NATIONAL GEOGRAPHIC

YELLOWSTONE

THE BATTLE FOR THE AMERICAN WEST

VOL 229 • NO 5 MAY 2016

Fairy Pitta *(Pitta nympha)*
Size: Body length, approx. 19 cm (7.5 inches) **Weight:** 67 - 155 g (2.4 - 5.5 oz) **Habitat:** Lowland forests; sometimes found in plantations and scrub jungle **Surviving number:** Estimated at 1,500 - 7,000

Photographed by John Holmes

WILDLIFE AS CANON SEES IT

Who's calling? It's the fairy pitta, whose flight calls resound throughout the thick underbrush of its home. Because the little ground forager is difficult to spot in the dense forest, researchers use playbacks of its calls and wait for responses to determine location. But fewer and fewer are being found as deforestation, extensive trapping for captivity and fatalities from striking windows during migratory flights have all taken their toll on fairy pitta populations. One day its calls may very well fall silent.

As Canon sees it, images have the power to raise awareness of the threats facing endangered species and the natural environment, helping us make the world a better place.

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NATIONAL GEOGRAPHIC

MAY 2016 • VOL. 229 • NO. 5

SPECIAL ISSUE

YELLOWSTONE

America's Wild Idea 30

By David Quammen

Principal photography by

Michael Nichols | David Guttenfelder | Charlie Hamilton James | Erika Larsen | Joe Riis

A male elk surveys his winter domain, the 24,700-acre National Elk Refuge near Jackson, Wyoming.
PHOTO: CHARLIE HAMILTON JAMES

On the Cover The central painting—a bird's-eye view of Yellowstone from the north—was created for the National Park Service by noted Austrian panoramist Heinrich Berann (1915-1999). *Art by Jordan Metcalf*

Corrections and Clarifications
Go to *ngm.com/more*.

Our Abundant Heritage

One crisp June morning in Montana's Big Sky country, I rode on horseback through the Centennial Valley with Bryan Ulring, manager of the J Bar L Ranch, a working cattle operation 45 miles west of Yellowstone National Park. The valley, which looks much as it did several hundred years ago when Native American hunters chased after herds of bison, is part of the migratory route for wildlife in the northern Rockies. As we rode, I asked Ulring to help me imagine the landscape as it might have looked on a day like this 200 years ago.

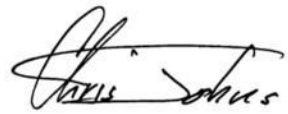
Photographer Louise Johns captured the silhouettes of (from left) her father, Chris Johns; herself; and a ranch hand riding through the Centennial Valley of Montana.

There are bison—hundreds, perhaps thousands, moving in to graze on the tall, rough grass emerging from melting snow. Elk herds follow, eating the tender shoots. The hillsides are covered with mule deer and pronghorn browsing on sagebrush.

A pack of wolves emerges from the shadows. Most of the bison escape them, but the wolves chase and pull down a straggler. After the wolves have eaten their fill, ravens and eagles settle on the carcass to scavenge the remains. The air is full of sounds and smells. It is a primal picture of abundance that, then and now, depends on the interconnectedness of the 22.6 million acres of land that make up the Greater Yellowstone Ecosystem. We know about this interrelation—how Yellowstone National Park is part of a larger entity that encompasses Grand Teton National Park and more—because of the work of ecologist Arthur Middleton and other scientists who have studied this landscape and understand its intricacies and patterns.

The contributions of scientists like Middleton and ranchers like Ulring were invaluable in shaping the issue you hold in your hands. Our *Geographic* team spent three years reporting, photographing, and creating this special edition. It's our way of commemorating the centennial of the National Park Service and of honoring Yellowstone, the world's first national park. It's also our way of showing what we have to gain by preserving the grandeur of this unique ecosystem and what we have to lose by neglecting it.

"Yellowstone retains more abundance than many places," Middleton told me. "It still offers us this ability to imagine—and remember."



Chris Johns, *Executive Director, National Geographic Society Centers of Excellence*

PHOTO: LOUISE JOHNS

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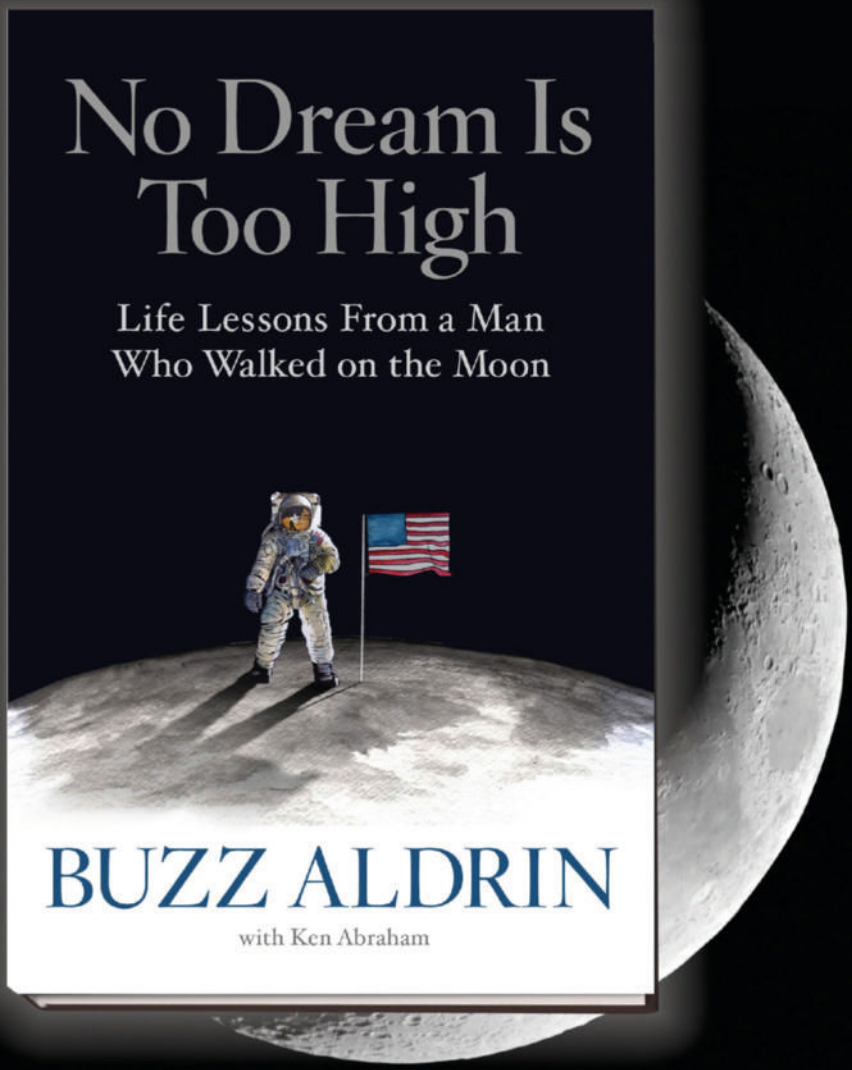

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Why Wildness Must Come First

As soon as **Caroline Byrd,** 56, graduated from college, she drove her Volkswagen bus from California to Wyoming—and never looked back. From early days on a Forest Service trail crew to her current role as the Greater Yellowstone Coalition's executive director, Byrd has held tight to one goal for the place she loves: keeping it wild.

