize climate change are "too general to accurately describe how species are experiencing climate, especially in heterogeneous environments," Hall said. Mountain slopes are heterogeneous because plants, rocks, and other local features can provide relief from extreme hot or extreme cold.

For the first of several approaches to learn how pikas respond to rising temperatures, Hall set up field tests across five mountain ranges in the Bridger-Teton National Forest in Wyoming. Instead of using average temperatures at the 146 plots in her study, Hall placed thermometers above and below the surface of the rock.

"We knew exactly what temperatures they were experiencing," Hall said.

She then surveyed each site to see which ones had pikas, and made a surprising discovery. The best predictor of whether or not the animals were present—better than elevation, slope, or food availability—was the difference in temperature above and below the talus. For every one degree difference, the animals were eighteen times more likely to occur. In other words, the best places for pikas had nooks and crannies where the animals could cool off, despite elevation or other factors. The results supported Hall's hypothesis that pikas use "microrefuges" to survive when the surface environment is less than ideal. Microrefuges are the spaces in snow or rock crevices that help soften harsh conditions, be they hot or cold. Pikas appear to huddle beneath the rocks to stay cool, just as they keep warm by insulating themselves in pockets of snow. According to Chalfoun, this more detailed understanding of pika habitats raises other concerns that animals in some areas may actually freeze due to thinner snowpack.

"Snowpack is going to be important for a lot of things—not just pikas," Chalfoun said. "But there seems to be a balance between heavy, insulating snowpack, and earlier melts, which give them more foraging time."

Hall and Chalfoun agree: this does not mean that the impacts of climate change will balance out, but only that the shifts that pikas and other animals are experiencing are more complex than a rising thermometer. Although they help the animals avoid lethal temperatures, microrefuges are not enough to buffer threat of heat. "You can't shelter forever," Hall said. "At some point, you have to be active on the surface, and you have to do the things that allow you to persist as a species, such as securing food or finding a mate."

Hall's latest project has been to discover how pikas are altering their behavior, so that they can collect food even as their habitats heat up. At a portion of her field sites, she set up cameras and thermometers near hay piles, and recorded videos, matching the temperature readings to the footage. Hall then analyzed 1,600 recordings to see how pikas foraged when it was hot outside.

Hall found that temperatures were keeping the animals from venturing out for forage. As averages crept from 60 to 77 degrees Fahrenheit, the portion of the day when pikas collected food slid from nearly 100 percent to just 30 percent. Individuals at hotter sites were losing two-thirds of a day's work to the heat. Come winter, that time could add up, and pikas pulling from a skimpy food stock could starve.

Hall said those results were not particularly surprising, but they confirmed that warmer conditions leave pikas with less time to forage. She wanted to know what the animals were doing about that, so she looked for patterns in what the animals were eating as well as when they were eating. What she found provided new insights into pikas and other species dealing with HIREC.

"Pikas were foraging at all hours of the day," Hall said. While there was anecdotal evidence that the animals sometimes gather food at night, her team was the first to document that happening. Nocturnal foraging provides pikas with a way to secure food and stay cool.

More exciting was Hall's discovery that pikas were generally choosier when they collected food during hotter periods. Hall described this concept as "high risk, high value." The warmer the weather, the riskier the foraging trip. To make it worth the effort, pikas selected plants that were more nutritious, with higher nitrogen and lower fiber content, especially when temperatures were hot.

In the third phase of her study, Hall watched the footage to see if pikas were avoiding heat by altering the timing of their foraging trips. The graph from those results is a tangle of lines: some steep and others flat. Hall said the variation in the slopes of the lines shows the variation in individuals' "plasticity," or their ability to adjust their habits as conditions change.

"Individuals are endorsing really different strategies," Hall said. "Some will continue to forage, but at a lower rate, whereas others will do really intense foraging when temperatures are mild and then shut off foraging when it's really hot."

Hall said the steeper lines on the graph represented the individuals that were more tactical in their food collecting habits: the more plastic pikas. In order to find out whether working smart, not hard, had any benefits for pikas, she took note of the content of their hay piles. She then took samples matching those plants from the surrounding meadows back to the lab to test them for nitrogen content. Sure enough, those individuals who saved their foraging for cooler hours secured more nutrition.

These results do not necessarily mean that more plastic individuals will survive while the others perish. Hall said it is actually better that not every individual had the same response, because it widens the possibilities for how the species as a whole might survive.

"I think a really interesting question going forward is to understand more about those individuals that were not expressing a high degree of plasticity," Hall said, meaning the slow-and-steady foragers.

Hall's next step may be to learn more about those pikas that are not changing their habits to match the heat. They may be slower to adjust, or they may be toughing it out. Higher tolerance, Hall says, may be another strategy.

"[Body] temperature is also under selection pressure, so I think it would be really interesting to go back and look at their body size," Hall said. Smaller animals have more surface area compared to their volume, which makes it easier for them to shed heat. Hall thinks the less-flexible individuals from her behavior study may have a size adaptation that makes it possible for them to forage all day long. This is only speculation, because Hall says, trapping the pikas at her plots and measuring them would have been too time-consuming for this study.

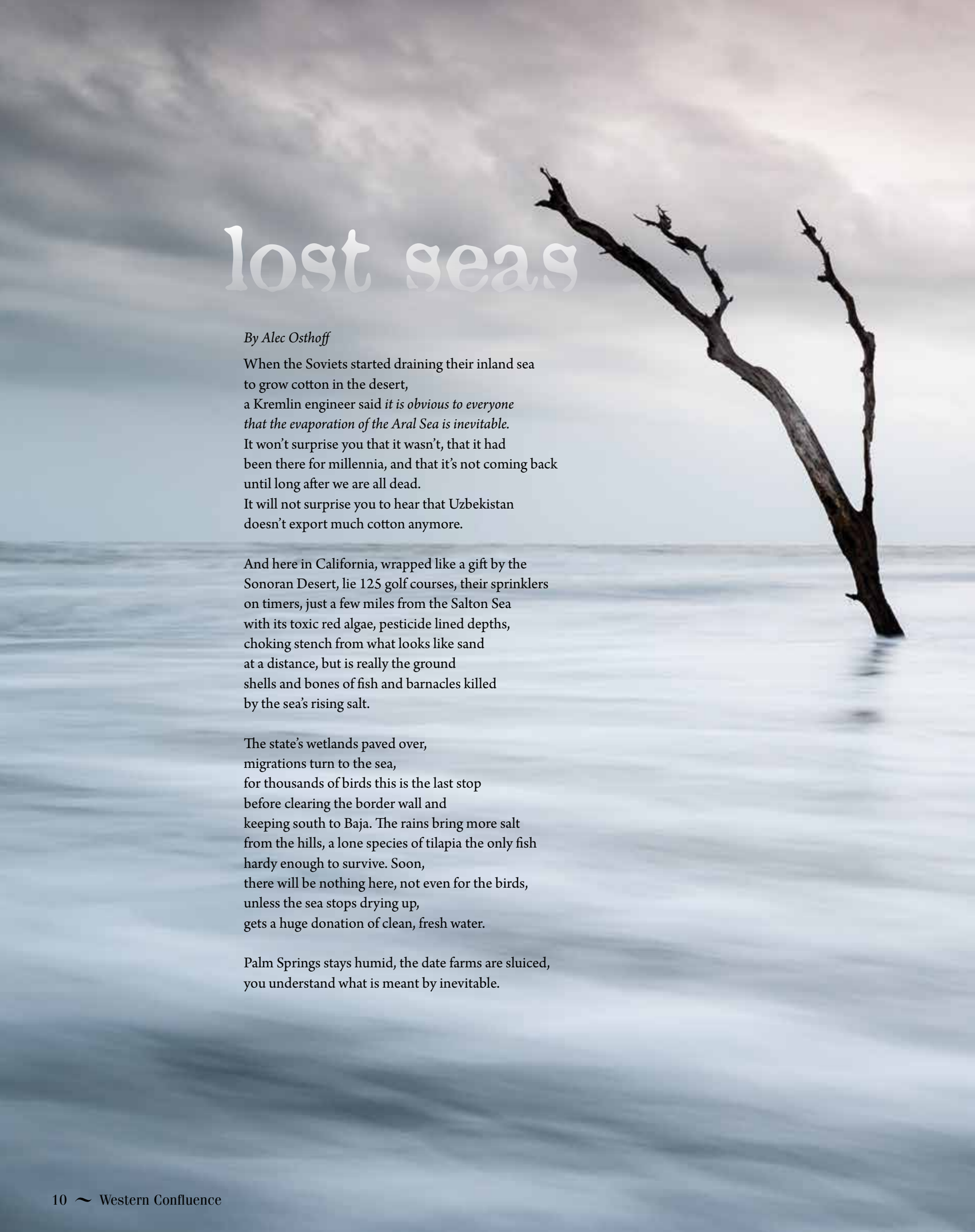
Because they evolved to be active in the alpine year-round, the American pika lives on the front lines of climate change. Wildlife advocates have made calls to list them under the Endangered Species Act, but so far, the US Fish and Wildlife Service has declined to list the species, citing a lack of information. Despite their visibility in science and media, little has been done to protect pikas. Hall is watching them for signs of resilience, but she does not want her research to give the wrong idea.

"I don't want you to think they are fine," Hall said. She pointed out that the creative behaviors she observed are not even options unless pikas have access to nitrogen-rich food, adequate microrefuges, and a way to shed heat when temperatures are deadly. As climate impacts accumulate, these tools may become less available. Even the industrious rock rabbit will likely need some help.

Alanna Elder *is a senior in agroecology and environment and natural resources at the University of Wyoming, and a part-time reporter at Wyoming Public Radio.*

Photo by Melia DeVivo

Pikas spend much of their time gathering food for hay piles that will keep them alive through the winter.



lost seas

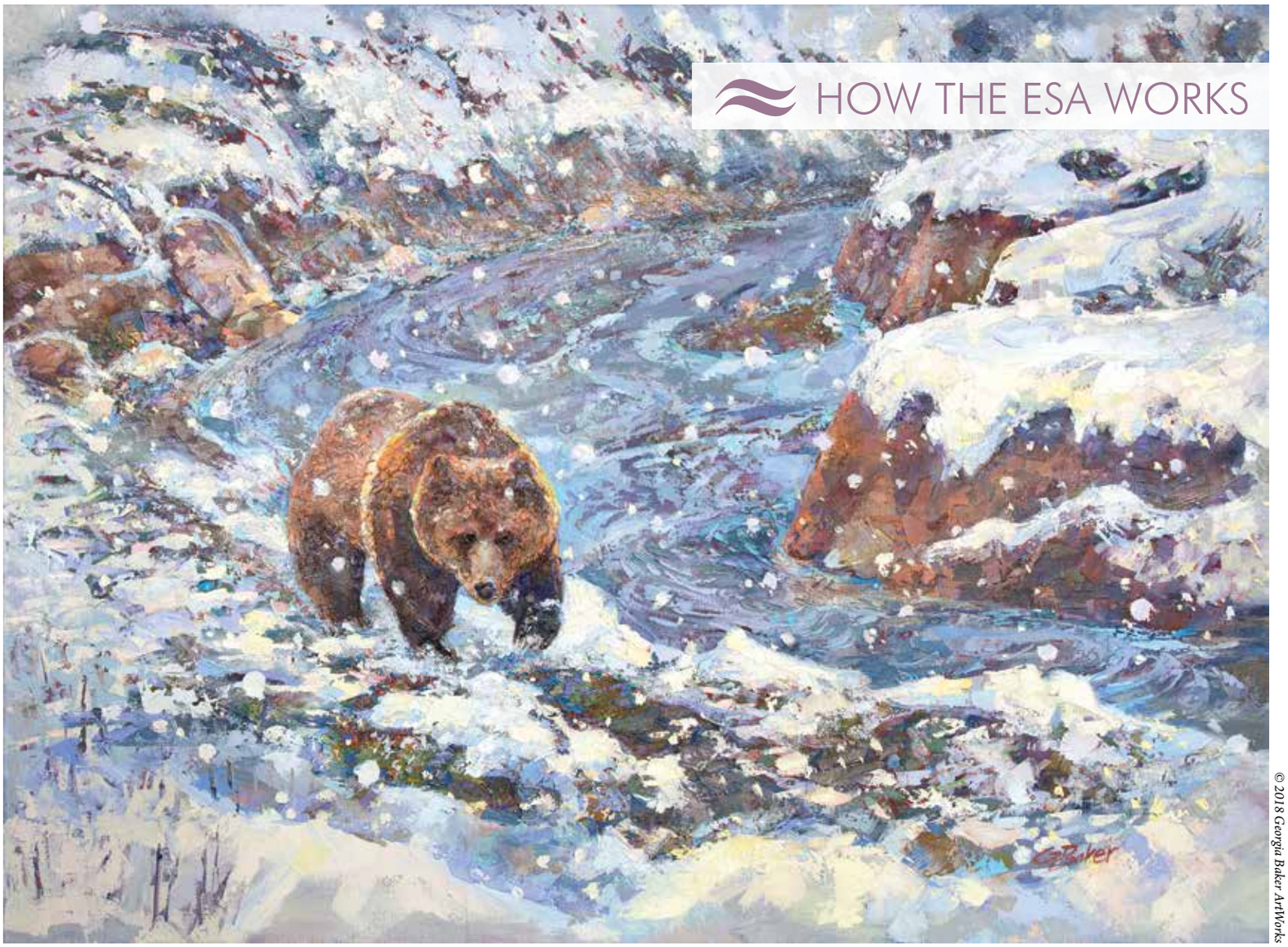
By Alec Osthoff

When the Soviets started draining their inland sea
to grow cotton in the desert,
a Kremlin engineer said *it is obvious to everyone*
that the evaporation of the Aral Sea is inevitable.
It won't surprise you that it wasn't, that it had
been there for millennia, and that it's not coming back
until long after we are all dead.
It will not surprise you to hear that Uzbekistan
doesn't export much cotton anymore.

And here in California, wrapped like a gift by the
Sonoran Desert, lie 125 golf courses, their sprinklers
on timers, just a few miles from the Salton Sea
with its toxic red algae, pesticide lined depths,
choking stench from what looks like sand
at a distance, but is really the ground
shells and bones of fish and barnacles killed
by the sea's rising salt.

The state's wetlands paved over,
migrations turn to the sea,
for thousands of birds this is the last stop
before clearing the border wall and
keeping south to Baja. The rains bring more salt
from the hills, a lone species of tilapia the only fish
hardy enough to survive. Soon,
there will be nothing here, not even for the birds,
unless the sea stops drying up,
gets a huge donation of clean, fresh water.

Palm Springs stays humid, the date farms are sluiced,
you understand what is meant by inevitable.



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Return of the GRIZZLY

No longer federally protected, is the great bear ready to strike out on its own?

National Park Service

Bear feeding area in Yellowstone National Park in the 1920s.

Text by Manasseh Franklin
Paintings by Georgia Baker

In the early 20th century, tourists gathered around dump pits in Yellowstone National Park to watch grizzlies devour trash. The National Park Service scheduled sanctioned feedings under signs reading "Lunch Counter for Bears Only." Grainy, black-and-white video depicts a scrubby bear standing on its hind legs to snatch food from a woman's upstretched hand. A photo shows bears feasting on piles of garbage, wrappers fluttering on the ground, while hotel guests stand by, enamored.

Bears quickly developed a taste for garbage. Between feedings, they sought food from tourists, at times destroying vehicles and injuring people, sometimes fatally. Finally, park officials shut down the lunch counters, leaving bears to fend for themselves. Hungry bears stayed hungry. Many starved.

Today, grizzlies are again one of Yellowstone and Grand Teton National Park's main attractions, though these days tourists spot them along the roads rather than at feeding stations. In 1976, not long after the National Park Service closed the lunch counters, wildlife managers listed *Ursus arctos* as threatened under the Endangered Species

Act, a status that came with special federal protections. Since then, the great bear has been on a long path from near extinction to recovery.

That path reached a potential end point on June 22, 2017, when Secretary of the Interior Ryan Zinke announced the Yellowstone grizzly, which now numbers around 750 bears, had recovered enough to have its threatened status removed. In a public statement, Zinke declared, "This achievement stands as one of America's great conservation successes, the culmination of decades of hard work and dedication on the part of the state, tribal, federal, and private partners." Delisting the grizzly removes some protections and returns management responsibility to the states from the federal government. But not everyone agrees that the bear is on solid ground, and some believe the bear has a long way to go to achieve full recovery.

A SHORT HISTORY

Prior to European settlers moving west during the late 1800s, an estimated 50,000-plus grizzlies roamed landscapes from the Pacific Northwest to southern California and from the high Rockies to the Great Plains. Pioneers saw bears as a threat obstructing the flourishing new America, and they killed the native omnivores for sport and subsistence. By the mid-1900s, grizzlies occupied only 2 percent of landscapes in the conterminous United States where they once thrived. They were on a fast track to extinction. In 1975, roughly 140 trash-dependent bears lingered in the core of Yellowstone National Park, with lesser numbers in the Northern Continental Divide, Selkirk, Cabinet-Yaak, and North Cascades Ecosystems.