Why is the Yellowstone area so special?
We have, in the heart of North America, this tremendous wild place that still works like nature can—and should. And while it is 20 million-plus acres, it's still not big enough. We've got three hubs of protected wildlands in the northern Rockies—Greater Yellowstone, the Crown of the Continent, and the central Idaho wildlands—and the connective tissue between them is crucial. None of those, in the face of climate change, are big enough on their own.

How do you balance pressures on the park?
There are people who say they are deeply committed to conservation and yet want more access for recreation. And we're still fighting 1872 gold-mining laws. It's the Old West and the 21st century all at the same time. Our goal is just that the integrity of the wildness comes first.

The 1872 act establishing Yellowstone declared it was "for the benefit and enjoyment of the people." Is that still the park's credo?
Yes, but it's different. The wildness is what we need to treasure, so that you're not seeing hot dog stands or a flotilla of rafts; you're seeing the North American West at its most elemental. Now. Not in the past. I think that's an important point. We shouldn't try to re-create, or have as a benchmark, what it was. We should embrace what it is.

PHOTO: ERIKA LARSEN

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Capturing the Wild: Meet the Yellowstone Coverage Team

For this special issue, top *National Geographic* photographers and writers fanned out across the Greater Yellowstone Ecosystem. Some lived and worked there for weeks; others, far longer. All came away with stories and insights.

Near Slough Creek, David Quammen examines a wolf that was sedated and fitted with a radio collar.

DAVID QUAMMEN

Contributing writer

In a sense David Quammen had a 30-year head start on this reporting assignment: That's how long he has lived in the Yellowstone area.

A three-time National Magazine Award winner, Quammen is also the author of 15 books. He'll add a 16th in August, when National Geographic Books publishes a volume featuring his writing in this issue. On this assignment Quammen traveled by ski, car, boat, small plane, helicopter, horse—and by foot, summiting Grand Teton peak (elevation 13,775 feet). He came away with concerns about "sprawl on private lands surrounding the parks—too many people wanting to own a piece of the wild rather than just visit it." But he also feels hopeful because of the caliber of scientists charged with protecting Yellowstone and its wildlife, and the depth of public concern. "America is watching this place," he says, "and that's good."

DAVID GUTTENFELDER

Photographer

After college David Guttenfelder left his native Iowa and spent the next 20 years living, working, and winning photojournalism awards (including seven World Press Photo Awards) around the globe. In 2015, he says, "I moved back to America specifically to work on this important Yellowstone story."

For his first year as a National Geographic Society photography fellow, Guttenfelder worked throughout the ecosystem. He regularly posted Instagram photos of his long, scenic commutes "to bring others along—and maybe rub it in that I got to drive through Yellowstone every morning.

"After exploring the world my whole adult life," he says, a year in this iconic American park "was the perfect homecoming."

MICHAEL 'NICK' NICHOLS

Photographer

For Nick Nichols, *National Geographic*'s longtime photo editor at large, committing to shoot the Yellowstone project meant living full-time in the park, accompanied by his wife, Reba Peck. From spring 2014 until summer 2015, Nichols barely stepped away from the assignment—with one notable exception. Late October found him in London, in a tuxedo, at a Natural History Museum awards ceremony where the Duchess of Cambridge presented him with an award: 2014 Wildlife Photographer of the Year.

Nichols won the prestigious award for his photo of a lion pride that he'd tracked through the Serengeti for six months. Returning from London, he resumed his coverage of Yellowstone and the paradox of its purpose: "Is it for the benefit of the people? Or is it to protect

PHOTOS: RONAN DONOVAN (TOP); NGM STAFF

Artist Reba Peck moved to Yellowstone with her husband, Nick Nichols, for his photo assignment.

the animals and the wonderland?" If telling Yellowstone's story encourages its stewards and visitors to find a balance between those two missions, he says, "then maybe we can help all of our parks solve that conundrum."

ERIKA LARSEN
Photographer

From the Sami herders in Scandinavia to Garrison Keillor in Minnesota, Erika Larsen's photography projects often take her to places "where the landscape is extremely important to people." Even so, the onetime Fulbright fellow says she was amazed by the hold that Yellowstone has on residents and visitors alike.

Larsen met Native American archaeologists who felt "tangible moments" of connection with ancestors from centuries ago. She met ranchers who were overcome with emotion when they spoke of passing on their land to future generations. She met travelers from all over the world making a once-in-a-lifetime journey.

Larsen also met park rangers who'd worked elsewhere before. Yellowstone was their last stop, they told her. "Why would you leave?"

CHARLIE HAMILTON JAMES
Photographer

Since photographing otters with his first camera, Charlie Hamilton James admits, he's been an "otter nut." One day during the year he spent in the Yellowstone area, Hamilton James got a call from a friend with a pond on his property: "Get here now. The otters are here." He grabbed his dry suit, his underwater camera, and the weight belt he'd last used in the ocean.

At the site, "I jumped in the pond and sank straight to the bottom," says the award-winning wildlife photographer. He had too much weight on the belt—but chances to photograph wild otters underwater are scarce, and he was determined. So he struggled to the surface, gulped air, and then sank again, repeatedly.

"Every time I got to the bottom, the otters swam down to hang out with me," Hamilton James says. "As an encounter, it's incredibly rare." But, he admits, "it was ruined by the fact that I was trying not to drown."

JOE RIIS
Photographer

The first migration that Joe Riis studied in the Greater Yellowstone Ecosystem was of pronghorn. Next the wildlife biologist turned photographer followed a 150-mile mule deer migration. Then Riis and ecologist Arthur Middleton spent two years documenting elk migrations, for which they were named the Society's 2016 Adventurers of the Year.

By photographing "all the animals that need the freedom to roam," Riis says, "I wish to show what is at stake." He hopes his work encourages "a new understanding and appreciation of our first national park."

Others on the team:
Filmmaker-photographer **Ronan Donovan** spent 2015 documenting Yellowstone's gray wolves. Writer **Todd Wilkinson** and photographers **Corey Richards, Drew Rush,** and **Louise Johns** also contributed to this issue.

Reporting: Rachel Hartigan Shea, Patricia Edmonds

PHOTOS (CLOCKWISE FROM TOP LEFT): RONAN DONOVAN; MARK THIESSEN, NGM STAFF; REBECCA HALE, NGM STAFF

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#Yellowstone

Assignment For this issue we asked Your Shot members to share their favorite views of the world's first national park using the hashtag #Yellowstone.

EDITOR'S NOTE

'Telling the story of a park as famous as Yellowstone means showing not just grand landscapes but also the daily life of the people and animals that live there.' ***Jeanne Modderman,*** *Your Shot photo editor*

Jess Danielle Roberts
New York, New York

Last August, close to midnight, Roberts positioned her tripod low and used a long exposure to capture the Milky Way reflected in Yellowstone's Grand Prismatic Spring. "To me," she says, "this photograph evokes a connection to our planet's ancient past."

WHAT AGE SHOULD YOU START SAVING FOR RETIREMENT?

WHAT AGE DID YOU ACTUALLY START?

The difference between those two ages is what's known as the "Action Gap," and it has a bigger effect than you might think.

To better understand the impact, we performed a simple experiment. We asked a group of young people to use paint rollers to show us what age they think they should start saving. Then we asked a group of older people to indicate what age they actually *did* start. What we found was that there was often a years-long Action Gap between the two. But closing it up by even just a few years makes a huge difference in how much people can save over the long run. Which makes right now the perfect time to get better prepared for your retirement.

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Wild Things natgeo.com/yellowstone

Fish School

Before Yellowstone boasted more than a dozen restaurants, adventurous visitors had to hunt and fish for their dinners. But supply was limited: Nearly half the park's lakes and streams lacked fish. To protect the scarce stock, park managers killed fish-eating wildlife, such as bears and pelicans. They also asked the U.S. Fish Commission to stock the waters "so that the pleasure seeker can enjoy fine fishing within a few rods of any hotel or camp."

Between 1881 and 1955, 310 million fish were planted in Yellowstone, wreaking havoc on the ecosystem's equilibrium. Native fish—such as the Yellowstone cutthroat trout, a source of food for dozens of animals—were displaced, attacked, and bastardized by non-native species. Today the ethos of that early era has flipped: The priority is on protecting the park's 13 native fish types (shown here), and strict catch-and-release rules govern rod-toting humans. *—Nina Strochlic*

Fish shown at approximately half their actual size

Mottled sculpin
Cottus bairdii

Redside shiner
Richardsonius balteatus

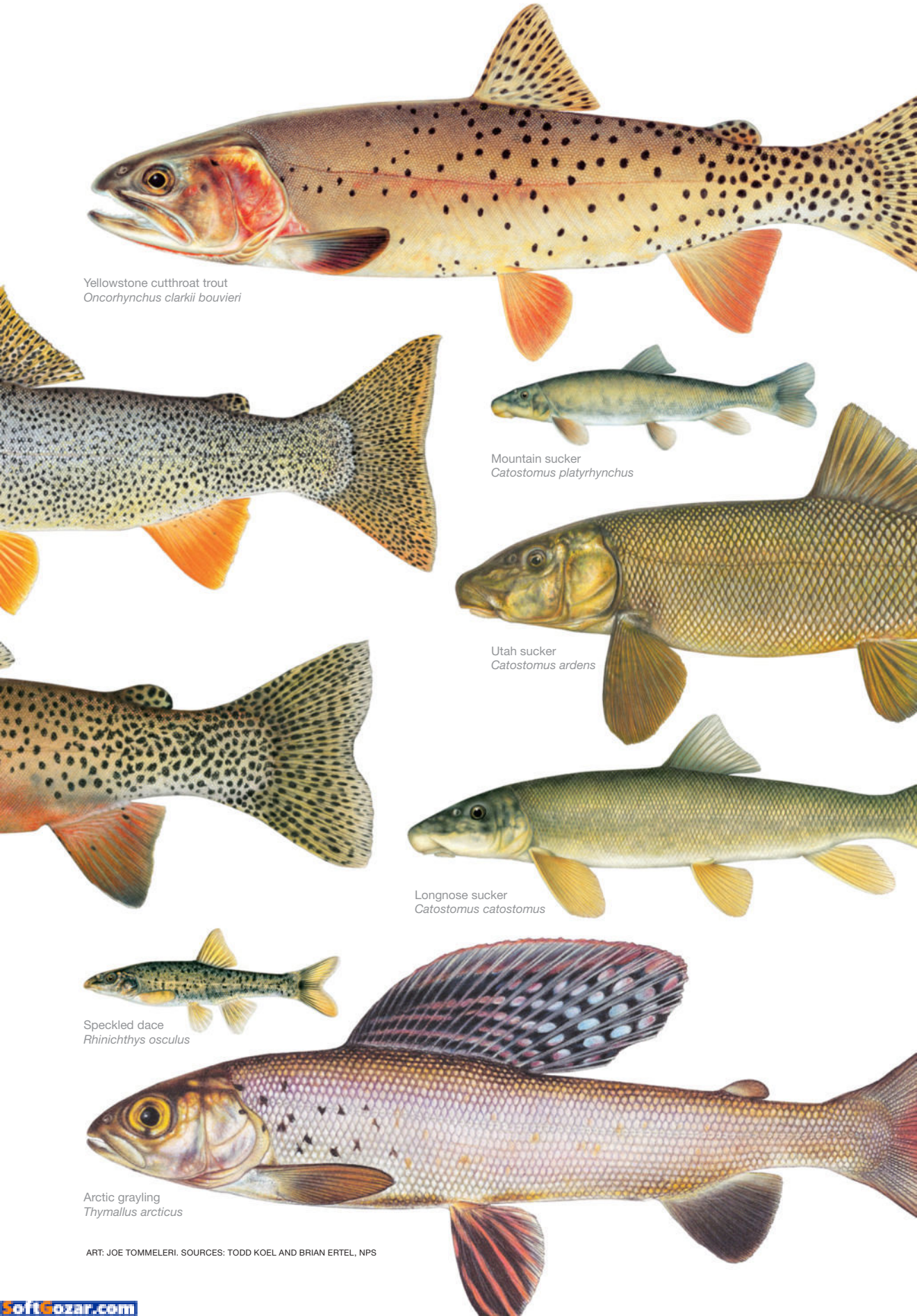
Snake River fine-spotted cutthroat trout
Oncorhynchus clarkii behnkei

Westslope cutthroat trout
Oncorhynchus clarkii lewisi

Utah chub
Gila atraria

Longnose dace
Rhinichthys cataractae

Mountain whitefish
Prosopium williamsoni



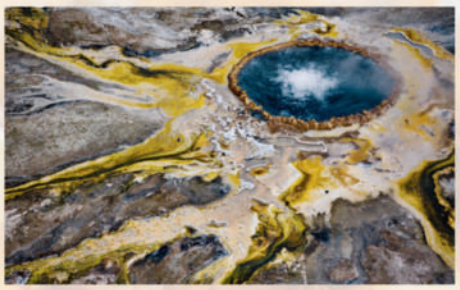
ART: JOE TOMMELERI. SOURCES: TODD KOEL AND BRIAN ERTEL, NPS

Breakthroughs From Park Pools

Yellowstone is a great refuge not just for large, charismatic creatures but also for microscopic ones. Its 10,000 hydrothermal features—steamy vents, sulfurous mud pots, hot springs (like the one below)—support a broad diversity of microbes. Among them, unusual creatures that microbiologists call extremophiles, which have figured in significant scientific discoveries.