The following year, the federal government listed the grizzly bear as threatened throughout the contiguous United States under the newly created Endangered Species Act. For the Yellowstone population, the Department of the Interior established an Interagency Grizzly Bear Study Team (IGBST), a coalition of federal, state, and tribal agencies charged bears' need for various food sources and wide ranges. The plan also described actions to limit human-bear interaction, and the bear deaths that usually follow such interactions. Additionally, the USFWS established a Demographic Monitoring Area, a boundary enclosing Yellowstone National Park and surrounding lands, where Yellowstone grizzly research and recovery work would focus.

The first step to recovery was to wean bears off the garbage they so heartily enjoyed in Yellowstone. The National Park Service replaced feeding areas with bear-proof food storage boxes and bear-safe trashcans. They launched a public education campaign with slogans like "A fed bear is a dead bear," and instituted food storage requirements for backcountry hikers. The states surrounding Yellowstone forbid grizzly hunting, and the Forest Service shut down motorized roads seasonally when bears were around to reduce human-bear interactions. They even raised guardrails to make it easier for cubs to pass beneath and get off roads.

The efforts worked. After an initial downward spike as trash-habituated grizzlies starved and human-bear conflicts increased, numbers slowly began to rebound. Over the following decades, conflicts decreased and so did bear mortality. Sightings of females and cubs increased. The population grew as fast as 4 to 7 percent in the mid '90s before tapering in the 2000s. It has remained more or less constant since, with an estimated 600 to 750 bears currently residing in the Greater Yellowstone Ecosystem.

WHY DELIST NOW?

In 2005, the USFWS declared the bear had reached its recovery goals, as measured by number and distribution of females with cubs of the year, and proposed to delist Yellowstone grizzlies. The agency delisted the species in 2007, but environmental groups filed a series of lawsuits that placed grizzlies back under federal protection two years later. The most pressing concern? Climate change and its effect on two primary foods: white bark pine nuts and cutthroat trout.

Grizzly bears are opportunistic omnivores, their diet a seasonally driven buffet of roots, tubers, fungi, berries, nuts, pocket gophers, army cutworm moths, fish, scavenged carcasses, and more. White bark pine nuts are particularly important in the fall for sows preparing to hibernate. Spawning cutthroat trout offer vital spring nutrition as bears emerge from hibernation. Since the 1980s, native cutthroat trout populations in the Greater Yellowstone Ecosystem have plummeted due to drought, the introduction of nonnative lake trout, and parasites. Cutthroat are listed as sensitive by state and federal agencies.

These forces led the 9th Circuit Court of Appeals to order the USFWS to vacate the delisting rule in 2009, and restore ESA protections by 2010. The IGBST launched an in-depth investigation to determine how bears were responding to shifting food sources—a critical element to understanding grizzly adaptability in the face of climate change. According to Frank van Manen, Team Leader of the IGBST,

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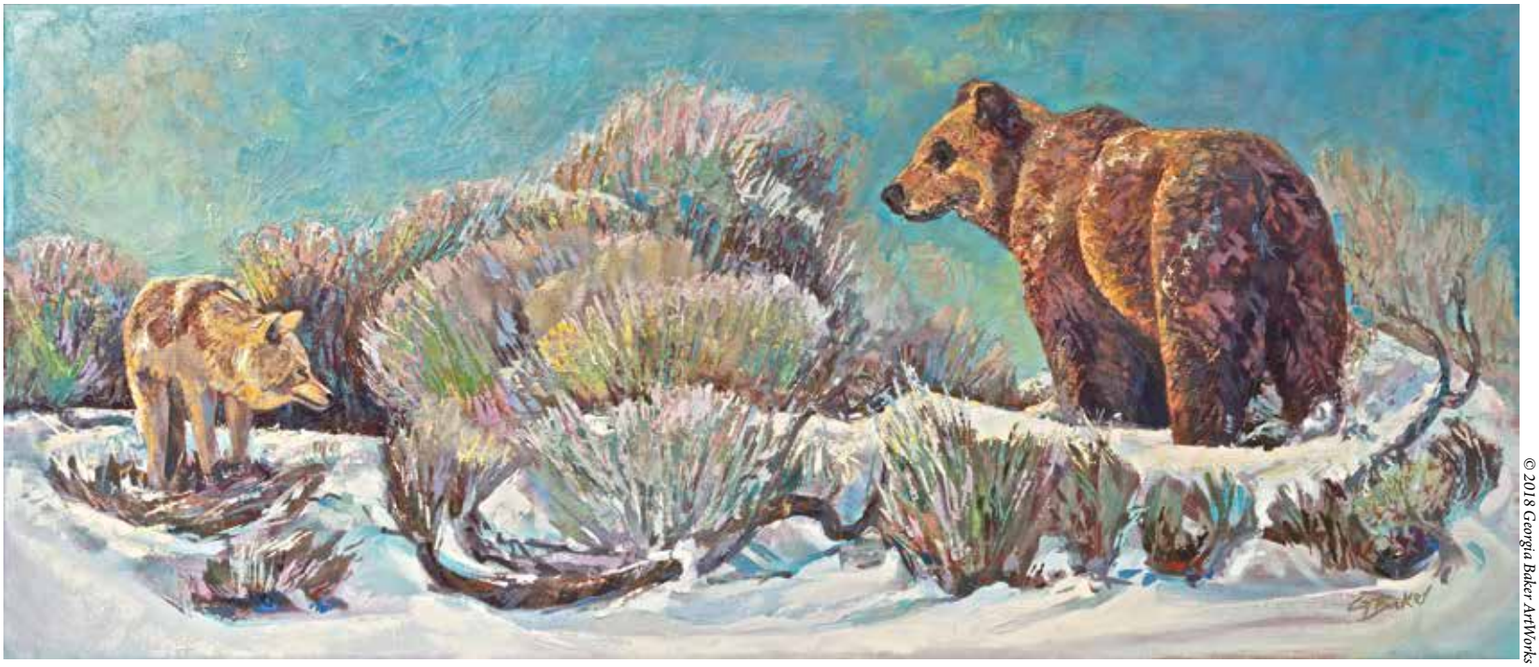

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five years of intensive research offered no conclusive evidence that climate change negatively impacts Yellowstone grizzlies.

"We observed more consumption of animal matter in the fall, which may indicate that bears were simply looking for carcasses of ungulates, scavenging, and in some cases maybe [increasing] predation as the availability of whitebark pine declined," he said. "We've seen that they showed a lot of resilience and plasticity in their diet composition, and that supports everything we know about the species." In other words, if bears can't access something they're accustomed to eating, they'll just look for something else to eat.

Another concern that surfaced during the relisting revolved around population stagnation. The robust growth that biologists witnessed during the '90s leveled off in the early 2000s. "We've done a lot of research to determine whether that was related to changes in food supply or whether there were other factors at play," van Manen explains. "One of those other factors could be that the population is reaching this conceptual idea of carrying capacity of the environment to support a certain number of bears."

Carrying capacity refers to the number of individuals a habitat can sustain in terms of food, territory, and other resources. The limits scientists observed among Yellowstone grizzlies were based on social tolerance among bears. In densely populated areas, cubs and yearlings are more vulnerable to mortality by adult male bears than in areas with fewer bears. The Demographic Monitoring Area may not be able to support any more bears, not because of climate change, but simply because of bear density.

Grizzlies are checking all the boxes in the 1993 Grizzly Bear Recovery Plan (a revision of the 1982 plan). By definition, they've reached recovery. The IGBST's peer-reviewed research—what the USFWS refers to as the "best available science," which the agency uses to inform its listing decisions—indicates that the Yellowstone grizzly has been meeting its population and distribution targets since the 1990s. The IGBST's investigation into potential climate change threats found enough evidence of recovery for the USFWS to announce the most recent delisting proposal in 2016.

But many citizens and scientists question the USFWS's quick dismissal of climate change and fear the impacts of proposed trophy hunting that accompanies the shift from federal to state management. For those people, the Yellowstone grizzly is anything but ready for life after delisting.

OPPOSING VOICES

During the 60-day public comment period following the USFWS 2016 proposal to delist, Gugenheim Fellow and author Doug Peacock, who's written numerous books including *Grizzly Years: In Search of the American Wilderness*, penned a letter to President Obama that asked the critical question, "Who benefits from delisting Yellowstone's grizzly bears? The only certain outcome of delisting bears will be trophy hunting in Idaho, Montana, and Wyoming." A collection of well-respected scientists signed the letter, including Jane Goodall, E. O. Wilson, and George Schaller. The letter continued, "We strongly suspect that America's great bears face a dire future, even with the continued protection of the Endangered Species Act."

Peacock's letter was one of 650,000 the USFWS received during the comment period. While not all of the letters expressed dissent, many did. Opponents voiced two primary concerns: the shift from federal protection to state management that will allow trophy hunting—a practice bears have been shielded from for 42 years—and the still-questionable impact climate change will have on grizzlies and their habitat.

In April 2017, a small crowd gathered at the National Museum of Wildlife Art in Jackson, Wyoming, to watch the double feature of *Trophy* and *Keep Grizzlies Protected*. The first film chronicled the controversial killing of grizzlies for sport in British Columbia where hunters shoot hundreds of bears each year for their heads, paws, and hides. The latter highlighted the role humans have played in bear declines in the past, and how trophy hunting will lead to more human-caused bear mortality. The Center for Biological Diversity, Sierra Club, Wyoming Wildlife Advocates, and Western Watersheds Project organized the event. The Center for Biological Diversity claims that state-sanctioned hunting wouldn't be sustainable given the bears' extremely low reproductive rates and marginal survival among cubs and yearlings.

Throughout the Greater Yellowstone Ecosystem and beyond, advocates against delisting are voicing similar concerns. In Bozeman, Montana, painter Georgia Baker curated an art exhibition to raise awareness about the dangers of delisting. More than 50 Native American tribes publicly rejected the delisting proposal. For tribes, the grizzly is a spiritual symbol. In an interview in *McClatchy DC*, Shoshone-Bannock Vice Chairman Lee Juan Tyler called the grizzly "a sacred being,

our brother, our sister," and said that allowing trophy hunting "would be like going out there and murdering."

The Yellowstone grizzly's genetic isolation also alarms many, who claim that the lack of genetic variation in the Yellowstone population is further cause for concern. If states allow trophy hunting on the edges of the Primary Conservation Area, which encompasses Yellowstone and Grand Teton National Parks, as well as some US Forest Service and private land adjacent to the parks, bears that leave the area in search of a mate in the Bitterroot Ecosystem, for instance, could be shot. Bears need to move between ecosystems to interact with other grizzly populations, but the increased danger of leaving Yellowstone National Park could hinder the genetic mixing that makes wild populations more resilient.

In addition to trophy hunting, climate change remains a crucial unknown according to groups like the Sierra Club who claim that science surrounding the decline of whitebark pine nuts and cutthroat trout isn't yet adequate. Despite years of dedicated research on behalf of the IGBST, many continue to ask how the USFWS can be certain about the impact on grizzlies in a continually changing climate. Peacock is in that camp, as is Dave Mattson, a biologist who worked with the IGBST until the mid-nineties.

Mattson is vocal against the delisting, due to both the uncertainty of climate change and the shift to state management. Under federal protection, the USFWS manages the grizzly, which he calls an "iconic population of national interest" with public interest in mind. The move from federal to state management will "disenfranchise 95 percent of the people of the United States who otherwise are enfranchised in theory now."

Additionally, Mattson's research indicates that although the decline in whitebark pine isn't causing bears to starve, it could be leading to higher mortalities, particularly for females and cubs who, in their search for other food sources, move closer to boars, which frequently kill cubs.

"There's ample evidence of lag effects amongst bear populations, which is to say, it takes a decade or more before you see decline in a population after the deterioration of its habitat," he says. He's referring to decline of whitebark pine nuts, which started in the early 2000s. In other words, the effects of climate change on bear habitat and food sources that started more than 15 years ago are only beginning to reveal themselves in the population, and if that's the case, grizzlies will become increasingly vulnerable to those effects.

LIFE AFTER DELISTING

So what's next for America's great bear? Does removing federal protection mean a free-for-all will ensue, making 42 years of monitoring, management, and research irrelevant?

Not exactly.

"Any species that we delist has a mandatory minimum five-year period of post-delisting monitoring," says Hilary Cooley, Grizzly Bear Recovery Coordinator with USFWS. After delisting, the USFWS will keep watch over states and other land management agencies, which are required to monitor bear population numbers and report to the USFWS. Bears will need active conservation management to sustain the population, so federal oversight will continue for the foreseeable future.

Furthermore, the USFWS teamed up with state land management agencies in Idaho, Montana, and Wyoming as well as with the US Forest Service, the National Park Service, tribes, and county commissioners to develop the *2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem*, essentially a roadmap to ensure a successful delisting, much like the 1993 recovery roadmap. Conservation strategies include continuing the monitoring and management that took place under the ESA.

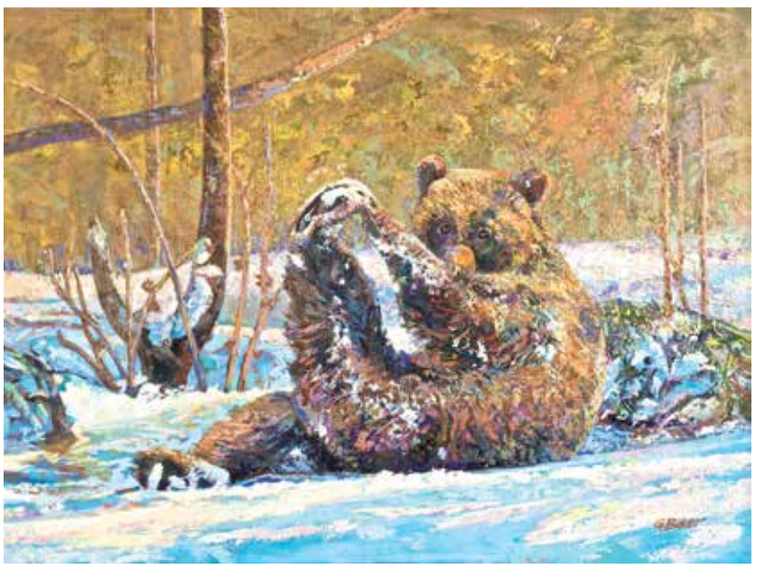
Idaho, Montana, and Wyoming have their own management plans, and they each include the option for grizzly hunting, a management shift Cooley supports. The states will manage grizzlies as a trophy game species, offering limited seasons that can change based on populations, similar to moose, elk, and deer. It's not yet clear how many tags states will offer, or what the tags will cost. To date, no state has proposed a hunt.

"Just because we're handing management to the states does not mean protections are gone," explains Cooley. "Yes, states will have the option to harvest but that doesn't mean there are no regulations or limits to that. There will be."

Regulations listed in the 2016 conservation strategy include maintaining at least 500 bears in the Greater Yellowstone Ecosystem and at least 48 females with cubs of the year in the Primary Conservation Area. This area is divided into 18 Bear Management Units to ensure accurate monitoring of family group numbers and distribution. The IGBST will closely watch food sources, including whitebark pine nuts and cutthroat trout, as well as human-bear conflicts. According to Cooley, the Grizzly Bear Coordinating Committee will make sure that management agencies, including state wildlife and land management agencies uphold their end of the bargain. And, if the bear population dips below the 500-bear threshold, citizens can petition the USFWS to investigate the species' status and consider relisting. At press time, several tribes and conservation organizations, including the Northern Cheyenne tribe, National Park Conservation Association, and Sierra Club have filed lawsuits against the delisting, a move that could put grizzlies back under the protection of the Endangered Species Act.

Despite the uncertainty and controversy regarding the delisting, one thing is certain: we've come a long way from the lunch counter days. Thanks to the recovery plan, Yellowstone grizzlies have rebounded from an estimated 140 in 1975 to 750 today. For the USFWS, the conservation accomplishment, thanks to protection from the Endangered Species Act, is clear.

"We've recovered grizzly bears in the Greater Yellowstone Ecosystem, this iconic species, and that's the goal of the act: to recover species," says Cooley. "It's not to keep them on the list in perpetuity, it's to recover them. That alone makes this a success."



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Manasseh Franklin *is a freelance writer based in southeast Wyoming. Her writing has appeared in* Adventure Journal, Alpinist, Rock and Ice, Trail Runner, *and* AFAR *magazines.*

Bozeman-based artist and conservationist ***Georgia Baker's*** *paintings encourage viewers to honor and respect wild animals and the lands on which they live. Learn more at georgiabakerart.com.*

Photo by Sara Kirkpatrick

Photo by Mike Lockhart

NEW NEIGHBORS

Wyoming ranchers are key to black-footed ferret recovery

By Sara Kirkpatrick

Lenox Baker's hands gripped the steering wheel, and the large silver ring on his finger glinted, revealing an outline of a black-footed ferret. He drove a dirt road toward the Pitchfork Ranch, which borders the Absaroka Mountains west of Meeteetse, Wyoming. The retired heart surgeon bought the ranch with his wife, Fran, in 1999, inheriting a connection to the black-footed ferret story. As his ring indicated, the ferret now holds significance in his own life.