In 1965 Thomas Brock noticed "pink gelatinous masses of material, obviously biological, at surprisingly high temperatures" in Octopus Spring. These stringy organisms were growing at 180 degrees Fahrenheit, an astonishing feat, at a time when bacterial life was thought impossible above 140. One year later Brock returned with a student named Hudson Freeze, and together they collected a different organism, a yellowish, heat-loving bug that Brock named *Thermus aquaticus* (enlarged view this page). Culturing *T. aquaticus* yielded a DNA-copying enzyme that works at high temperatures—and that enzyme made practical the technique of polymerase chain reaction. Now an essential tool in molecular biology, PCR earned inventor Kary Mullis the Nobel Prize in chemistry in 1993.

About that time Norman Pace led a team doing microbial analyses in Yellowstone. In samples gathered at Obsidian Pool, using PCR and other methods, the team found many new life-forms within Archaea, a vast and anomalous domain distinct from bacteria. The park's role in microbiology's history had completed a circle: Organism leads to tool, which leads to organism. And the work continues. *—David Quammen*



PHOTOS: JILL SCARSON; MICHAEL NICHOLS (INSET)

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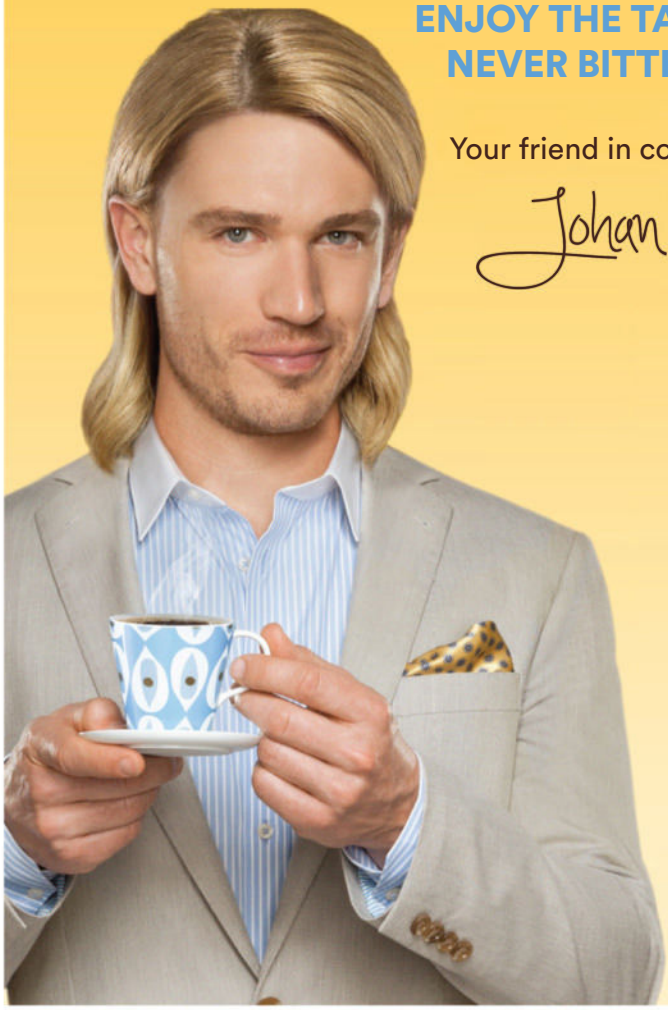
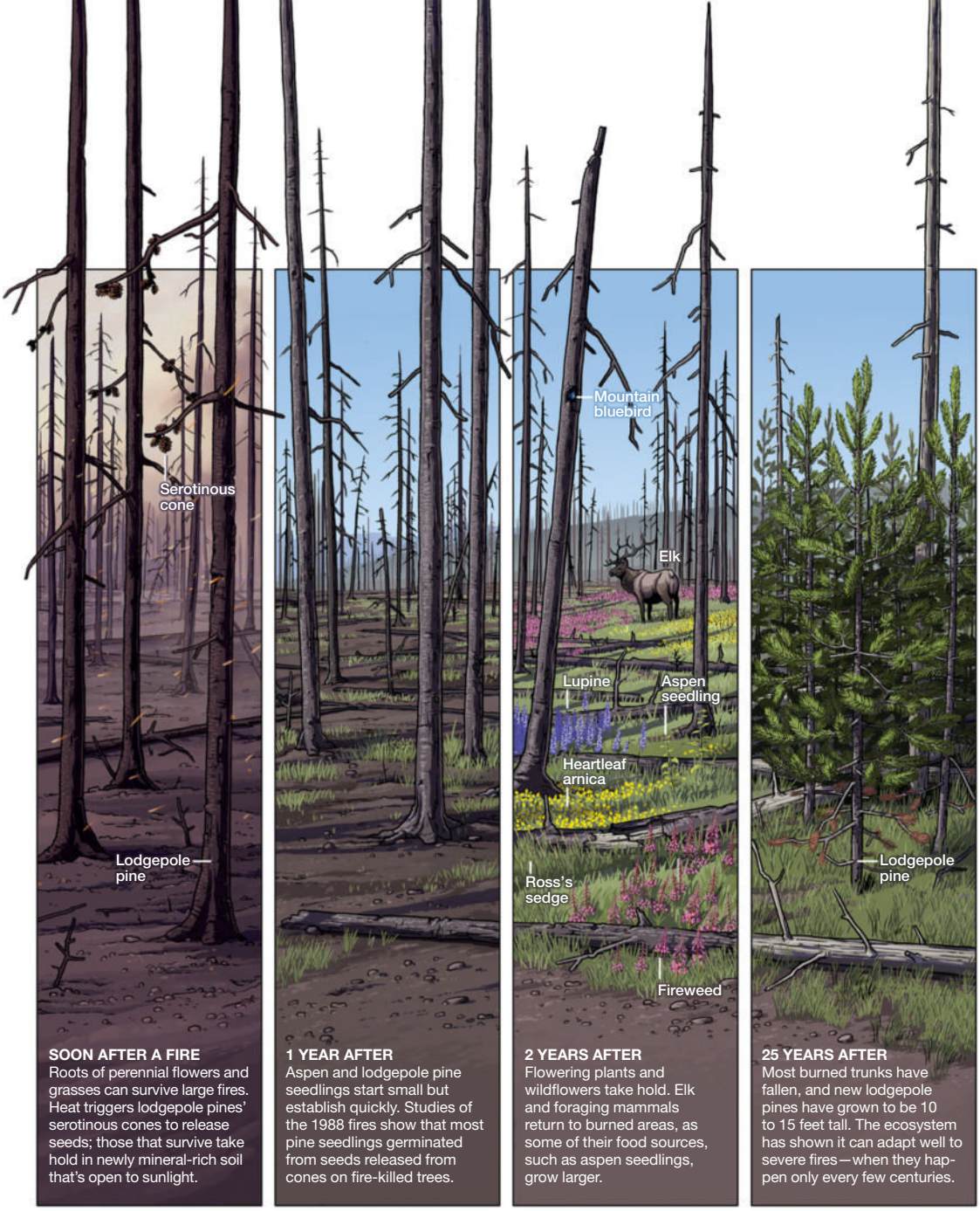
Your friend in coffee,

Johan



Based on a January 2016 national taste test of coffee drinkers conducted by an independent third party comparing Gevalia House Blend and Starbucks House Blend.



Yellowstone Fires, Past and Future

Ecologists Monica Turner and William Romme witnessed the 1988 fires that burned more than one million acres of the Greater Yellowstone Ecosystem and are still studying the aftermath. They've seen the charred landscape rebound with a great diversity of species. Their research suggests that far northern coniferous forests like Yellowstone's can regenerate after severe fires if they occur every 100 to 300 years, Turner says. "Infrequent high-severity fires are business as usual."

But what if severe fires become more frequent?

During several summers since 1988, multiple fires have burned in Yellowstone, Turner says. And the hot, dry conditions that set records in 1988 may be the norm by mid-century. As climate change advances, it could significantly affect the frequency, size, and severity of fires; the conditions under which forests grow and regrow; and ultimately the health of places like Yellowstone. —*Patricia Edmonds*

ART: MATTHEW TWOMBLY. SOURCE: MONICA TURNER, UNIVERSITY OF WISCONSIN

RIVETING STORIES THAT MUST BE TOLD

EXPLORER

NEW EPISODE

POINT OF NO RETURN

An elite team of climbers navigates the sweltering jungles and local warlords of Myanmar in a quest to be the first to scale its highest peak.

SUNDAY MAY 1

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NATIONAL GEOGRAPHIC CHANNEL

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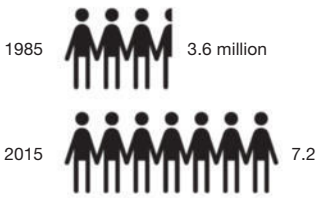
Visits Rise, Profitably

Public awareness campaigns and low gas prices encouraged more than four million visits—a record number—to Yellowstone in 2015. "Last year's visitation tested the capacity of Yellowstone National Park," says Park Superintendent Dan Wenk. People were caught in miles-long traffic jams, and rangers had to contend with more crowding issues like human-wildlife encounters.

But limiting visitors to Yellowstone would be controversial, in part because it and neighboring Grand Teton fuel the region's economy. This year federal funding will increase to deal with the visitor influx. —*Kelsey Nowakowski*

THE TOURISTS

NUMBER OF ANNUAL VISITS
Yellowstone and Grand Teton

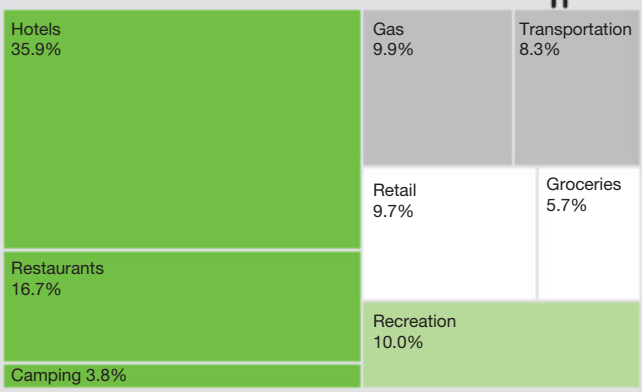


THE MONEY

Yellowstone and Grand Teton National Parks are a boon to the local economy, driving millions of dollars in spending each year in the Greater Yellowstone Ecosystem, which encompasses 22 counties in three states.

$911 million

VISITOR SPENDING IN YELLOWSTONE AND GRAND TETON BY SECTOR, 2014



IMPACT OF VISITOR SPENDING

14,500
Jobs and **$419 million** in labor income

$1,180 million
Value of all goods and services produced in the parks and within 60 miles of them

INCREASE IN VISITS, 1996-2005 VS. 2006-2015

+9.3%
Yellowstone and Grand Teton

+1.8%
National parks average

23% INCREASE IN TOUR BUSES
17% IN BUS PASSENGERS
2014-2015

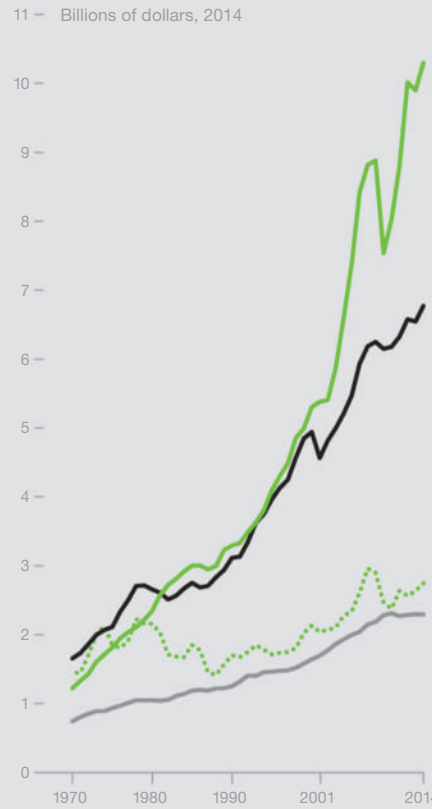
This growth is attributed largely to the rise of Asian tourism in the parks.

Each federal dollar invested in Yellowstone generates $16 in economic activity; in Grand Teton the return is $52.

MAKING A LIVING

The region's economy has shifted over the past 40 years. Extractive industries like oil and mining generate 3 percent of local income; service jobs and nonlabor sources, like retirement funds, generate 78 percent.

SOURCES OF LOCAL INCOME



Nonlabor
More retirees are choosing to settle near Yellowstone for natural beauty that will remain protected. Their spending injects money into the local economy.

Services

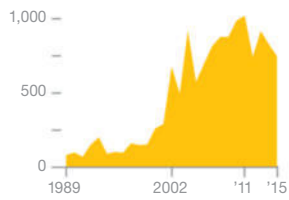
Government

Nonservices
Manufacturing, construction, agriculture, and extractive industries like mining, oil, and gas now account for a smaller share of local employment.

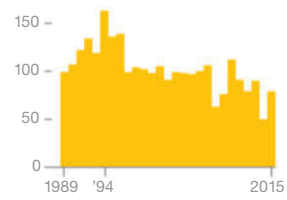
SHARING YELLOWSTONE WITH ANIMALS

More visitors mean more traffic. The number of animals killed by vehicles isn't up, but "bear jams" are—tourists can't resist slowing down to look at roadside wildlife.