Black-footed ferrets once numbered so few that they were thought to be extinct. Now, a massive effort entailing years of work from multiple government agencies and private landowners is underway to restore their populations. The Meeteetse area is the most recent place among many targeted for ferret recovery. This region is a historic range for the animal, but ranchers haven't always welcomed endangered species, or in the case of ferrets, their prairie dog prey, onto their lands. If the ferret's recovery is to eventually succeed, landowners like Lenox will be essential.

Ferrets are mysterious, difficult-to-find, nocturnal creatures. Prairie dogs make up 90 percent of the ferret's diet, and ferrets use prairie dog burrows for habitat. Ranchers often view prairie dogs as a pest; they compete with cattle for forage, dig holes, and carry disease. Over the last century, eradication of prairie dogs and encroachment of farms and other developments into the prairie reduced prairie dog and ferret habitat, while disease, including sylvatic plague, killed both species. The ferret started to disappear. Black-footed ferrets were one of the first animals listed when the Endangered Species Act passed in 1973, but the listing didn't keep the ferret population from declining, and by 1979 the species was considered extinct.

This would change at a ranch neighboring the Pitchfork on the morning of September 26, 1981. John Hogg's ranch dog, Shep, brought a dead animal to the doorstep. At breakfast, John mentioned the unusual animal to his wife, Lucille. When she did not recognize the creature, they took it to a local taxidermist who identified it as a black-footed ferret. Knowing the ferret was an endangered species, the taxidermist notified the US Fish and Wildlife Service. The USFWS, along with Wyoming Game and Fish Department and consulting firms, investigated the Lazy BV Ranch in hopes of finding more ferrets.

To the surprise of the Hoggs and many others, wildlife officials found a population of about 124 black-footed

Photo by Justin Joiner

Photo by Wyoming Game and Fish Department

Photo by Sara Kirkpatrick

Photo by Jessica Grant

Clockwise from top left: Wyoming Game and Fish Department non-game supervisor Zack Walker joins Allen and Kris Hogg to release a captive-raised black-footed ferret on the Lazy BV Ranch. / Jesse Boulerice, a non-game biologist with Wyoming Game and Fish, holds a wild-born kit from Meeteetse. / Jesse Boulerice releases a ferret to the wild. / A captive-raised ferret peers out of its hiding place. / Black-footed ferret in a trap. / A mounted black-footed ferret adorns the mantle in the Hogg home. The mount was a gift from the US Fish and Wildlife Service to thank the Hoggs for their role in the ferret recovery effort.

ferrets on the ranch and in the surrounding area. For several years, the multi-agency team monitored the population. Then in 1985, sylvatic plague and canine distemper spread through the region, killing both ferrets and their prairie dog food supply. Ferret numbers dropped drastically, so in 1987 the agencies captured the few remaining wild ferrets to begin a captive breeding program.

Wyoming Game and Fish started raising ferrets in the Sybille Wildlife Research Center in southeast Wyoming. Little was known about ferret biology, and out of the 18 wild ferrets captured, only seven reproduced successfully. But that was enough to build a captive population. After several years, Game and Fish and the USFWS prepared to reintroduce captive-raised ferrets into the wild.

One site the agencies evaluated for a potential ferret reintroduction was in the Shirley Basin between Medicine Bow and Casper, Wyoming. Anyone who hurts or kills an endangered species, even unintentionally, can incur a hefty fine, and so to get locals to accept the ferret reintroduction, the agencies needed a mechanism for protecting ranchers and other people who lived and worked in the Shirley Basin. Section 10(j) of the Endangered Species Act lets the USFWS reintroduce a "nonessential, experimental" population of an endangered species and holds private landowners harmless if they accidentally kill an animal while conducting

Photo by Mike Lockhart

Photo by Jessica Grant

otherwise-lawful activities. USFWS made the 10(j) designation for the Shirley Basin site, protecting landowners and allowing Game and Fish to move forward with recovery plans.

In 1991, Game and Fish released captive-raised ferrets in Shirley Basin. This became the first ferret reintroduction site in the world, where over four years the agency would release 228 ferrets. This was only the beginning of the recovery effort for the species, and the animal would soon experience setbacks. Plague hit prairie dog colonies, reducing the ferret's main food source and directly killing some ferrets. With its ferret budget down, Game and Fish couldn't survey the introduced population as often as needed. Still, in the early 2000s biologists found a strong, growing population that had survived the plague outbreaks. By 2008, the Shirley Basin population was stable at an estimated 250 wild ferrets.

While the black-footed ferret story has its roots in Wyoming, it has grown into a nationwide effort. Federal, state, tribal, and non-governmental entities have worked together to release ferrets at over 30 sites in South Dakota, Montana, Arizona, Colorado, Utah, Kansas, and New Mexico. The genes from these released ferrets can all be traced back to the original wild ferrets from Meeteetse. The USFWS set a Wyoming recovery goal at 341 ferrets. Both Game and Fish and USFWS have a substantial amount of work to do before the ferret can be delisted.

Game and Fish has long expressed interest in a statewide 10(j) designation to encourage more private-landowner involvement in ferret recovery efforts. In 2015, the USFWS approved a statewide 10(j) to protect landowners who could provide habitat for the ferret. With the new ruling in place, Game and Fish approached Lenox Baker, owner of the Pitchfork Ranch, and Kris and Allen Hogg, owners of the Lazy BV Ranch, about the potential of a new reintroduction site on their land.

The landowners' engagement and support of the ferret reintroduction was critical. Lenox had already let Jesse Boulerice, a non-game biologist for Game and Fish, and his team stay on the Pitchfork to work on an experiment for plague vaccines for prairie dogs. Jesse found the vaccine showed potential as a tool for managing plague, further boosting support for ferret reintroduction. Meanwhile, Allen Hogg, John and Lucille's son, and his wife Kris, were ready to carry on the family legacy. Their involvement in the recovery effort was driven by their personal connection to the ferret's rediscovery. "My dad would light up when he told the story," Allen said.

Many county commissioners were nervous, considering the recent controversy with wolf reintroduction interfering with ranching operations, so Game and Fish assured them the 10(j) rule would protect landowners and surrounding residents. "With the 10(j) rule, if our neighbors did find ferrets on their land and didn't want them there, they can ask Wyoming Game and Fish to have them removed," Allen explains. With the county commissioners' support, in addition to landowner cooperation, the Wyoming Game and Fish Department was ready to move forward.

In July of 2016, the agencies released 35 captive-raised ferrets on the Pitchfork and neighboring Lazy BV Ranch. Thirty-five years after its rediscovery, the ferret returned to its historic home.

In a survey of the Meeteetse site in September 2016, Game and Fish biologists counted 19 ferrets on the two ranches, more than half of the original 35, and some ferrets likely went undetected. In 2017, the agency found three wild-born kits and released 15 more captive-raised ferrets. Game and Fish hopes to see a self-sustaining population of ferrets in this location with at least 30 breeding adults.

As the more than three-decade-long ferret story attests, recovering an endangered species from the brink of extinction is no easy task, and private landowners such as Lenox Baker and the Hoggs are essential to this work. Allen said, "It's been an honor to be a part of this."

Sara Kirkpatrick *is an undergraduate student at the University of Wyoming, double majoring in journalism with environment and natural resources.*

A Tale of Two Species

Plants and animals receive different protections under the Endangered Species Act

Text by Kristen Pope
Drawings by Emilene Ostlind

In 1998, the US Fish and Wildlife Service listed a small brown mouse with large hind feet and a 6-inch-long whip-like tail as threatened under the Endangered Species Act, which dismayed ranchers and others whose daily activities overlap with the mouse's habitat.

"People were really worried," says Gary Beauvais, director of the Wyoming Natural Diversity Database. "A lot of agriculture producers say, 'Technically, if I go burn my ditch or cut my hay, I'm in violation of the Endangered Species Act.'"

The listing decision for the Preble's meadow jumping mouse forced ranchers and developers to stop or alter some of their activities in the animal's habitat, or face steep penalties.

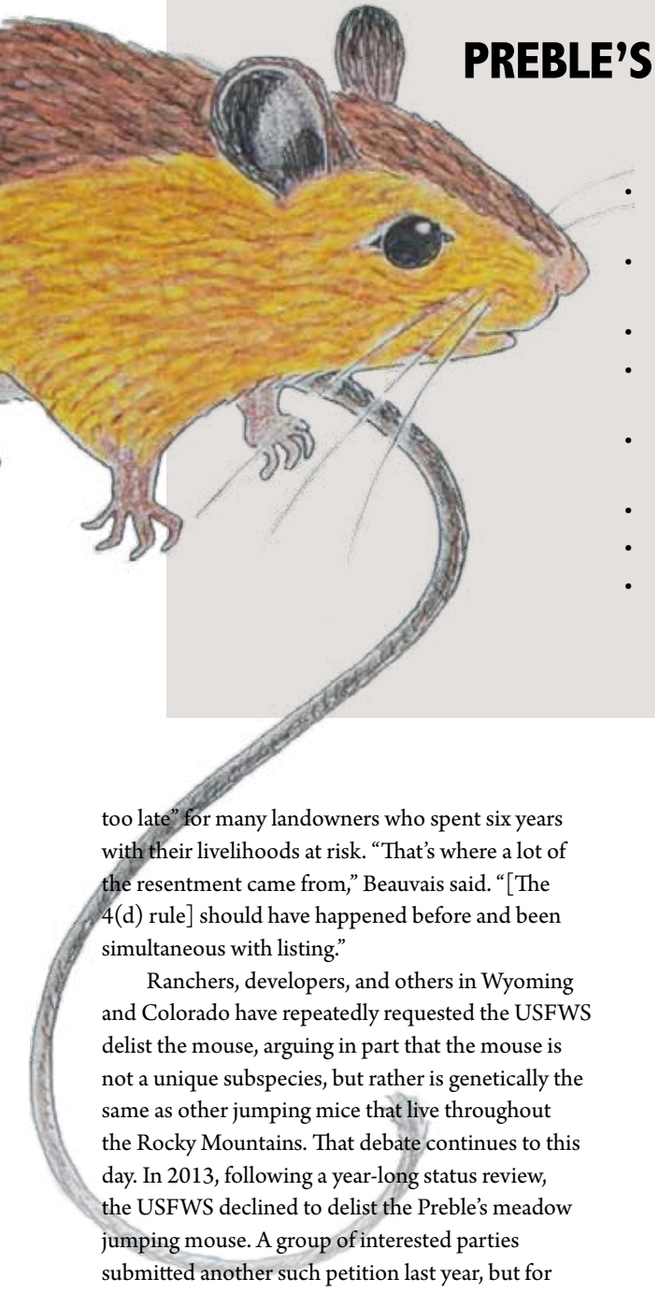
"The mouse is a symbol of the potential impact of federal regulation and the potential for the presence of a listed species to fundamentally impact the way a rancher can use his or her property," says Mike Brennan, Wildlife Conservation and Mitigation Program Director at Texas A&M University.

Meanwhile, another threatened species that lives in the same riparian meadows as the jumping mouse didn't cause any trouble. The Ute ladies'-tresses orchid, listed as threatened since 1992, didn't interrupt ranching or other activities the way the mouse did. This is in part because the Endangered Species Act places different restrictions on how people, especially private landowners, can interact with listed plants and animals.

Most people know the Endangered Species Act makes it illegal to "take" fish and wildlife species, a term which is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." But a lot of people don't realize that, "'Take' doesn't apply to plants," says Nathan Darnall, Deputy Field Supervisor for the USFWS's Wyoming Ecological Services Office. "There are some prohibited acts. You can't sell a plant across state lines and can't engage in commerce across the high seas." Collecting or maliciously harming endangered plants on federal lands is also prohibited.

However, landowners are free to trample and destroy endangered and threatened plants, such as the Ute ladies'-tresses orchid, on their land (unless a project there has a "federal nexus"—typically a federal permit or authorization). Some states have their own laws that protect threatened or endangered plants on private lands, though Wyoming does not. So, under the Endangered Species Act, it would be perfectly legal to bulldoze a whole bed of Ute ladies'-tresses on private property.

How are these different levels of protection playing out for the Preble's meadow jumping mouse and the Ute ladies'-tresses? In 2004, the US Fish and Wildlife Service implemented what is called a 4(d) rule for the Preble's meadow jumping mouse, under which landowners can apply for permits to inadvertently "take" a few mice in the course of certain normal agricultural activities such as mowing, landscaping, and ditch maintenance, as long as a habitat conservation plan is in place. However, this was "too little



PREBLE'S MEADOW JUMPING MOUSE

A controversial rodent

- **Size**: Nine inches long, more than half of which is a bi-color tail
- **Color**: Orange-black fur with a dark stripe down its back
- **Unusual characteristic:** Large, powerful hind feet
- **Range:** Southeastern Wyoming's foothills south to Colorado Springs
- **Habitat:** Shrubby riparian areas and nearby heavily vegetated uplands
- **Diet:** Insects, fruits, seeds, and fungus
- **Hibernation:** From September or October until May
- **Secret trick:** It can jump three feet to escape predators

too late" for many landowners who spent six years with their livelihoods at risk. "That's where a lot of the resentment came from," Beauvais said. "[The 4(d) rule] should have happened before and been simultaneous with listing."

Ranchers, developers, and others in Wyoming and Colorado have repeatedly requested the USFWS delist the mouse, arguing in part that the mouse is not a unique subspecies, but rather is genetically the same as other jumping mice that live throughout the Rocky Mountains. That debate continues to this day. In 2013, following a year-long status review, the USFWS declined to delist the Preble's meadow jumping mouse. A group of interested parties submitted another such petition last year, but for now landowners must continue writing habitat conservation plans and applying for incidental take permits.

Meanwhile, the Ute ladies'-tresses population has been healthy enough to delist for more than a decade, though its status doesn't seem to bother anybody, and no one has gone to the trouble to actually remove it from the threatened species list.

***Kristen Pope** is a freelance writer and editor in Jackson, Wyoming.*

UTE LADIES'-TRESSES ORCHID

A protected flower

- **Size:** Five to 20 inches tall
- **Color:** Cluster of small white or ivory flowers
- **Unusual characteristic:** Petals look like braided tresses of hair
- **Range:** Wyoming, Utah, Colorado and four other western states
- **Habitat:** Riparian areas, old oxbows, gravel bars, meadows, and wetlands
- **Estimated population:** 3,800 in 10 different populations
- **Season to find them**: Look for flowers in late summer
- **Secret trick:** They grow underground, undetectable for years

MAPPING RECOVERY

Once missing from Yellowstone, reintroduced wolves make a comeback

By Kit Freedman

On a crisp March morning in 1995, wolf biologist Doug Smith and colleagues from the National Park Service and US Fish and Wildlife Service made their way toward a makeshift pen in Yellowstone National Park's northern range. Inside, six wolves from Alberta, Canada, watched as the men opened the gate to their new home.

"There was a great deal of anticipation," recalls Smith. "It was this magical feeling that we were restoring Yellowstone. We were making Yellowstone whole again."

Several days passed before all six wolves left the pen. Within weeks the animals settled into the northeast region of the park, beginning one of the largest and most controversial species reintroduction experiments ever. Over the following year, managers released 25 more wolves from six additional pens across Yellowstone. By 2000, the population in Yellowstone expanded to 119 individuals, and as early as 2002, wolf numbers reached the recovery goal: 300 individuals and 30 breeding pairs distributed across Wyoming, central Idaho, and northwest Montana.

Despite meeting the delisting criteria, controversy—or as Smith puts it, "human bickering"— kept the animals on the Endangered Species List. Although the US Fish and Wildlife Service first filed a rule to remove wolves from the list in 2008, ultimately the decision to delist the animals came not through the power of the ESA, but as a rider to a budget bill passed by Congress in 2011.

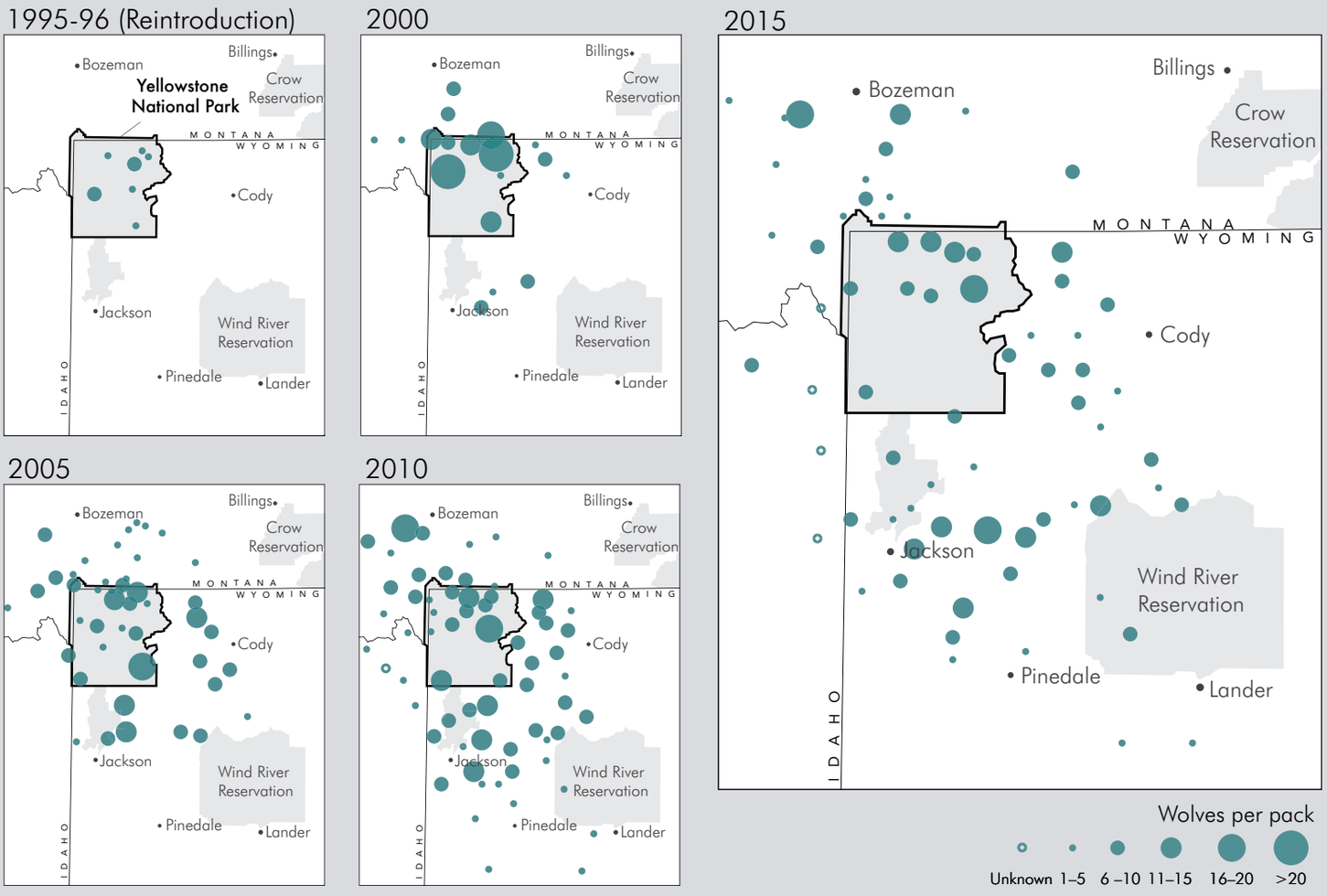
In the years that followed, wolves were relisted and delisted several more times as environmental groups and states litigated each listing decision. Most recently, in April 2017, Congress again returned wolf management to the states.

Today, around 1,700 wolves inhabit the Northern Rocky Mountain Recovery Area, with the Yellowstone population hovering around 100. That population, Smith says, is one of the most protected in North America. Several states including Alaska, Idaho, and Montana, have opened hunting seasons on the animals. And in Wyoming, hunters harvested a dozen wolves from a single area in the first 40 hours of the state's managed hunting season, which began October 1, 2017.

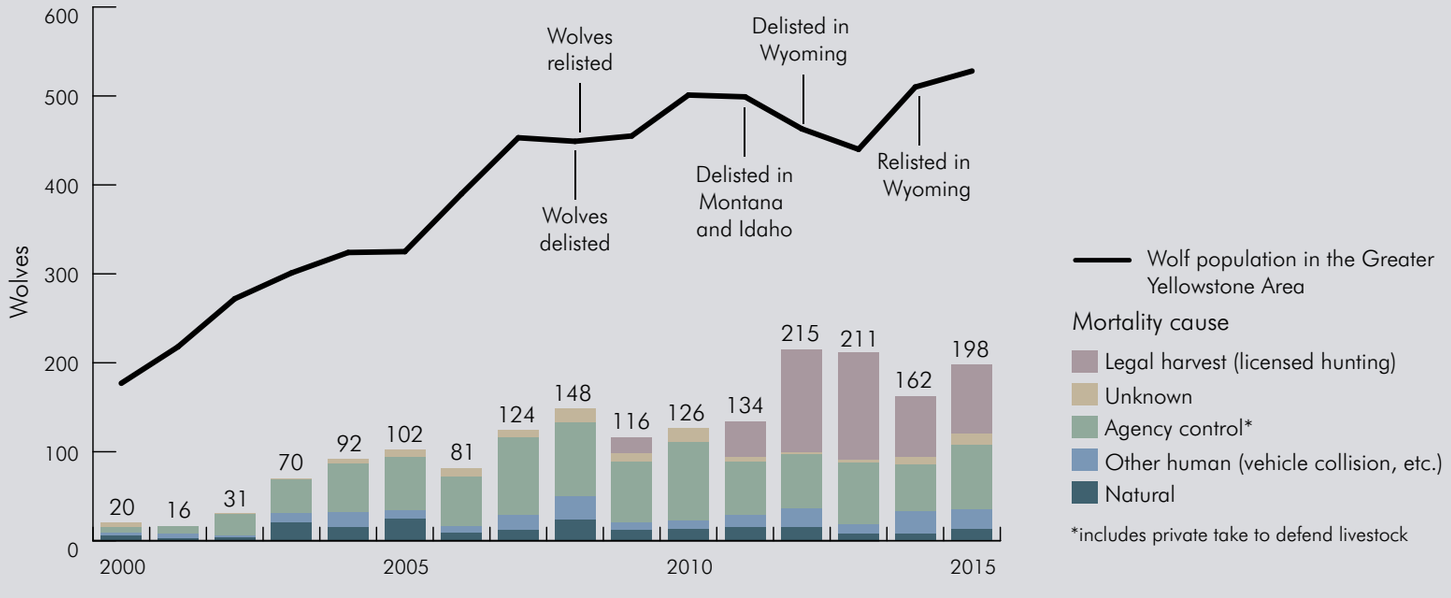
With wolves now off the endangered species list, there's nothing legally preventing the states from reducing wolf populations down to the bare, biological minimum of 300 individuals across the Northern Rocky Mountain Recovery Area. As Smith points out, for wolves outside of Yellowstone National Park, "the story of their lives is, eventually a human is going to kill you."

***Kit Freedman** is Project and Outreach Coordinator for the Ruckelshaus Institute of Environment and Natural Resources at the University of Wyoming.*

WOLVES IN THE GREATER YELLOWSTONE AREA



Population Size and Mortality



Source: US Fish and Wildlife Service

COLLABORATE OR LITIGATE

Local collaboration faces off against outsider litigation in the long, slow process to help a threatened species

By Courtney Carlson

From his Chevy Silverado, Phil Fine watched heavy rain fill up an irrigation ditch on his family farm in central Oregon. An affable third generation farmer in Jefferson County, Fine relies on water from the Deschutes River to grow grass, carrot, and garlic seed; alfalfa and grain hay; and wheat. "We can't do a thing without water," Fine said. "That Deschutes River is why we're all here." Fine and other agriculturalists in the arid region have come to depend on the dams and reservoirs that alternately hold the Deschutes' water back and then release it when farmers most need it to water their crops. The system, though imperfect, works well enough for irrigators. But the pressing question in central Oregon is what it means for a pocket-sized frog.

In August 2014, the US Fish and Wildlife Service listed the Oregon spotted frog as threatened under the Endangered Species Act. Under the terms of the act, the frog's habitat warranted immediate protection. Environmental advocates and conservation groups in central Oregon, long concerned about the Deschutes River's degraded fish and wildlife habitat, erosion issues, and poor water quality, saw an opportunity to reverse the river's decline in overall health. But agriculturalists such as Fine, who depend on seasonal variations in streamflow for irrigation, worried that the frog's water needs might take precedence over their own. Some feared that the listing would trigger another crisis like the timber wars that waged in Oregon during the '80s and '90s, when efforts to protect the northern spotted owl from extinction led to an ideological clash between environmental and timber interests: logging restrictions in old-growth forests aimed at preserving the owl's habitat left timber and mill workers feeling as though their livelihoods had been sacrificed to the ESA, while northern spotted owl numbers nevertheless dwindled. Everyone I spoke to in central Oregon wants the story of the spotted frog to take a more positive turn.

"Listing has forced a number of competing interests to come to the table to seek common ground for conserving the species," explained Jay Bowerman, a local biologist who has studied the amphibian for nearly 20 years. With so much on the line for those who live and work in Deschutes River Basin communities like Bend, Madras, Prineville, and Warm Springs, myriad stakeholders have joined the spotted frog recovery effort. Together they seek to navigate the complexities of the Endangered Species Act and produce a plan to conserve the ecosystems upon which the frog depends—one that will pass muster with the federal government and address the nuanced economics of water, wildlife, and work in the region. But they will have to act quickly to outpace legal challenges from outside environmental groups dissatisfied with the speed and scale of local conservation.

US Fish and Wildlife Service

*An Oregon spotted frog (*Rana pretiosa*) peers out from its wetland habitat.*

Once common across Oregon and Washington, now the Oregon spotted frog, *Rana pretiosa*, occupies just 10 percent of its historic range. Small, isolated populations crop up throughout central Oregon in or near perennial water bodies—including the Deschutes River's riparian zones, ponds, and even roadside ditches. The frog's ecology is not well understood, but the amphibian, named for the inky blotches covering its head and back, is likely sensitive to changes in the river's hydrologic system. The species is subject to other pressures too, such as loss of wetland habitat in a rapidly developing region and predation from introduced species like brook trout and bullfrogs.

Formal collaboration efforts related to spotted frog recovery actually got underway in central Oregon a decade ago. In 2008, eight irrigation districts joined the city of Prineville to prepare a habitat conservation plan for the Upper Deschutes Basin. The process galvanized a coalition of 20 stakeholders ranging from Portland

The Deschutes River flows through central Oregon, providing water for both irrigation and wildlife.

General Electric to Trout Unlimited to steward several fish and wildlife species in the basin. At the time, the frog was still a candidate species. The resulting plan would map out a vision for protecting it and several other proposed, candidate, or listed species, including bull trout and steelhead. If approved by the USFWS, it would also act as a kind of insurance policy for irrigation districts, buffering them against costly civil and criminal penalties should they accidentally harm or kill a threatened or endangered species, or damage its habitat, all violations of the Endangered Species Act.

The irrigation district-led collaborative effort to safeguard species as well as irrigators' livelihoods appeared to be off to a good start. A wide swath of people with differing perspectives and values were coming together to devise solutions. But six years later, when the USFWS released its decision to list the frog as threatened, the group still did not have a plan in place. "We should have been working harder, stronger, faster," lamented Fine, who is also a member of the North Unit Irrigation District and Deschutes River Conservancy Boards. The latter is a Bend-based nonprofit working to improve leaky, aging irrigation canals and keep more Deschutes water instream.

Listing reignited grassroots engagement. One month after the spotted frog appeared in the Federal Register, a confederation of irrigation districts established the Basin Study Working Group with funding from the Bureau of Reclamation. The working group brought together constituents representing agriculture, conservation, local tribes, recreation, government, and industry to seek strategies for increasing flows in the Upper Deschutes while conserving water for cities and agriculture well into the future.

By initiating both the habitat conservation plan and the basin study as collaborative efforts, the irrigation districts hoped to get out in front of environmental concerns, and to better anticipate and mitigate water management issues that might imperil the frog or local farmers' livelihoods. "I want to fix the river," avowed Phil Fine. "I believe every species has a right to survive and potentially thrive, and I really mean that." Some environmental groups declined to participate in the basin study, fearing that irrigators with the force of western water law on their side would retain too much power in the facilitated process. Others saw a rare opportunity to make headway on an intractable resource management issue.

Gail Snyder, co-founder of the nonprofit Coalition for the Deschutes, which promotes restoration and protection of the Deschutes River and its watershed, was among those who joined the basin study's steering committee. For Snyder, these stakeholder-driven efforts ramped up during a critical time for the modern Deschutes, the lifeblood of the region. "Our entire economy in central Oregon really hinges on water," Snyder said, her vowels revealing her Western Australian origins. The river fuels agriculture as well as the massive outdoor recreation and tourism economies woven into the fabric of central Oregon life. Snyder imagines such interests can coexist in a basin that can also one day win a clean bill of ecological health. "We can have a healthy river, we can have agriculture," she averred.

As conservation planning advanced, new local alliances in central Oregon began to form. Fine described how Snyder introduced herself to him "at some water thing," saying that she would like to sit down

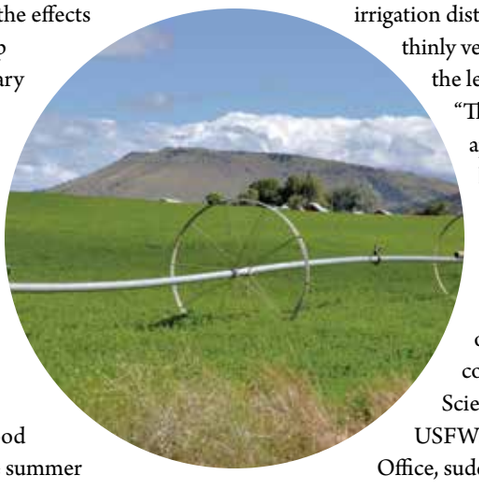
and talk. "So I ended up going to her house and sitting around her table for two hours, with her cat, drinking coffee and talking about water. She actually gets it. She understands all sides of it."

"In order to have a successful outcome for the river, agriculture, and our community, we must have a truly collaborative process. We must talk to each other, treat each other with respect, and cooperate and compromise," Snyder added. Still, by the close of 2015, after years of local conservation planning, stakeholders still had little to show in the way of tangible outcomes. Environmental advocacy organizations based outside of the region took note.

In January of 2016, the Center for Biological Diversity in Arizona and WaterWatch of Oregon, headquartered in Portland, filed twin lawsuits against three irrigation districts and the US Bureau of Reclamation (the agency that oversees western water storage, diversion, and delivery projects). The litigants asserted that the Crane Prairie, Wickiup, and Crescent Reservoirs and their dams damaged or destroyed frog habitat, and therefore violated the Endangered Species Act, and they called for a radical change to water management on the Deschutes and its tributaries. The Center for Biological Diversity and WaterWatch wanted minimum instream flows during the winter storage season to increase from 20 cubic feet per second to a minimum of 770 cfs to match historic flows in the Deschutes. In recent decades, flows in the Deschutes have ranged from 20 cfs during the winter, when irrigators divert water into upstream reservoirs for storage, to 2,000 cfs during summertime release. Increasing winter flows to 770 cfs would mean less stored water in the cold months, and leave many irrigators without sufficient water at their headgates during the growing season.

"We basically had to circle the wagons," said Fine. "We were scared. We went into protection and survival mode." Irrigators lined up to guard their livelihoods. For the next ten months, while the courts considered the lawsuit, agriculturalists felt as though they had been left in limbo. "I had 20 percent of my ground idle because of the frog," Fine said, describing that period of uncertainty. "There are a lot of guys who lost a whole year's production on quite a bit of ground because of the timing of the whole thing. It was a big deal in Jefferson County."

In late 2016, the irrigators agreed to a settlement that called for temporarily increasing wintertime flows to 100 cfs. Fine says North Unit first agreed to the higher wintertime flows, and other districts followed suit, some begrudgingly. "We did it voluntarily," said Fine, who predicts that the effects of the stopgap regime will vary from year to year. "In really good water years, it is not going to make much difference because we have really good inflows in the summer that will hopefully carry us through. But we're just coming out of a drought cycle. If we get several drought years in a row, you're going to see a lot of farm ground sitting idle because we don't have the water to irrigate it."



The settlement also compelled the Bureau of Reclamation to consult with the USFWS to determine how dam and reservoir operations might impact spotted frogs. In September 2017, biologists in the USFWS Bend Field Office submitted their 300-page "biological opinion," concluding that the temporary changes to water management are unlikely to further jeopardize the frog or destroy its critical habitat. But in the document the USFWS also recommends the Bureau of Reclamation ramp up winter flows over the next 20 years to eventually reach 600 cfs, a number much closer to the river's historic flows. And the opinion nudges along the collaborative work begun in 2008: the irrigation districts and other constituents will need to finalize a formal habitat conservation plan soon. The USFWS, which has already provided $3.6 million in grants to support planning, expects to publish the final plan by this summer.

The quick one-two of listing and lawsuit clearly shook up local stakeholders playing the long, slow game of species recovery. Irrigators regarded the suit as a setback to cooperation. On the heels of the settlement, Mike Britton, president of the Deschutes Basin Board of Control representing central Oregon's eight irrigation districts, released a thinly veiled critique of the legal challenge: "The collaborative approach has proven successful in our region, and results in better outcomes than confrontation." Scientists in the USFWS Bend Field Office, suddenly pressed to fast track their analysis of the impact of dams and reservoirs to the frog, felt the impact too. "Rather than spending time on important research and monitoring that allows us to develop effective conservation measures for the species, we must spend time addressing the legal aspects of the ESA," wrote Bend-based USFWS biologist Jennifer O'Reilly in an email.

Now seemingly everyone fears the chilling effect of more litigation. When the parties settled the 2016 suit, the Center for Biological Diversity and WaterWatch reserved the right to contest the biological opinion. Almost every stakeholder in the basin believes they will, and that will likely cast a pall over the community's ongoing collaborative efforts.