BEAR-GENERATED TRAFFIC JAMS

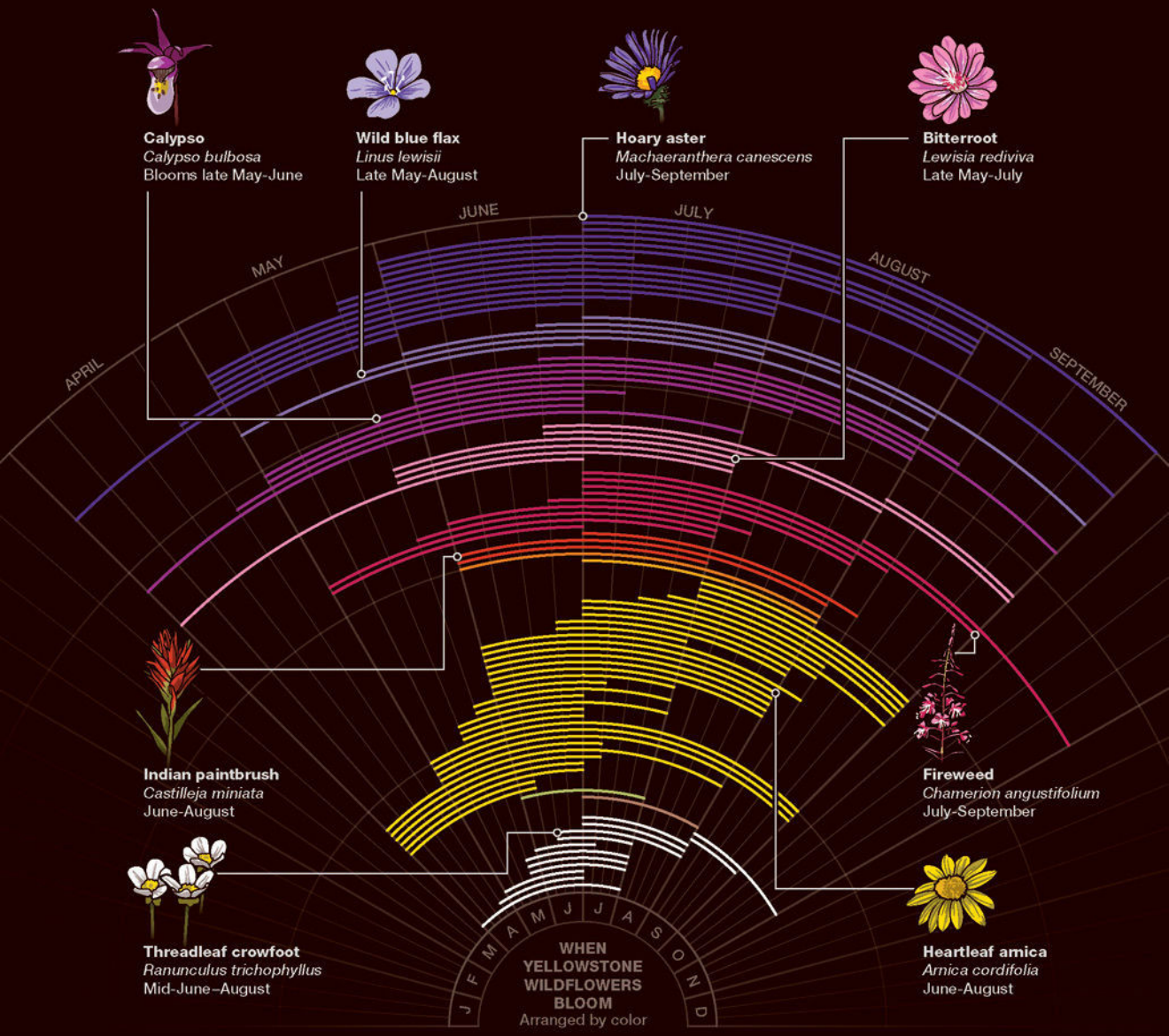


ROAD-KILLED MAMMALS



No black bear has attacked a human since 2006, but since 2011 there've been three fatal grizzly attacks.

GRAPHIC: ÁLVARO VALIÑO. SOURCES: YELLOWSTONE NATIONAL PARK; NATIONAL PARK SERVICE VISITOR USE STATISTICS PROGRAM; HEADWATERS ECONOMICS



Garden Variety

"The Yellowstone is a wild-flower garden." What American naturalist Enos Mills wrote in his 1917 book on national parks remains true a century later: From spring through autumn, Yellowstone's meadows and hillsides host a rainbow of native wildflower species. The graphic above shows the spectrum and the blooming seasons of a hundred of the park's most common and colorful flowers.

All this beauty might tempt visitors, but picking blooms is illegal, says Yellowstone botanist Heidi Anderson. Protecting native flowers is a priority because the plants are an important nutrition source for wild animals, and some flower varieties are so rare that they're not found anywhere else in the world.

Want to help preserve them? Don't drive or tread on any patches of green in the park, Anderson suggests. And before visiting, rid shoes and boots of mud, which can transport potentially damaging invasive seeds. *—Catherine Zuckerman*

ART: MATTHEW TWOMBLY. SOURCE: NPS

The Best in Yellowstone

What draws you to a park? Wildlife? Landmarks? Ski trails? Scenery? National Geographic's book *The 10 Best of Everything: National Parks* lists top-ten picks in 80 categories of park features—and Yellowstone is home to plenty of these superlative attractions.

Horseback riding is among the highly rated recreational activities in Yellowstone National Park.

PHOTO: DAVID GUTTENFELDER

ACCESSIBLE TRAILS One of the park's top trails for people with limited mobility begins at the fully accessible Old Faithful Inn and visitor center. The 1.5-mile hike-bike path, accessible to wheelchairs, leads to Morning Glory Pool.

BICYCLING For the brief period between mid-March and mid-April, as Yellowstone's roads thaw, cyclists have exclusive access to portions of them. For example, the route from the park's West Entrance to Mammoth Hot Springs—thronged with vehicles in season—is reserved for nonmotorized traffic those few weeks. Once cars return, there are still paved and gravel trails designated for cyclists' undisturbed exploration.

FIELD TRIPS The Yellowstone Association Institute offers park visitors a variety of educational experiences. Naturalists can learn about the park's wolves, raptors, and bison; history buffs can learn about the horse-and-buggy

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If You Purchased Certain Glucosamine and Chondroitin Joint Supplements Manufactured by Rexall Sundown, You Can Receive Money from a Class Action Settlement.

A class action settlement has been preliminarily approved in *Pearson, et al. v. NBTY, Inc., et al.*, No. 1:11-cv-07972 (N.D. Illinois). Your rights may be affected by this settlement. Plaintiffs say that glucosamine/chondroitin joint supplements manufactured or sold by Rexall Sundown, Inc. or NBTY, Inc. or their affiliates ("Rexall") do not provide certain benefits claimed in the labeling. The Court has not decided in favor of either side. Rexall stands by the products.

Rexall has agreed to a settlement, including labeling changes and a $7,500,000 fund ("the Fund"), plus an additional $1,500,000 for notice and administration of the settlement, in order to avoid the expense, inconvenience, and risk of litigation. The Fund will be used to pay eligible claims, attorneys' fees and expenses (not to exceed $2,500,000), Class Representative awards (up to $5,000 each), and notice and administration costs (if they exceed $1,500,000).

Who Is A Class Member?

The Class includes all consumers who purchased certain joint supplements sold or manufactured by Rexall under various brands ("Covered Products"). **This is only a summary.** Specific dates and areas of sale apply. For a complete list of all products covered by this settlement, visit the website, or write to the address at the bottom of the notice.

What Does the Settlement Provide to Class Members?