"If everything gets litigated, in the final analysis it just puts up bigger walls between the sides that need to be talking and working together," observed Simon Wray, a veteran conservation biologist with the Oregon Department of Fish and Wildlife. "It's a tool to get a process that is stalled moving, but it can have some pretty negative effects."

Almost everyone I spoke with in the basin allowed that the local collaborative processes have moved slowly, often too slowly. But most also view litigation, and in particular the lawsuit from the out-of-state Center for Biological Diversity, as corrosive to local problem solving.

For irrigators committed to modernization measures, for instance, another legal tangle will almost certainly sidetrack projects to pipe or line canals and to improve on-farm efficiencies, projects intended to keep more water in the frog's habitat. "We're spending millions of dollars a year on attorneys," Phil Fine told me. "That money could be going to water conservation projects."

It may be too soon to tease out precisely how the lawsuit will affect local collaboration, and ultimately, the recovery of the Oregon spotted frog. On one hand, litigation shook trust in the region and tied up resources that might have otherwise gone to protecting the frog from extinction. But on the other, the specter of litigation, especially from outside the region, motivates locals to turn to one another for creative solutions and expedites an otherwise slow-moving process. O'Reilly wrote, "Conservation is a long process, and we have yet to see how this will play out for the spotted frog. My hope is that we can move beyond a litigious environment and come together to work towards conservation."

Courtney Carlson *is assistant professor in the Haub School of Environment and Natural Resources at the University of Wyoming, where she teaches environmental literature and writing courses.*

MODERNIZING THE ACT

As calls for ESA reform have conservationists on high alert, western governors offer a way forward

By Emilene Ostlind

"Here's the problem. The Endangered Species Act isn't working today," said Senator John Barrasso (R-WY) at a hearing on Capitol Hill last February. As chairman of the Senate Environment and Public Works Committee, he hosted the hearing to discuss opportunities for modernizing the ESA, suggesting the act needs to be improved.

"The Endangered Species Act is not broken. It does not need to be fixed, or, in the vernacular of the hearing, 'modernized,'" said Jamie Rappaport Clark, president and CEO of Defenders of Wildlife, in her testimony at that same hearing. She went on to argue that "legislation proposed by Congress over the past decade has all sought to roll back and undermine ESA protections."

Barrasso's and Rappaport Clark's perspectives represent two sides of a long-standing debate. On one hand, those in extractive industries like grazing, mining, energy production, and timber harvest, many of whom face restrictions on their activities in the name of protecting listed species, argue the act is overly burdensome and ineffective. They point to the low proportion of listed species (about 2 percent) that have recovered enough to be delisted.

On the other hand, conservation organizations and those with an interest in protecting biodiversity and ecological function call the ESA one of our country's bedrock environmental laws. They point to the high proportion of listed species that have avoided extinction (more than 99 percent). The act helped species like the bald eagle and American alligator, once in rapid decline, rebound. Other species like the black-footed ferret, once considered extinct, now live in dozens of populations throughout several western states thanks to ESA-driven recovery efforts.

Still, even conservationists recognize the act could work better. While many are skeptical of any efforts from Congress to alter the law, they are interested in improving how the act is funded and implemented. Take, for example, the recovery plan, a key aspect of how the US Fish and Wildlife Service works to bring back threatened and endangered species.

"The median age is 19.1 years for a recovery plan," said Jake Li, VP of endangered species conservation for Defenders of Wildlife. "I mean, if this is a roadmap for how you recover a species, and people aren't using it because it's so outdated, that's a very low hanging fruit for improvements in day-to-day implementation."

As a response to such challenges, the Western Governors' Association launched a bipartisan initiative to bring interested parties together and look for ideas to make the ESA work better. Defenders of Wildlife came to the table.

"We're very open and enthusiastic to work with anyone, including the Western Governors' Association on regulatory improvements to the ESA, meaning changes to regulations, policies, day-to-day practices, things that really Congress has no role in," Li said.

The Western Governors' Association effort seems to be gaining traction on both sides of the aisle and may actually offer a path toward solutions that Republicans from the rural West, like Barrasso, as well as national conservation organizations, like Defenders of Wildlife, can agree to. In an atmosphere of increasing political division, the

"Having just gone through all the work that we'd done with sage grouse and then everything that we'd gone through with grey wolves and everything we'd been through with grizzly bears highlighted a need to start talking regionally and nationally about ESA issues and see if there is a way to make the act work better."

David Willms, Governor Mead's policy advisor

western governors are proving that transparent, inclusive collaboration may offer a viable opportunity to improve the function of the ESA.

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In 2015, the Western Governors' Association elected Wyoming Governor Matt Mead as its chair, and he made species conservation and the ESA the focus of his term. Mead had seen more than a decade of fighting over wolves in Wyoming, with federal courts addressing five different lawsuits and ultimately reinstating an earlier USFWS delisting. He saw a lawsuit rush the listing decision for the greater sage grouse and cut the states, which were leading conservation efforts on the ground, out of the decision about when the listing determination would happen. And he saw Yellowstone grizzly bears reach their recovery goal with help from Wyoming and be delisted, only to have lawsuits place them back under federal protection.

"Having just gone through all the work that we'd done with sage grouse and then everything that we'd gone through with grey wolves and everything we'd been through with grizzly bears highlighted a need to start talking regionally and nationally about ESA issues and see if there is a way to make the act work better," said Mead's policy advisor David Willms.

"What we'd most like to see is that landowners who step forward and do good things for wildlife and for habitat, that they are rewarded for those things," said Lesli Allison, executive director of the Western Landowners Alliance, whose members include ranchers across the West.

"You get better buy-in for the law if the act incentivizes good stewardship and conservation rather than is viewed as a punitive law," Willms added.

Conservation groups had their own desires for species protections as well. The Environmental Defense Fund issued a statement calling on Congress to redirect its attention away from legislative changes to the ESA and toward "supporting wildlife solutions that are flexible, efficient, and cooperative," pointing to state-led sage grouse conservation efforts in the West as a model.

Revising the act aside, "There is a lot of room for improvement. Everyone will say that," said Steve Smutko, Spicer Chair for Collaborative Practice at the Ruckelshaus Institute (where this magazine is published) who facilitated discussion groups at the Western Governors' Association ESA meetings. "It's just how it gets done is the critical component."

Governor Mead had a particular vision for how to get it done. He designed a process meant to break through the stalemate. The initiative asked ranchers and energy industry representatives to sit down with the very conservationists they'd been at war with for years. Any party with an interest in the future of endangered species management in the United States would have not just a seat at the table, but a real opportunity to insert their values and desires into the discussion. All the webinars, comment letters, and other meeting materials would be publicly available online. This would be a lengthy, deliberate, transparent process, a bipartisan dialog, and a genuine search for solutions.

The USFWS even sent its Assistant Director of Ecological Services, Gary Frazer, to attend. "My role is to inform the discussions, not to defend how we implement the act, not to advocate for any particular position, but just to inform," he said. This included sharing details about how the USFWS implements the ESA. Others began to call him "the endangered species guru." He and his superiors at the agency deemed his participation in this initiative, of all opportunities, a worthy investment of time and energy due to the bipartisan, state-led approach.

Over the next few years, the Western Governors' Association hosted meeting after meeting. The first round, in late 2015 and early 2016, attracted some 500 attendees and resulted in a lengthy report and a resolution from the western governors. In a following round, from late 2016 into early 2017, smaller groups developed specific recommendations. And a third round of meetings, currently underway, is digging deeper into challenges like funding species recovery on private lands and designing landscape-scale conservation plans.

"I thought they did really good at reaching out to all sides," said Bill Van Pelt, Grassland Coordinator for the Western Association of Fish and Wildlife Agencies, who attended most of the meetings and workshops. "They had livestock and they had conservationists and they had states and they had agencies."

The Western Governors' Association referenced ideas from the meetings to compose a set of recommendations, which they adopted by resolution in June 2017. Three statutory recommendations entail actual revisions to the Endangered Species Act, and would require Congress to take action. For example, WGA recommends altering the 12-month deadline for listing decisions and replacing it with a priority system where species in greater danger of extinction get action sooner than those with state-led conservation plans underway.

While several of the conservation organizations involved in the process

oppose legislative changes to the ESA under the current Congress, they are on board with some of the other recommendations. Eleven administrative recommendations outline revisions to the regulations and policies that the USFWS uses to implement the ESA. For example, one calls on the agency to take into account conservation efforts by states, federal agencies, and private landowners when making listing decisions, and another requests a "'playbook' to inform citizens on how to engage throughout various steps of the ESA process."

"I'm just going to look at number five," said Li with Defenders of Wildlife. "'Encourage the Service to develop Species Status Assessments that inform listing determinations. If listing is warranted, use that same assessment to develop a recovery plan.' Half of those words are actually mine. Absolutely, that's a great thing."

The four funding recommendations call for actions like increasing financial support from Congress for ESA implementation, and pairing economic incentives with critical habitat designations on private land to reward habitat stewardship.

The Center for Biological Diversity, a group others point to as the most left-leaning of those who participated, called the initiative a "sham process," but most participants, regardless of their perspectives on endangered species conservation, seemed to find something in the recommendations they could support.

Ethan Lane, executive director of the Public Lands Council and the National Cattlemen's Beef Association, puts it this way: "If we as an industry were going to sit down in a room and sketch out what we want to change with the ESA, it would probably look very different than what the governors recommended." But he appreciated the value of having all parties at the table, working together.

"What the governors put out is middle ground," he said. "It's a path forward that ostensibly everyone on the spectrum can find some value in. That's the point. This was not intended to be a one-sided deal or a lopsided exercise or a predetermined outcome.

> "What we'd most like to see is that landowners who step forward and do good things for wildlife and for habitat, that they are rewarded for those things."
>
> *Leslie Allison, Executive Director of the Western Landowners Alliance*

So, what happens next? The western governors took their resolution to the National Governors' Association, which incorporated its language into a policy position in 2017. Whether any Congressperson proposes a bill incorporating the initiative's statutory recommendations remains to be seen, and the Western Governors' Association does not lobby in DC. Still, the initiative is on the minds of leaders in Congress. At the US Senate Environment and Public Works Committee hearing last February, former Wyoming Governor and Democrat Dave Freudenthal advised Senator Barrasso and other members of the committee to take into consideration the work of the Western Governors' Association. "The recommendations reflect a growing consensus about areas to be addressed within ESA modernization," Freudenthal said. "I hope the Committee will take seriously the good work of Governor Mead and his colleagues."

As far as the regulatory and administrative recommendations, it's still unclear whether any will be adopted. "As part of the new [Trump] administration, the new policy team getting on board and setting a course will determine what are the next reg[ulatory] changes and policy revisions and the next steps we will take," said Gary Frazer, "and this is certainly going to inform that discussion."

And in November 2017, WGA started its third round of meetings. Work sessions continuing into January and March 2018 will focus on funding mechanisms, proactive and voluntary conservation, and landscape-level conservation as opposed to single-species approaches.

Despite the lack of real change so far, one after another, the participants described the initiative as worthwhile. "This dialog has been among the most well-structured, well-informed, and constructive conversations about how to improve species conservation and implementation of the ESA that I have ever been engaged in," Frazer said. "I think that their recommendations have a lot of weight on the basis of the quality of the process that was used to produce them."

"Conservation groups like ours are on high alert for political tampering with the ESA," said Li with Defenders of Wildlife. But, he added, "that should not get in the way of collaboration. Because it's only through collaboration that we are going to realize a lot of what everyone wants out of the ESA, which is successful conservation that works for species."

The example set by the initiative goes beyond species conservation issues, too. If the idea of building partnerships isn't radical enough in today's world, consider the Western Landowners Alliance plea for working together, "to renew a vision for what this country can be."

"Place-based collaboration really is the only viable solution to the complex challenges of any given landscape," Allison said. "People need to remember that collaboration is the basis of civil society. Collaboration is what we do as people in communities and families. It's what our entire political system arises out of. Collaboration is a foundation of the way that people live in the world together."

Emilene Ostlind *edits* Western Confluence *magazine at the University of Wyoming. Her colleagues in the Ruckelshaus Institute of Environment and Natural Resources facilitated the Species Conservation and the Endangered Species Act Initiative collaborative process for the Western Governors' Association.*

Laser Focus on Sage Grouse

Researchers deploy cutting-edge technology to understand sage grouse and their habitat

By Marissa Fessenden

Alarms wake the researchers, students, and technicians living in "Chicken Camp" at 3:45 a.m. this chilly April morning. Now, caffeinated and bristling with gear they head out into the rolling sage-tufted hills near Lander, Wyoming. They drive trucks down a rutted two-track and walk stealthily the last few hundred yards to a small clearing in the sage. The crew quietly sets up blinds, microphones, Go-Pro cameras, an amplifier, an mp3 player, and other gear. They settle in, switch off headlamps, and listen, prepared to wait more than an hour.

"It sounds like a bomber coming in—you'll hear whistling through the feathers," says Gail Patricelli, leader of the crew and a professor at the University of California, Davis. "Almost like a helicopter landing," says Ryane Logsdon, a PhD candidate in Patricelli's lab.

Soon, the listeners hear other sounds: Two swishes like rubbing corduroys precede an other-worldly "coo," followed quickly by a "pop" like a rubber ball bouncing, a whistle, and another "pop." The bizarre sequence echoes around the sage.

These are the sounds of a sage grouse lek, a place where males gather and display competitively for mates. And this is the most intensively monitored lek in the sagebrush sea. Patricelli and her colleagues have been studying the birds' behavior on this lek for more than a decade. Here, researchers record strutting males and lurking females through sound, video, and photographs; scan the lek with lasers; capture the olfactory fingerprints of crushed leaves; and fly small airplanes low over the sage, mapping the terrain. Researchers like Logsdon and Patricelli are deploying cutting-edge technology to examine the sage grouses' habitat from the landscape scale down to the individual bushes they prefer. The grouse face an uncertain future. Plummeting population numbers have spurred scientists to collect detailed data about the birds and their habitat needs. What they find could save the birds from extinction.

An estimated 16 million sage grouse once foraged and strutted across about a quarter of a million square miles of sagebrush steppe. During the past century, habitat loss sent sage grouse numbers tumbling to as few as 200,000 birds and contracted their range to about half its historic reach.

The decline put the grouse under consideration for listing with the Endangered Species Act. This in turn ignited concern among the people and industries that use the sagebrush landscape about the effects regulations would have on their livelihoods. During years of sometimes-heated negotiation, an unprecedented collection of conservation plans arose between state and federal agencies, private landowners, and nonprofit organizations across 11 Western states. In 2015, the US Fish and Wildlife Service declared a listing was not warranted, due to the strength of the collaborative plans for the bird's protection.

The threat of a listing brought the bird's fate to the nation's attention and triggered new research to inform the decision and monitor the success of the conservation plans. Rapid advances in remote sensing, robotics, and biochemical methods are flooding into conservation research. Sage grouse are seeing many of these advances. The sprawling, remote nature of their habitat demands a technological approach and scientists are deploying a variety of devices and approaches across the West.

Patricelli has spent years refining her two female sage grouse robots, nicknamed Salt and Pepa. Each is crafted from taxidermied sage grouse skin, fit over a body of model airplane parts, circuitry, and a remote-control vehicle base, complete with nubby tires that can motor over rocks and around plants on the lek. The "fembots" turn their heads and bend down to browse plants convincingly enough to deceive most real males.

Only one of the fembots is on duty at a time. Logsdon, in the main blind, radios Patricelli in a smaller blind on the lek itself with driving directions to help guide the bot through a preset route. "I have her stop at each of those spots for about a minute and look around as if she is scanning the lek," Logsdon says. "That gets the guys really amped up and trying to impress...sometimes the male will rush up and we have to take evasive maneuvers." When not backing the bot away from the enthusiastic advances, she takes notes about how the news that an interested female is present reaches other males around the lek.

This is her third season spent near Lander, trying to learn how sage grouse use their microhabitat —individual clusters of sagebrush. Where the males move and how they place themselves in the lek affects what they can see and whether females can see them. Some leks are open, grassy spaces while others are closed and filled with wild-looking sage clusters. Males may have different strategies for these different lek types. The robots are helping researchers understand the birds' preferences and the factors that allow them to survive. "Despite the presence of sagebrush all over, it is not necessarily good sage grouse habitat," Patricelli says.

A close look reveals details in the vast sagebrush landscape important to the grouse. Earlier last year, collaborators from Boise State University in Idaho scanned the three-dimensional structure of the lek, capturing every last sage leaf, using a technology called Terrestrial Laser Scanning. The system looks like a small Star Wars droid mounted on a tripod. It sends out laser pulses that bounce back when they hit a sage stem, leaf, or hillside.

The team, headed by Jennifer Forbey, an associate professor of biological sciences, will construct a digital version of the lek with the TLS data. They could, for example, note the location of a nest and explore its surroundings. "You get 360 degrees any distance away, any height, you can assess how vulnerable that nest would be from a predator like a raven perched on a nearby juniper tree," Forbey says.

The researchers also explore the habitat through the sage grouse's senses. Forbey is coordinating work to test the use of an electronic nose, a handheld sensor that "sniffs" the air to detect specific particles. The researchers wrap sagebrush in plastic bags to capture chemicals

As new technology allows scientists to ask and answer questions that were impossible to address a few years ago, future research will show whether sage grouse conservation is actually helping the birds over time.

it emits and examine the olfactory "fingerprint" of different sage species. They hope this information can help them learn what types of sage the grouse prefer to eat. Patricelli measures the soundscape of leks. Since the sage grouse strut involves unique vocalizations, she wondered if noise could drive males from the lek. Her team recorded sound from nearby towns, roads, and well pads and then played the recordings back to grouse on the lek through a hidden mp3 player. Stress hormones spiked in the fecal pellets of noise-disturbed males and lek attendance dropped.

"All this technology gives us a way to smell and see from the perspective of the actual animal," Forbey says. "You can detect things in ways that our own sensory systems cannot."

Focused surveillance on a single species may seem unusual, but the technology is offering a more nuanced understanding of sage grouse and their conservation needs. Some of the findings are already informing conservation efforts: The realization that human sounds can drive sage grouse from leks helped wildlife managers put a limit on noise near critical areas in Wyoming. However, exactly how the research and conservation efforts will translate to sage grouse recovery remains to be seen.

Tom Christensen is the Sage-Grouse Program Coordinator for the Wyoming Game and Fish Department. Most states base their management decisions on population monitoring, done through some combination of spring lek counts, summer brood surveys, and collecting wings from hunters during the fall. The state also flies airplane surveys using infrared cameras to offer clues on where the birds winter.

To extract trends from those counts, experts like Christensen look long-term, going back as far as 1965, when Wyoming monitored only 28 leks. (Today the state watches nearly 1,700.) Sage grouse populations explode and decline regularly, much like rabbit numbers do. In 1968 Wyoming's leks averaged 58.8 males. Three years later, that number dropped to 25.5, and by 1978 it climbed back up to 40.1 males per lek. Sage grouse reached their nadir of 13.1 males per lek in 1996. The trends in Wyoming have never been as grim as those range-wide because much of the sagebrush is relatively intact in the union's least-populous state. But the decline is there.

"Generally over the last century, the peaks of those population cycles have dropped lower and also the valleys," Christensen says. "The long-term trend is why you see the concern."

The males-per-lek measure climbed in 2014, 2015, and 2016, as compared to previous years, leading some reports to tout a "rebound" in sage grouse numbers. However, Christensen points out that the natural cycle should put the birds in an upswing right now. It would be far more concerning if the grouse weren't doing well these past few years.

The USFWS aims to review the state-led sage grouse conservation plans in 2020. But by that time the conservation efforts and regulations may have long been overturned: In fall 2017, the Department of the Interior announced an intent to replace the existing sage grouse plans with new ones.

Even if the current sage grouse conservation plans were to stay in place, Pat Deibert, a wildlife biologist and the USFWS Sagebrush Ecosystem Science Coordinator, doesn't expect the 2020 review, five years after the listing decision, to determine if sage grouse have recovered. (Instead of tracking numbers, the review will focus on whether commitments to conservation goals are being kept.)

"We are not entirely out of the woods yet, or out of the sage, but the conservation commitments and the recent trends in population numbers give us a lot of hope that we are turning a corner," Deibert says. It may take 20 or 30 years to know if sage grouse are recovering or going extinct.

The current conservation plans rely on the detailed view of sage grouse biology and landscape use offered by researchers like Logsdon, Patricelli, Forbey, and many others to inform better management decisions. As new technology allows scientists to ask and answer questions that were impossible to address a few years ago, future research will show whether sage grouse conservation is actually helping the birds over time.

"Quite honestly, I don't think we had the tools before to really focus on the larger perspective," Deibert says.

On the lek with Patricelli's team that chilly April morning, the faintest glow of red brushes the horizon and blushes against distant peaks of the Wind River Range and Owl Creek Mountains. The birds angle their bodies in a proud upright stance, puff up two air sacs on their chests, fan out their tail feathers spectacularly, and with coordinated wing and body movements, brush their white ruffled collars, flap their sacs, and try to attract mates. Recorded, videoed, surrounded by observers but unaware of the scrutiny, the sage grouse dance.

Marissa Fessenden *is a freelance science journalist based in Bozeman, Montana. Find more of her work at marissafessenden.com.*

TIME WARP

Wyoming peatlands harbor plants of bygone eras

By Bonnie Heidel

We have all seen movies where characters step back in time. I had that sensation the first time I set foot in Swamp Lake, one of the largest peatlands in Wyoming, and found a suite of beguiling plants from long-ago times when the climate was colder than today.

Peatlands are wetlands in which stable groundwater inflow maintains the water table at or near the surface. The peat that builds up in them is a saturated organic soil that accumulates under cold, oxygen-free conditions, as slowly as a centimeter or less per century. Peatlands are refugia for plants and animals of bygone eras—denizens of colder climates.

The present-day plants at Swamp Lake and other well-developed Wyoming peatlands include an endowment of species that today live mostly in Alaska and Canada. While these plants of the far north are not federally endangered, they are rare in Wyoming.

Swamp Lake is unique for its size and number of rare peatland plants. Though botanists have documented hundreds of additional peatlands across Yellowstone National Park and national forests in the state, only a fraction like Swamp Lake harbor rare plants. Look closely, and these soggy microcosms offer a window into a distant world, one that otherwise exists many hundreds of miles away or far back in time.

These plants are like the tantalizing film clip previews that lure us to see more, ultimately helping us understand Wyoming landscapes. Scientists are discovering the importance of peatlands to watersheds, and probing their clues to the past as windows into the future.

***Bonnie Heidel** leads the botany program at the Wyoming Natural Diversity Database. Read more about her work with rare plants in Wyoming peatlands at fs.usda.gov/treesearch/pubs/55247.*

Round-leaved orchid
Amerorchis rotundifolia

A boreal plant at its southern limit in Wyoming, distant from the nearest populations in northwest Montana. It grows in forested peatlands, the rarest peatland type in Wyoming.

Maria Mantas

English sundew
Drosera anglica

A floating mat carnivorous plant with sticky leaves that trap insects. There are more of these plants in Yellowstone National Park than the rest of the state combined, a dwarf carnivore alongside the big carnivores of the park. It grows in peatlands that can be more acidic than car battery acid.

Sabine Mellmann-Brown

Lesser bladderwort
Utricularia minor

An underwater carnivorous plant that is scattered across northern latitudes. Trap doors on its little balloon-like "bladders" capture zooplankton. It grows in pools ringed by peat.

Bonnie Heidel/USFS

Bog bearberry
(also called red bearberry)
Arctous rubra

A small white-flowered shrub typical of the arctic. Located at only one alkaline Wyoming peatland and nowhere else as far south.

Jennifer Whipple

Arctic cottongrass
Eriophorum callitrix

An arctic-alpine plant stretching from Greenland to Wyoming. Grows in alpine peat in Wyoming, at its southern limits in the Beartooth Mountains and Wind River Range.

Bonnie Heidel/USFS

BIGHORNS
Back from the Brink

Photo courtesy Tom Stephenson

Science and the recovery of an alpine specialist

By Tom Stephenson

It was shaping up to be a brutal winter. We already had quite a bit of snow in the alpine in late October of 2016. Then, in mid-December it really started dumping. As one atmospheric river after another arrived off the Pacific Ocean, the snow piled up—40 feet by early February. I hoped avalanches would not wipe out some of our smallest bighorn sheep populations.

The Sierra Nevada is a rugged mountain range that lies almost entirely within California. It contains the 14,505-foot Mount Whitney and some of the most extensive roadless wilderness in the lower 48 states. These mountains once supported a thriving population of bighorn sheep that are genetically unique from other members of the species. Like bighorn sheep throughout the West, the Sierra Nevada population declined following the arrival of European settlers who brought disease in domestic sheep and unregulated market hunting. The subspecies known as Sierra Nevada bighorn sheep was close to extinction in the 1990s when the entire population numbered just over 100 animals, and it was listed as federally endangered in 2000.

I joined the recovery effort for Sierra Nevada bighorn in 2001 and now run the program for which the California Department of Fish and Wildlife is the lead agency. Our job is to implement a recovery plan prepared by scientists, agency personnel, and members of the public. The plan serves as a road map, with the goal of recovering the species to 305 adult and yearling females distributed among 12 populations.

Compared to many endangered species, bighorn sheep have been well studied, and the plan was based on the best available science at the time it was written. But the more we learn through the science of the bighorn sheep recovery program, the more we're surprised by their ecology. Those surprises have prompted us to modify our recovery approach. The journey has shown us that recovering a species is not as straightforward as preparing a recovery plan and adhering to its initial recommendations. With each new ecological discovery, we adjust our recovery actions in accordance with the emerging science.

For instance, our understanding of the relationship between migration and survival has evolved over the past decade. Scientists had assumed that Sierra bighorn must migrate to lower elevations during the winter to avoid deep snow and meet their nutritional needs. But whether all sheep actually migrate and what habitats provide the best forage for rams and ewes was unknown until just recently. Answering these questions would be key to managing the species back from extinction. So we began monitoring bighorn sheep populations with GPS collars that show us where animals spend their time. What we found surprised us. Some animals weren't migrating at all—they were wintering high in the

Photo courtesy Tom Stephenson

Tom Stephenson ascends to bighorn sheep habitat in the Sierra Nevada.

alpine where huge amounts of snow and scarce forage make survival seem impossible.

To investigate how some bighorn sheep could remain at high elevations year-round, I began skiing into the mountains in 2002. During some trips, the wind was so strong it could knock you down. But the wind was the secret to sheep survival at high altitude. There could be 20 feet of snow at 10,000 feet but no snow on a wind-swept ridgeline at 12,000 feet, where bighorn sheep could stay through the winter. At that elevation, food is sparse and spring arrives late. In contrast, for sheep that winter at the base of the mountains, snow conditions are comparatively mild and more nutritious forage is available. But bighorn that winter down low are at much greater risk of predation by mountain lions. Sheep that winter in the alpine trade off forage quality for freedom from predation.

I wondered how sheep could survive harsh alpine winters with less forage, so I used ultrasound during our captures to measure body fat in animals across a range of habitats and seasons. I found that bighorn survive winter in the alpine by storing large amounts of fat during summer. They essentially hibernate standing up, living off fat during the winter and conserving energy. Now that we know bighorn can comfortably survive winters on mountaintops with limited forage, we have a new understanding of winter habitat.

The complexity of ecological relationships grows as we scale our perspective from individuals to populations. Although Sierra bighorn are adapted to a harsh winter environment, wintering in the alpine isn't always the best strategy. Whether to stay in the alpine or brave mountain lions lower down, for example, depends on winter severity and predation risk in any given year. In drier years, animals that winter high have greater survival, but in very heavy snow years those wintering high can starve. In those snowy years wintering low provides access to forage that may outweigh the risk of being eaten by mountain lions. Choosing the wrong strategy can mean death, but large, healthy populations have enough animals to support multiple strategies.

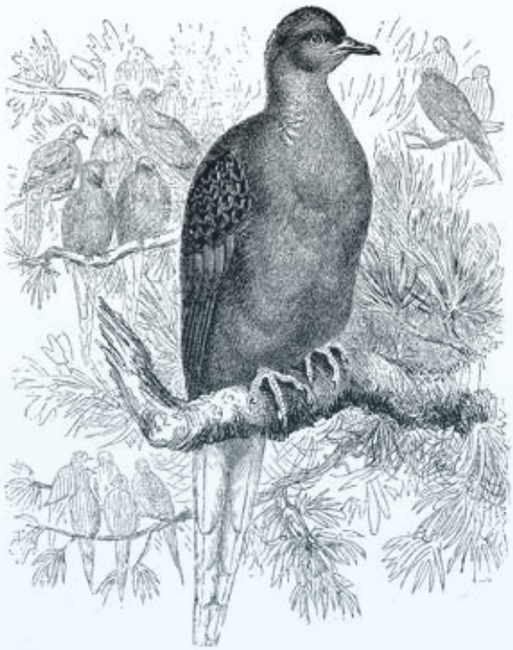
Population models are one of our most robust scientific tools in ecology; we use them to tell us how small is too small. We feed the data that we gather from collars and surveys into models that predict whether a population or the entire subspecies will persist. The models incorporate the variation we observe in survival and reproductive rates and assess the likelihood and consequences of catastrophes. We can model how mortality rates compare among populations with different migration strategies and how the species responds to variation in climate and habitat changes following wildfire. We can calculate how long it will take a small population to recover from a severe winter, or how many animals we can safely remove from a larger population to augment a small population that is struggling.

The models tell us that when populations are small, random events such as big snow years become catastrophic. Fortunately, our reintroduction efforts expanded Sierra bighorn distribution from three populations in the 1970s to 14 by 2015, though we still didn't have enough adult and yearling females in those populations to call the species recovered. The expanded distribution means catastrophic events are less likely to affect all populations of Sierra bighorn and the subspecies is more likely to persist.

If I were writing this article a year ago, I would have noted the speed at which we were approaching recovery. But by the end of last year's severe winter, we estimated the population of Sierra bighorn had declined by at least 20 percent. Still, I was relieved that at least some animals in all of our populations survived such an extreme winter, and I continue to be amazed at how tough bighorn sheep are. Depending on future weather patterns and other threats, the population may rebound quickly or recovery could be delayed for years.

Bighorn sheep recovery also tells us that science is a process and not an answer. Species evolve over millennia—it shouldn't be surprising that it takes time to fully understand their ecology. We must move forward with incomplete knowledge about the species we are managing and be ready to shift course as we learn more or conditions change. Endangered species need oversight and assistance until we are confident that they will persist on an ecological time scale—that requires sound science and patience. Like bighorn sheep themselves, the science is evolving.

Tom Stephenson, *PhD, is a senior environmental scientist with the California Department of Fish and Wildlife, and program leader for the Sierra Nevada Bighorn Sheep Recovery Program.*



ENDLINGS

By Alec Osthoff

When the last passenger pigeon dies in the Cincinnati Zoo,
it is autumn,
a hot September day,
and the flight paths of the birds have been mapped,
invisible sky corridors they fly and then they don't.
Her name is Martha, as in Washington.
Across the zoo, not four years later,
the last Carolina Parakeet will die
just a couple feet from where he is now still breathing.

The last kaua'i 'o'o has his mating song recorded
and that song could play on loop until
the needle scrapes through the record
and the tape tangles
without a female ever hearing.

Benjamin, the Tasmanian Tiger,
stalks in his pen,
turning at the bars, over and over
not realizing he's a tragedy.

That he's the last beating heart,
all he's thinking
is of getting out of this cage
to the no one waiting for him
somewhere out there.

Booming Ben, the last heath grouse,
goes missing from Martha's Vineyard,
wandered off or eaten by a neighborhood dog.
And Celia, the last Pyrenean Ibex, crushed
under a fallen tree in Spain.

And watch the people watching Turgi in London,
Polynesian tree snail, its siblings choked by fungus,
devoured by invaders.
And what, good people, are you expecting to see?
What is it you want Turgi to do?

HELP US EXPAND OUR REACH AND IMPACT

This is our eighth issue since the magazine launched in 2014. We send over 2,500 copies out to land managers, elected leaders, landowners, agency staff, educators, and other engaged citizens. Additional readers receive the magazine to their email inboxes. Our subscribers hail from all 50 states and Washington, DC, and our readership expands with each issue.

We are committed to high-caliber, unbiased, original reporting and storytelling. That kind of work does not come for free. An issue of *Western Confluence* costs about $25,000 for reporting and writing, graphic design, printing, mailing, and website design (not including the staff time of our editors).

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From the very beginning, the magazine has been free to our readers. All of the magazine expenses are covered by private gifts.

We especially thank the **Walton Family Foundation** as well as the **Ordway Family GO Forward Fund** for believing in this work and making the magazine possible with generous contributions.

Heartfelt thanks, also, to the many individual readers who have mailed in donations that supported this issue. Your dedication to the magazine is so important.

Photo by Kathryn Walpole / WYNDD

*Wyoming Natural Diversity Database Zoologist Ian Abernethy examines the wing of a western long-eared bat (*Myotis evotis*) for signs of potential white-nose syndrome infection.*

STAYING VIGILANT

Scientists are on the lookout for white-nose syndrome in Wyoming bats

By Kristen Pope

Just miles from Devil's Tower National Monument, the sun was dropping in the sky, and Ian Abernethy, lead vertebrate zoologist for the Wyoming Natural Diversity Database, was preparing for the night ahead, pulling out mist nets, tiny radio transmitters, and other tools. Abernethy wasn't sure what species he would encounter that night, but there was a good chance that some of the animals would be northern long-eared bats, *Myotis septentrionalis*.

He also knew that this species is in grave danger. A disease called white-nose syndrome is decimating the species, which was listed as threatened under the Endangered Species Act in 2015. White-nose syndrome, which is caused by the aptly named the fungus *Pseudogymnoascus destructans*, kills up to 99 percent of the northern long-eared bats that become infected. The disease affects many species of bats, with varying mortality rates. It's spreading rapidly and, while Wyoming bats are not yet infected, the disease lurks in eastern Nebraska, leading to concerns that it may spread to the Cowboy State.