You will receive $8.00 per bottle of Covered Product purchased, up to a maximum of thirteen (13) bottles, or **$104.00 per household**. If money is available in the Fund after claims and other payments are made, it will be distributed *pro rata*, up to a maximum of **$200 per household**. Any remaining funds after that are to be paid to the Orthopedic Research and Education Foundation.

What do you need to do?

To get money, you must submit a claim form, postmarked or submitted online by September 28, 2016. Visit the website, or call the number below to obtain a claim form. If you already submitted a claim in the previous settlement, you can – but are not required to – submit a new claim form; you will receive compensation based upon the highest number of bottles from either claim. Please visit the website for complete details on how this new settlement affects you. **To exclude yourself from the settlement class**, you must submit a written exclusion postmarked by May 26, 2016. You will not receive any money, but you retain your right to sue on your own regarding these claims. Even if you excluded yourself from the previous settlement, you must submit a new letter of exclusion for this settlement. **If you do not exclude yourself, you can object to the terms of the settlement.** If you wish to object to the settlement, you must submit a written objection postmarked by May 26, 2016. Instructions on how to exclude yourself or object can be found on the website. **If you do nothing**, you will not receive any money and you will be bound by the terms of the settlement. All members of the Settlement Class who do not exclude themselves will release any claims, including some future claims, related to the Covered Products.

A final hearing will be held on June 30, 2016 at 9:30 a.m. at the Everett McKinley Dirksen United States Courthouse, 219 South Dearborn Street, Chicago, Illinois 60604, to determine the fairness, reasonableness and adequacy of the settlement and to award attorneys' fees and costs. The motions for attorneys' fees and costs and Class Representative awards will be posted on the website after they are filed. You may attend the hearing, but you do not have to.

For detailed information and notices, **including a complete description of the Covered Products**, visit www.GlucosamineSettlement.com, or write to: Glucosamine Settlement c/o Settlement Administrator, P.O. Box 170, Philadelphia, PA 19105-0170, or call (888) 972-6583.

www.GlucosamineSettlement.com

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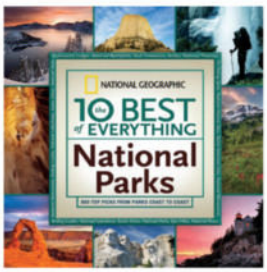


Visitors pose for photos at Artist Point. Yellowstone's scenery is praised in *The 10 Best of Everything: National Parks.*

days. The park's beauty inspires photography and art courses. Lessons in fly-fishing and animal tracking round out the curriculum.

HIKING Some of the park's biggest attractions can be seen from roads and overlooks, but others take a bit more legwork. The unusual Uncle Tom's Trail has stairs descending 500 feet into the Grand Canyon of the Yellowstone and delivers hikers to the base of the Lower Falls, a roaring 308-foot waterfall. On the eastern boundary, the four-mile trail up and down Avalanche Peak in the brief summer season showcases colorful subalpine wildflowers.

SWIMMING HOLES "Hot-potting" is the slang for taking a dip in one of Yellowstone's celebrated thermal features. But only one still allows swimmers; it's a half-mile walk along the trail north of Mammoth Hot Springs.

VOLCANIC WONDERS Earth's most astounding concentration of thermal features is on vivid display at the park's geyser basins. Norris Geyser Basin, the oldest and hottest hydrothermal region in the park, is home to Steamboat, the world's tallest active geyser. Upper Geyser Basin boasts the famous Old Faithful geyser.

WIND SPORTS With its steady breeze and wide-open water, Yellowstone Lake is an ideal place for wind sports. It's the nation's largest high-altitude lake, roughly 20 miles from north to south and 14 miles from east to west. Windsurfers and sailors have easy access; special "boat party" campsites dot the shore.

WINTER SPORTS The park's snow blanket is punctured in spots by steam and percolating hot water. Visitors may explore by snowmobile and snowcoach when accompanied by an authorized commercial guide. Those who cross-country ski or snowshoe have miles of groomed trails and untouched expanses of backcountry snow.

PHOTO: MICHAEL NICHOLS

Bay of Fundy

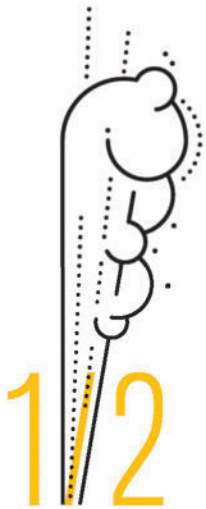
Surprising facts from the world's first national park

MOSQUITOES GALORE

At least 35 species of mosquitoes live in Yellowstone.

BIG EXPANSE

If you drive every road, you'll cover only one percent of the park.

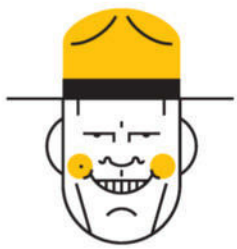


GEYSER PARADISE

One-half of the world's known geysers are in Yellowstone.

CAMERA CAUTION

Park rules require that visitors stay at least 25 yards away from bison. Want a close-up? You'll need a zoom lens.