The main purpose of Abernethy's study was to learn about bats' roost locations and habitat selection, but he also monitored them for evidence of white-nose syndrome.

He set up mist nets to capture bats near water sources soon after they awoke for the evening. When a bat would fly into the net, researchers would gently untangle the animal before measuring and examining it

Photo by Doug Keinath / WYNDD

*Researcher Ian Abernethy attaches a radio transmitter to a northern long-eared bat (*Myotis septentrionalis*). He will track the animal to its roost to better understand what types of roost structures the species requires.*

and recording the findings. Northern long-eared bats have small bodies, just 3–4 inches long and, predictably, long ears. The northeast corner of Wyoming, where Abernethy was conducting his research, is at the northwestern edge of the species' range.

Abernethy would use surgical cement to adhere tiny radio transmitters to larger individuals before releasing them. The next day, the team would track the animals to see where each one roosted during the day. In summer, many bats roost in trees or rock crevices. In winter, many roost in hibernacula, usually caves and mines that host large numbers of bats in close contact. That proximity is thought to be a major factor contributing to the spread of white-nose syndrome since the disease can easily spread between animals huddled together.

Abernethy and his team checked each bat for signs of white-nose syndrome, visually inspecting wings, tails, and noses for tissue eaten away by the fungus. Infected bats act strangely during the winter months, sometimes flying outside during the day or clustering near the entrance of the cave. The disease depletes the fat reserves bats need to make it through the winter. So far, scientists estimate white-nose syndrome has killed 5.7 to 6.7 million bats from many different species in North America.

Over the course of 21 mist net sessions in 2015 and 2016, Abernethy captured 166 bats, including 29 northern long-eared bats; none showed symptoms of the condition. While white-nose syndrome is not yet in Wyoming, scientists fear it could infect many bat species in the state at any time. Since it was first recorded in New York in 2006, it has spread rapidly to 31 of the 37 states where long-eared bats occur. Scientists believe it came from Europe.

"How it got to North America is unclear, but it is most likely that humans have spread the fungus," Abernethy says.

Last year scientists found white-nose syndrome in dead bats outside a cave in Cass County, Nebraska, just 450 miles from the Wyoming border. With the disease appearing to spread about 200 miles per year, this is troubling for Wyoming bats.

"It's probably only a matter of time before it affects bats in Wyoming, unfortunately," Abernethy says.

Laura Beard, non-game biologist for Wyoming Game and Fish, is also on the hunt for any sign of white-nose syndrome or the *Pseudogymnoascus destructans* fungus in Wyoming. While white-nose syndrome is transmitted bat-to-bat, it is also spread via contact with contaminated caves and mines. So Beard swabs the inside of caves and sometimes even gently swabs roosting bats themselves for samples, using a black light to detect fungal spores that fluoresce orange when exposed to UV radiation. Her team has surveyed around 30 hibernacula in recent years.

Humans visiting multiple caves may inadvertently transport fungus spores on their clothing, boots, or gear—which has led to strict guidelines for bringing equipment into caves. To protect bats, people should also avoid disturbing them, especially when they are hibernating, and report bats that are acting strangely to wildlife management authorities. Hopefully, these steps will slow the spread of white-nose syndrome and decrease mortality.

"We haven't had any positives yet," Beard says. But the fungus is "capable of jumping much greater distances than from eastern Nebraska to eastern Wyoming."

However, Abernethy notes that even if the disease comes to Wyoming, it may not affect local bats as severely as eastern populations. One reason is that Wyoming bats don't typically have massive hibernacula like bats back east, which might help limit the spread of the disease. While New York has hibernacula with tens of thousands of bats, Wyoming's largest hibernaculum has fewer than 1,000 animals. Environmental conditions such as temperature and humidity might also affect the spread of the disease.

Also, not every bat species is affected the same way by white-nose syndrome. Hibernating bats are most at risk, but not every species hibernates. Some bats, such as eastern red bats, test positive for the infection but typically stay active and survive. Big-eared bats also seem to have less mortality, and Abernethy notes they like to hibernate in cold areas. While the fungus is found throughout Europe, bats in Europe rarely die from it, which may indicate they have developed some level of immunity, though researchers are still seeking answers.

While scientists are spending time in labs, caves, and out in the field trying to stop the spread of white-nose syndrome, they are also spending their time in offices, meeting rooms, and conferences, talking to each other and sharing their knowledge.

Beard notes the unity the scientific community is showing while fighting the threat, including sharing data and working together to coordinate a unified response.

"There's been this amazing national response," Beard says. "It's one of the best examples of cooperation in science I've ever seen."

***Kristen Pope** is a freelance writer and editor in Jackson, Wyoming. Learn more about threats to bats at whitenosesyndrome.org.*

GONE

A meditation on extinction

Text by Charlotte Austin
Illustration by Noah Smith

No more northern white rhinos live in the wild, and the three in captivity are too old to reproduce. Singapore's Ridley's stick insect went extinct. The Guam reed warbler, the Santa Lucia skink, the Costa Rican golden toad. Scientists have named this period the Anthropocene, the geologic era in which human beings are causing the sixth mass global extinction. Today, species vanish 1,000 to 10,000 times faster than natural extinction rates. Of the 2 to 100 million species on the planet, we lose thousands, maybe tens of thousands, each year. Lives are blinking out around us at an unprecedented rate.

> ***"Lives are blinking out around us at an unprecedented rate."***

These extinctions happen so fast and so quietly, that we fail to notice. There is no collective narrative about the Anthropocene; the loss is so overwhelming that we seem incapable of addressing it. Extinction transforms the biosphere more than any other phenomenon in this era, and yet due to its invisibility, we don't know how to think about it. The scale of each loss is so blinding that many of us simply look away.

Perhaps we can better grasp extinction of species by thinking about extinctions in our own experiences. Things that aren't plants or animals, but constructs and concepts and softly held ways of life slip away as well. Consider: Anonymity. Silence. Awareness. Our sense of connection to the natural world. Without checking your iPhone, do you know what phase the moon will be in tonight? When is the last time you moved anonymously through a landscape? As you read this, do you hear ambient noise? Does it matter?

Studies suggest that the extinction of silence, at least, matters very much. In wild areas where noise persists, animal numbers consistently drop. The endangered northern spotted owl in the Hoh Rainforest of Washington state neglects its young and even ejects eggs and juveniles from the nest when it hears unnatural noises like passing trucks or electric tools. Noise reduces the density and slows reproductive activity of animals including reptiles, marine mammals, and birds by a third or more. Humans perceive jarring noises as danger warnings, triggering physiological stress responses—elevated blood pressure, higher heart rates, high stress hormones—even in deep sleep. Long-term exposure leads to lasting cardiovascular problems. The

extinction of silence is literally hurting our hearts.

Darkness is disappearing, too. At the start of the nineteenth century, the Milky Way was clearly visible above the streets of New York City; today an estimated 80 percent of the world's population lives under what the International Dark Sky Association has named "skyglow." In its 2016 study, the association estimated that exposure to artificial light has already altered the melatonin, serotonin, and dopamine levels in our bodies. Our light pollution affects animals just as badly. For billions of years, organisms adapted to respond to the rhythms of the sun. Today scientists agree that the extinguishing of darkness alters their migration patterns, hunting habits, and even reproduction.

It is hard to hold space in our minds for these losses—how many there are, how much they matter, how we are just plankton in the tide. We'll likely never fully understand extinction, given the limitations in our understanding of living species. An example: as recently as 1980, scientists surveyed just 19 trees in a tropical forest in Panama and found 1,200 beetle species, of which 80 percent were previously unknown to science. "Surprisingly, scientists have a better understanding of how many stars there are in the galaxy than how many species there are on Earth," the World Resources Institute wrote of the discovery.

As we struggle to understand the Anthropocene, we might look to the physicist's definition of extinction: the reduction in the intensity of light as it passes through an object, due to absorption, reflection, and scattering. Every atom that made each Ridley's stick insect and each golden toad is still present on this earth, but rearranged into new forms. Silence is slipping away. Darkness is dwindling. What will fill the space each loss leaves behind?

> ***"The extinction of silence is literally hurting our hearts."***

The sixth extinction is upon us as surely as a slowly spilling sunset. We do not have the power to reverse the sun's trajectory toward the horizon. So we simply watch, and we try to learn, to understand, to tell the stories of the vanishing creatures. Some we fight to save. A few we do save. Paul Hawking wrote: "Extinction is silent, and it has no voice other than our own."

Charlotte Austin *is a Seattle-based adventure writer.* ***Artist Noah Smith*** *designs multidisciplinary graphics.*

Photo by Bonnie Heidel

Botanist Emma Freeland pauses to sniff a half buried blowout penstemon in Wyoming.

Wyoming's Only Endangered Plant

A tale of re-discovery

By Bonnie Heidel

In the 1850s, the geologist Ferdinand Hayden crossed the Nebraska Sandhills on an expedition to map uncharted territory and chronicle its natural resources. He discovered a species new to science, a pale lavender flower on a thick stalk that would become known as blowout penstemon. An 1877 Hayden Expedition collected the same species of plant, and for the longest time, scientists assumed this later collection also came from Nebraska.

One hundred and ten years later, in 1987, the US Fish and Wildlife Service listed the blowout penstemon as endangered under the Endangered Species Act. Then botanists knew the plant to live only in Nebraska, where its blowout habitat was scarce and declining. Blowouts are bowl-shaped depressions scoured out of sand dunes by wind, and many had vanished in Nebraska.

In 1996, Bureau of Land Management biologist Frank Blomquist stood on top of a towering sand slope among blowouts, northeast of Rawlins, Wyoming, and photographed a penstemon that he had never seen before. A few years later, a team returned to obtain specimens and send them off to experts, who confirmed that it was blowout penstemon. Meanwhile, Robert Dorn, author of *Vascular Plants of Wyoming* among other texts and expert on early explorers, examined the 1877 Hayden Expedition journals' description of the blowout penstemon collection location. The journals described towering sand slopes and referred to vague place names, which Dorn deciphered as a route between modern-day Casper and Rawlins. Thanks to Dorn's detective work, Blomquist's discovery of blowout penstemon in Wyoming is widely accepted as a re-discovery, 119 years later.

Under the ESA, plants are always designated as endangered or threatened throughout their range, so blowout penstemon became Wyoming's first—and remains its only—endangered plant species. Since 2000, Wyoming Natural Diversity Database botanists have surveyed blowout penstemon to map its distribution and monitor its population trends, while others studied its pollination and seed biology. We now know it occupies multiple blowouts in three areas of the Ferris Dunes. Studies have revealed its elegant pollination system and other adaptations to survive and thrive in the punishing environment of blowing sands.

The BLM has funded studies of the plant and designated the penstemon's habitat on BLM lands in Wyoming as an Area of Critical Environmental Concern. The USFWS is currently assessing blowout penstemon data from the two states to determine its conservation status. While we await the conclusions of the assessment, we have a new chapter in the blowout penstemon discoveries as written by Blomquist and collaborating botanists. New data on Wyoming populations of blowout penstemon will contribute to the species' conservation.

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Photo by Bonnie Heidel

*The blowout penstemon (*Penstemon haydenii*) is one of the few penstemon species that has fragrance.*

A Win-Win Situation

What's good for sage grouse is good for landowners

By Maria Anderson

I met Peter John Camino in the lobby of the Johnson County Public Library in Buffalo, Wyoming. A past president of the Wyoming Wool Growers Association, member of the Wyoming Agriculture Hall of Fame, and third-generation sheep rancher with Basque roots—his grandfather left Spain in the early 1900s to herd sheep in Wyoming—he and his family have been in the sheep business for over a century. He carried a rolled-up map of his property, which he spread out across the table. "We had just one spot for water in this main pasture," he says, pointing to a creek bottom on the map. "The sheep were just hammering the grass in that one area."

At the time his ranch outside Buffalo was divided into just three pastures, only two of which had any water. Overgrazing was a huge problem. Still, Camino told me, he thought things were working fine, and even if he'd realized he needed help to improve his pastures, he would have been reluctant to accept it. So when a government employee showed up asking him to join a federally funded conservation program meant to improve range conditions for livestock in the name of saving a treasured wild grouse, Camino did not immediately take to the idea.

"The North American [greater sage grouse] population was cratering. And it was a big cratering," says Bert Jellison, a Wyoming Game and Fish Department Habitat Biologist in the Sheridan region at the time. Greater sage grouse (*Centrocercus urophasianus*) populations in the West used to be in the millions, but development in the form of growing cities, natural resource extraction, and, to a lesser extent, farms and ranches, wreaked havoc on sage grouse. By 2013, sage grouse numbers had sunk to fewer than 500,000. In 2010, the US Fish and Wildlife Service decided that the bird was in sufficient trouble to merit consideration for an endangered species listing, which would mean more government intrusion and regulations throughout the bird's sagebrush steppe habitat. The threat of a listing kicked off a race to protect the greater sage grouse and to prove the species didn't need federal protection. Over the next few years, the US Department of Agriculture invested more than $400 million in conservation efforts across the West.

Jellison was charged with protecting sage grouse habitats in Johnson County, and, since the county was mostly private land, he needed to get ranchers like Camino on board. He aimed to do that in part by directing federal sage grouse money toward habitat restoration on private ranches in the county. The sage grouse requires specific areas, called leks, to perform mating rituals. It was these leks that Jellison sought to protect, which made Camino a perfect candidate for this project; his property was located right in a core lekking area.

Jellison had read about a successful grouse project at the Deseret Ranch, in Utah—the first of its kind, as far as he could tell. The ranch used mechanical treatments and livestock rotation systems to enhance sage grouse habitat. The Deseret grouse population exploded even as the ranch doubled its livestock numbers. "That told me that you can manage livestock and improve the range to benefit both livestock and sage grouse," says Jellison. "I wanted to show how a group of ranchers can choose to dictate their own destiny when it comes to conserving a species." But could he replicate such success in Johnson County?

Jellison approached the local conservation district twice about funding such a project, and eventually, with the board's approval, Nikki Lohse, Lake DeSmet Conservation District Manager, and Phil Gonzales, Natural Resources Conservation Service District Conservationist, took his idea and ran with it. The Lake DeSmet

Conservation District's Sage Grouse Program was one of many efforts across the United States under the umbrella of the broader Sage Grouse Initiative, a partnership of ranchers, agencies, universities, non-profit groups, and businesses working toward wildlife conservation through sustainable ranching. In the Lake DeSmet Conservation District, this entailed crafting "best management practices" tailored to each ranch, which provided recommendations for projects involving grazing rotations, mechanically enhancing rangeland health, water distribution, and fencing.

When Gonzales first approached Camino about joining the project, Camino had some reservations. A lot of government programs he'd seen in the past came with too many stipulations or asked for too big of a cost-share. The Lake DeSmet Conservation District's Sage Grouse Program, however, paid 100 percent of costs for the improvements the best management practices would suggest. There was no cost share. Gonzales explained the kinds of projects the program would cover, such as new fences and water lines. Such projects would improve the rangeland for both sage grouse and livestock, and enhance the value of Camino's land as well, Gonzales said. Eventually Gonzales warmed Camino up to the idea, and two years after their first discussion, the seasoned sheep rancher agreed to give the program a try.

"We found out we weren't as efficient as we thought we were," he says. "You fall into a groove and you don't like change. You think it's working, and sometimes it's not."

With the Sage Grouse Program support, Camino divided his three pastures into nine. He also added new water lines to better disperse the sheep over the pastures. "We reduced the pastures acre-wise to where we could rotate from pasture to pasture instead of hammering that main one," he says. With the new fences and the waterlines, Camino could better utilize the entire property, and native grasses started to come back.

"It was a good situation for us all the way around," says Camino. Since joining the Sage Grouse Program, Camino says with nine pastures instead of three, his sheep are healthier than ever and his ewes produce more lambs.

"Since we've joined the project, you can see the difference in the range. You can see the difference in the grasses. The stress on the sheep is way less," says Camino. "Without this project, we couldn't have done any of this work. It was cost prohibitive."

In the end, the Johnson County Sage Grouse Program ran from 2004 to 2011 and included 24 landowners, 340,000 acres, and a budget of over $3 million. Each participant got a customized grazing plan. The program covered the costs of adjusting pasture layouts, building new fence, repositioning waterlines, and aerating pastures. The Lake DeSmet Conservation District planted over 17,000 pounds of shrub and forb seed, and installed six solar-powered water systems.

In 2008, the US Forest Service and the Natural Resources Conservation Service presented Nikki Lohse with the prestigious Two Chiefs Partnership Award for her leadership and hard work. Lohse was one of only four recipients that year.

Roy Roath, one of the project's consultants and a Colorado State University range extension specialist who played a critical role in communicating the financial benefits of switching to best management practices, grew up in the ranching business. "As far as stretching a dollar in the district," he says, "Lake DeSmet stretched it like a rubber band and shot it out of the park."

How did this all work out for the grouse? In 2015, in part due to this and hundreds of similar collaborative efforts throughout the West, the US Fish and Wildlife Service decided not to list the sage grouse as an endangered species. Landowners breathed a sigh of relief. In Johnson County, booming natural gas development confounded population monitoring, but Camino has noticed sage grouse coming back. The other day he saw a hen and eight or nine chicks walking out in the road. "We see more birds, more little ones, and birds through the summer," he says. "This past year there were a lot more grouse. We've had one hell of a spring, and the grass is clear to your belly."

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TO THE BAT CAVE!

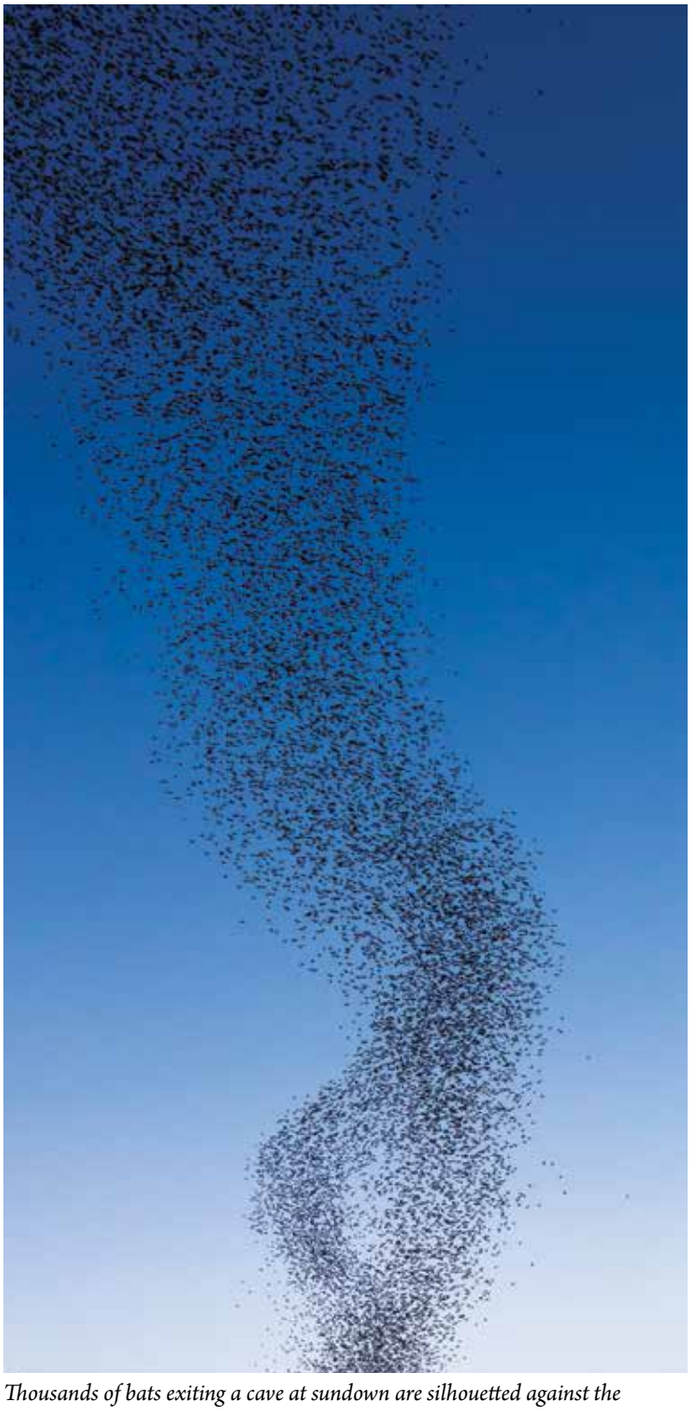
Conservationists turn to tourism to protect endangered bats

By Emily Powers

In the 1980s, more than 50,000 visitors toured Colossal Cave annually. A naturally formed limestone cave in Vail, Arizona, Colossal Cave brought in a small fortune, drawing adventure seekers and curious road-trippers alike. At the time, these tourists largely ignored the many species of bats that inhabited the cave system by the tens of thousands, other than to wrinkle their noses at the overwhelming smell of guano. To freshen the cave for visitors, the owners installed a large fan, blocking the entrance to the roost site. The blockage, air flow, foot traffic, and noise of so many tourists disturbed the bats, and their population declined rapidly. In 1988, only a few bats roosted in the cave, and one of the species, the lesser long-nosed bat, was added to the federal endangered species list.

More often than not, tourism—which can draw massive crowds to fragile habitats like the roosts of Colossal Cave—clashes with species conservation. Because they provoke fear and disgust in many people, bats in particular have fared poorly when they cross paths with the tourism industry. But in what might be an unexpected twist, people interested in bat conservation are now turning to ecotourism to help protect what many consider some of our least charismatic endangered species. Can tourism actually help conserve bats rather than harm them?

The lesser long-nosed bat (*Leptonycteris yerbabuenae*), often confused with the vampire bat and once eradicated for fear of rabies, varies from reddish brown to gray, with a patch of brown fur across its underside. It is about three inches long with a 10-inch wingspan and weighs less than an ounce. A small triangular nose-leaf sticks up from the tip of its long snout, resembling a spade. With help from this characteristic nose, along with a tongue as long as its body, the bat laps nectar from agave, other desert plants, and the occasional hummingbird feeder. In late spring, the bat follows an agave corridor north from Honduras and El Salvador to southern Arizona and New Mexico. It feeds and travels at night, roosting in large colonies during the daytime. In summer, the female lesser long-nosed bat gives birth to just one pup. In the early fall, the bats return south. Threats to roosting sites and food sources from development along their long migration drove the bats to near extinction.



Thousands of bats exiting a cave at sundown are silhouetted against the evening sky.

With very few bats left and an endangered species designation to contend with, the then-manager of Colossal Cave, Joe Maierhauser, implemented a tourism-friendly bat conservation plan in 1988. Maierhauser removed the fan, which reopened the original roost area and decreased the air movement through the cave. He also formed a committee of biologists, bat experts, structural geologists, and representatives from various legal, environmental, and health groups. Based on the recommendations of this committee, Maierhauser installed a system to monitor the temperature and humidity of the cave and built a new bat house near the entrance to lure the bats back. Multiple species, including

the lesser long-nosed bat, slowly returned to the cave, and as of 2017, roughly 5,000 bats reside in the cave during the winter and nearly 20,000 in summer.

Drawn by the promise of bats in their natural habitat, tourists visit the cave from all over the world. They pay $16 for a 40-minute cave tour and $85 for the three-and-a-half-hour "wild cave tour," which takes them a quarter of a mile down into the cave and past the bat colonies via cramped tunnels. These visitors also spend money at local businesses, such as hotels, campsites, and restaurants. By protecting the bat colonies in Colossal Cave, Maierhauser converted bats from a nuisance into an attraction. Now, the monetary success of Colossal Cave depends on a healthy bat population, which has only grown over the past two and a half decades.

Other places, such as state parks throughout the southwest, have also turned bat conservation into a tourist attraction that benefits both visitors and bats. For over 20 years, Friends of the Rio Grande Nature Center has sponsored a Winter Bird and Bat Festival in its namesake state park. Beth Dillingham, Rio Grande Nature Center State Park Superintendent, says the January festival "fosters an appreciation of the role bats play in the ecosystem." Between 400 and 600 visitors attend the indoor festivities, which include presentations, arts and crafts, games, and a live bat predator demonstration. The festival boosts annual attendance to the nature center and generates a more widespread appreciation for an important species, one that visitors may otherwise be predisposed to fear. State parks all across New Mexico and Arizona also host bat festivals to make money for and educate the public about bat conservation. These events have been especially popular with children. "Kids are fascinated by bats," says Dillingham. "Everyone is, I think, but kids aren't afraid to show it." And parents, who flock to festivals alongside their eager children, are learning to be fascinated by bats as well.

A lesser long-nosed bat (Leptonycteris curasoae yerbabuenae) *sips nectar from an agave blossom.*

A less obvious form of bat ecotourism comes via the tequila industry, which has done its part to raise awareness and help the lesser long-nosed bat avoid extinction. As pollinators, lesser long-nosed bats feed on the nectar of night-blooming blue agave and dust themselves in the pollen. They dart from flower to flower, mixing and dispersing plant genetic material across the northern part of Mexico. But for years, tequila producers in Mexico harvested agave before it bloomed, when its sugar content was highest. That deprived bats of a consistent food source on their migration from Mexico to the southwestern United States and contributed to their decline. When a blight destroyed much of the agave in the 1990s, tequila producers recognized how the bats could cross-pollinate and thereby diversify their crops, protecting them from future diseases. To help the bats pollinate, producers started letting the agave flower bloom naturally. The bat population rebounded and the industry has not seen a blight since. The Tequila Interchange Project, a non-profit advocacy coalition focused on the sustainability of agave-derived alcohol, has begun to dole out "bat friendly" labels for conservation-centric products to encourage conscientious buying. This "bat friendly" tequila is popular not only with locals and tourists, but with international buyers as well. Like Colossal Cave, Mexico's tequila industry has discovered just how economically valuable it can be to protect the lesser long-nosed bat.

The National Park Service may be able to learn something from the tequila example. In a time when budget cuts are a real concern for many national parks, ecotourism may be a smart way to raise the necessary funds for bat conservation. Carlsbad Caverns National Park in New Mexico provides a major roosting site for seventeen species of migratory and non-migratory bats, including the endangered lesser long-nosed bat. CNN calls Carlsbad Caverns one of the best caves in America, and the Smithsonian listed it among the world's best places for bat sightings. In 2016, almost half a million people visited Carlsbad Caverns to see the cave's bats. Sunset bat flights occur daily May to October, and visitors pay a $10 entrance fee, plus more for ranger-led tours. Each year, Carlsbad funnels over a million dollars of revenue into habitat conservation and public education.

Not all caves can generate as much money for bat conservation as Carlsbad Caverns and, for certain caves, the costs of ecotourism outweigh the benefits. Visitors can easily spook lesser long-nosed bats and drive them from the roost, or worse, wake them from hibernation. To best protect bats, some cave sites have opted out of tourism altogether. For example, Jornada Caves are critical to lesser long-nosed bat migration. The New Mexico Nature Conservancy, which owns the caves, closed them to the public after deciding disturbances to the bats were not worth the benefits of raising public awareness. Ecotourism cannot be a blanket solution for every cave but, in the right situation, it has the potential to generate both money and deep appreciation for even our smallest or creepiest endangered species.

On the outskirts of Albuquerque, tourists crowd Carlsbad Caverns' rock amphitheater nestled beside the mouth of the low, gaping cave as the sun begins to set. A ranger instructs the visitors to turn off their cell phones and cameras—anything with a light or electrical signals—and look toward the sky. "The bats exit in a thick black cloud," Ranger Valerie Gohlke describes, "If you stand near the entrance you can hear the *whoosh, whoosh* sound of their flight and oftentimes smell them." She compares the swarm of hungry bats to a tornado against the evening sky.

For lesser long-nosed bats, ecotourism conservation efforts such as festivals, bat viewing programs, and tequila consumption, seem to be working. The US Fish and Wildlife Service considers the species recovered from its brush with extinction, and recently proposed removing it from the endangered species list. As evidence of the conservation success, hundreds of thousands of bats exit Carlsbad Caverns for an hour every night, cheered on by a crowd of awed onlookers. And if you time it just right, visiting the cavern at summer's end, you can watch newborn bats swarm the night sky on their very first flight.

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Lesson from a Tortoise

The Endangered Species Act works best when it's never invoked

By Mike Brennan

A first encounter with a gopher tortoise (*Gopherus polyphemus*) may not leave a lasting impression in one's mind; indeed, you might think this brown tortoise could just as easily be at home in any neighborhood park or pet store. Its modest appearance, however, greatly understates its immense contributions to both conservation and endangered species policy. This drab-colored tortoise has inspired an unprecedented collaboration of conservation efforts among federal and state wildlife agencies, and for that, it at least deserves a second, more admiring glance.

The gopher tortoise, a keystone species in the open, fire-maintained longleaf pine ecosystems of the southeastern United States, was listed under the Endangered Species Act as a threatened species in the western part of its range. When the US Fish and Wildlife Service was petitioned in 2006 to list the eastern population, a decade-long cooperative range-wide conservation program was born, championed by the Southeast Regional Partnership for Planning and Sustainability. Federal, state, and private sector conservationists devoted years to learning the conservation needs of the tortoise and the measures necessary for its protection, leading to the adoption of a multi-state gopher tortoise Candidate Conservation Agreement. Along the way, gopher tortoise conservation research fueled and invigorated region-wide efforts to restore longleaf pine, which, in addition to the tortoise, is home to

other ESA-listed species such as the red-cockaded woodpecker, the indigo snake, and more than 200 other commensal species. These efforts, independent of regulations that would come into play as a result of an ESA listing, promise to conserve the tortoise and its habitat to the point where the direct application of the ESA is unnecessary.

Too often we read about species-related crises and conflict, while success stories go relatively unpublicized and uncelebrated. While the ESA is frequently portrayed as a draconian, command-control approach to wildlife conservation, that portrayal isn't always true, and it certainly does not need to be. Indeed, the ESA works most effectively when its requirements never come into play because it spurs proactive conservation actions among federal, state, and private sector stakeholders. The successes of the gopher tortoise, the greater sage grouse, and others are examples of the flexibility and creativity that can be employed under the ESA. At a time when "ESA reform" makes the headlines, it's critical to look deeply into the innovation and efforts that are actually working to accomplish species conservation, rather than praising or condemning the act based on anecdotes that may be wholly uninformed by direct experience or engagement in ESA work.

The conflicting interests that surround endangered species policy are what necessitate the development of new tools and strategies that promote species conservation while supporting other land use requirements. The gopher tortoise is found on some 19 military installations in its eastern range, all of which must manage their training and firing range activities pursuant to Integrated Natural Resource Management Plans. Ironically, this has resulted in more robust populations of gopher tortoise on training ranges, firing ranges, and other military lands than are generally found on other landscapes. Like the red-cockaded woodpecker, gopher tortoises do better on installation lands than they do on lands converted to crops and subdivisions. This is both a benefit to the species and potentially problematic to the military; the presence of listed species on the installations constrains the use of those lands for the military training and readiness activities the lands are intended for. These juxtapositions in interests necessitate innovative solutions, such as the recently developed Gopher Tortoise Conservation and Crediting Strategy.

The strategy—developed by the Department of Defense, USFWS, and state governments within the range of the eastern population of gopher tortoise over the last three years—intends to provide a net conservation benefit to the species. The strategy focuses on high-priority conservation lands that host important gopher tortoise populations but are not under permanent conservation management. It encourages interested military installations to purchase these lands and dedicate them to conservation management, which will protect viable tortoise populations, increase the size or carrying capacity of viable population areas, and promote the establishment of new viable populations, which will help make an ESA listing unnecessary. And in addition to promoting the conservation of gopher tortoise, management of these lands will benefit the other species, thriving or not, and longleaf pine habitats as a whole. The strategy will also provide participating Department of Defense installations a substantial amount of regulatory predictability should the eastern population of gopher tortoise be listed, by providing ESA mitigation credit that could help offset the impacts of future military actions that may adversely affect the species or its habitat, in concert with other conservation activities performed pursuant to installation Integrated Natural Resource Management Plans. The objective here is to ensure that current and reasonably foreseeable mission activities can continue without the need for additional species-specific restrictions.

Indeed, the ESA works most effectively when its requirements never come into play because it spurs proactive conservation actions among federal, state, and private sector stakeholders.

In many regards, implementation of the ESA has gone largely unchanged over the last 30 years, despite the many real opportunities to improve its efficacy and efficiency. Actual on-the-ground experiences or attempts at making the ESA work should guide much-needed future efforts to improve its functionality. And the Gopher Tortoise Strategy is one good example of what works. Its development was motivated by a common desire to head off the need to list the species, based on the reality that negotiated, voluntary conservation regimes are more comfortable than imposed regulatory obligations and processes. It afforded an opportunity for the involved states to preserve their primacy over the management of their wildlife species and find a common interest between ensuring the conservation of the species and providing mission flexibility on the military installations. And it was done quietly, something made possible by the close working relationships and willingness to collaborate among wildlife professionals at the installations, the state wildlife agencies, and the USFWS.

Sometimes the ESA and its elaborate processes and mandates are absolutely essential to conserve threatened and endangered species. As Chief Justice Warren Burger reminded us almost 40 years ago in Tennessee Valley Authority v. Hill (also known as "the snail darter case"), in enacting the ESA, "Congress intended endangered species to be afforded the highest of priorities," and viewed the value of such species as "incalculable." That notwithstanding, the ESA functions best when it need not come into play at all, because the presence of the act and the clear federal mandate to protect threatened and endangered species serves to encourage federal and state governments, and the private sector, to work collaboratively to ensure species conservation makes ESA listings unnecessary.

The gopher tortoise stands in mute testimony as an example of what can be accomplished to ensure species conservation without the need to put the protection of the ESA into play. So too does the greater sage grouse (for now, at least). But once short-term goals are met, it's critical to recognize that they likely would not have occurred without the long-term security of the ESA to motivate people to work together in the name of conservation. So, don't form your views of the ESA based on the stories that make the best headlines. Don't disregard or underestimate the value of the ESA. And don't underestimate what can be achieved through collaboration, or what even an unassuming, brown tortoise can inspire.

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