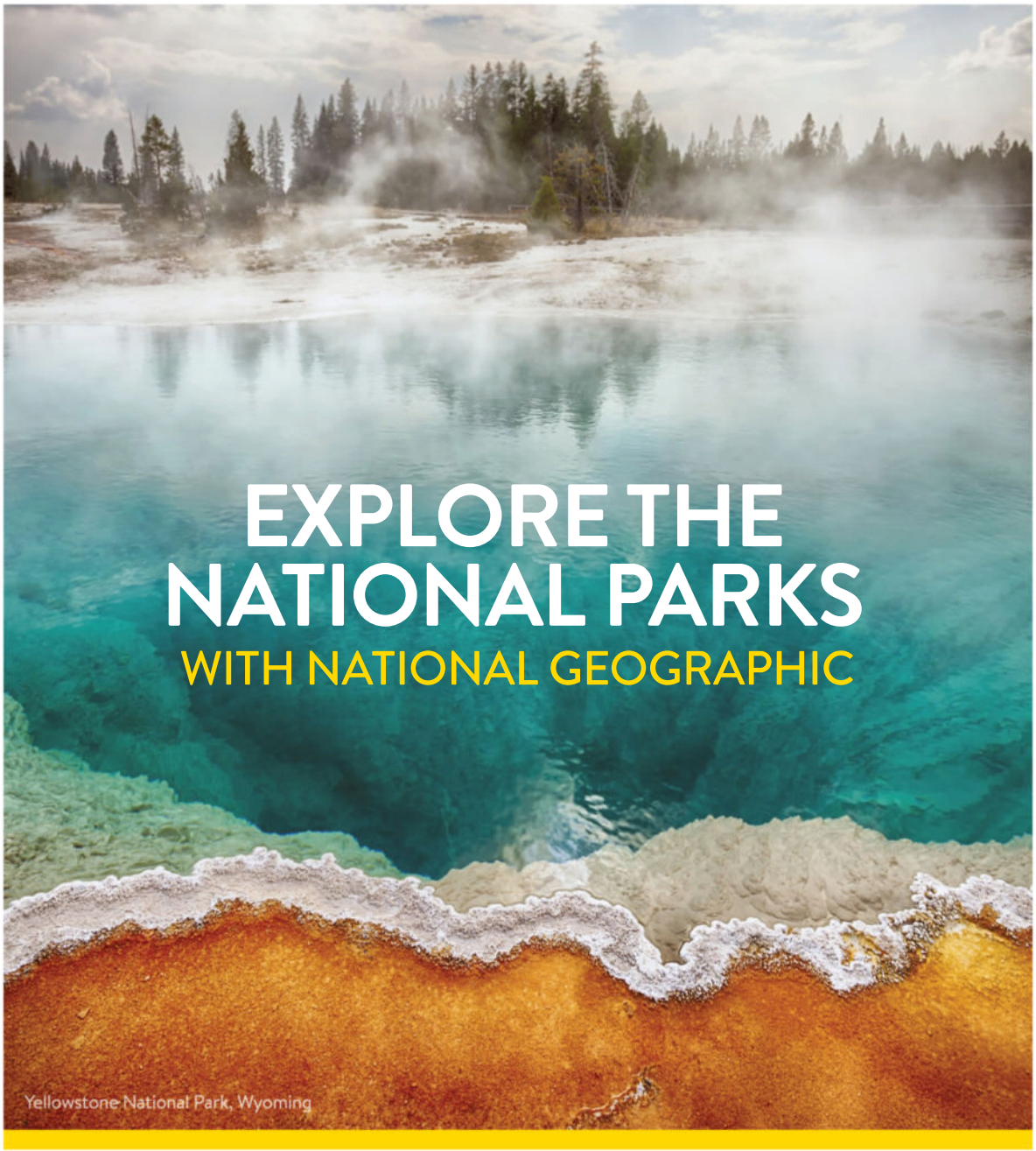
PRESIDENT RANGER

Gerald Ford said he spent "one of the greatest summers of my life" as a park ranger in Yellowstone in 1936.

WELCOME TO WONDERLAND

Early on, the park's natural marvels earned it the nickname "Wonder-land," after Lewis Carroll's classic.

ART: ÁLVARO VALIÑO



Venture into the wilderness with National Geographic's experts to celebrate the 100th anniversary of the National Park Service. Get an insider's view of majestic landscapes and incredible wildlife from Alaska's Glacier Bay to the Grand Canyon. Bring the whole family along on trips geared for kids and adults. Learn how to best capture Yellowstone in winter or the granite domes of Yosemite on special departures for photographers. Or grab your hiking boots and hit the trails on an active adventure. National Geographic has been helping to preserve and promote these national treasures for more than a century—come discover their hidden wonders with us!

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The Artist Goes West

Before Thomas Moran arrived, Yellowstone in the popular imagination was a harsh, wild place pocked with hellish geysers. After the painter's work was finished, Yellowstone was established as a national park and marketed as a wonderland. In 1871 Moran and photographer William Henry Jackson had joined the first U.S. government survey of the region. For two weeks Moran filled a sketchbook with the landscape's most stunning sights. The survey results, Jackson's photos, and Moran's watercolors—the first color renderings of the area—were presented to Congress that fall. "The photographs were proof that what the artist was showing really existed," says Eleanor Harvey, senior curator at the Smithsonian American Art Museum. In March 1872 lawmakers officially made Yellowstone a national park, the world's first. By April, Moran had transformed some of his sketches into a 7-by-12-foot painting (above). The gold-splattered valley and billowing Lower Falls of "The Grand Canyon of the Yellowstone" captivated the public. "It is too grand and wonderful for words," declared the *Ladies' Repository* that August, "and none can ever judge of its wonders from any engraving or photograph in mere black and white." Though Moran later painted Lake Superior, the Grand Canyon, and the Rockies, his reputation was so intertwined with Yellowstone that he took to signing his paintings "TYM," for Thomas "Yellowstone" Moran. *—Nina Strochlic*

Moran at Yellowstone's Mammoth Hot Springs

PHOTOS: SMITHSONIAN AMERICAN ART MUSEUM/ART RESOURCE, NY (TOP); WILLIAM HENRY JACKSON, EAST HAMPTON LIBRARY, NEW YORK

America's Wild Idea

YELLOWSTONE

By David Quammen

It's more than just a park. It's a place where, more than 140 years ago, people began to negotiate a peace treaty with the wild. That negotiation continues today, with growing urgency, at Yellowstone and all over the planet, as the human world expands and the natural world retreats.

Can we come to terms?

Photographs and paintings of sights such as this—the Grand Canyon of the Yellowstone—inspired Congress to create the park in 1872. It was a revolutionary step.

PHOTO: MICHAEL NICHOLS

Parts of the Yellowstone region are wilder now than they've been in a century. Grizzlies are spreading. This one, in Grand Teton National Park, fends off ravens from a bison carcass. Workers moved it away from the road to keep scavengers and tourists apart.

PHOTO: CHARLIE HAMILTON JAMES

‘Nothing ever conceived by human art could equal the peculiar vividness and delicacy of coloring of these remarkable prismatic springs,’ wrote Ferdinand Hayden, leader of an early expedition to Yellowstone. It was the landscape and especially the hot springs, more than the wildlife, that moved Congress to set the land aside as a park. Yet the colored springs conceal their own extreme wildlife—microbes that hint at what might live on other, harsher planets.

The colors of Grand Prismatic Spring come from thermophiles: microbes that thrive in scalding water. The green is chlorophyll they use to absorb sunlight.

PHOTO: MICHAEL NICHOLS

Rutting bison joust in Yellowstone's Lamar Valley. More than 4,500 bison roam free in the park. They're descendants of a few dozen animals given sanctuary more than a century ago, rescuing the species from extinction.

PHOTO: MICHAEL NICHOLS

The Mollie's wolf pack investigates grizzly bear tracks in Yellowstone's Pelican Valley. Wolves were reintroduced into the park beginning in 1995, and Yellowstone now has the full complement of large animals that existed there before Europeans arrived in North America.

PHOTO: RONAN DONOVAN

Park Service biologist Doug Smith races toward a gray wolf that he shot from the air with a tranquilizer dart. Before it awakens, he'll give it a quick physical exam and fit it with a radio collar. Wolves are now thriving in Yellowstone, but researchers monitor them closely.

PHOTO: DAVID GUTTENFELDER

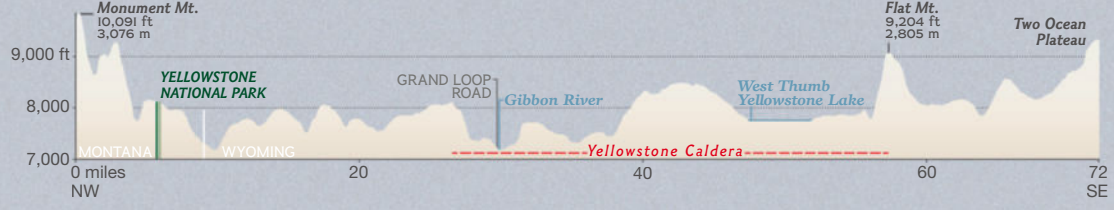
As one of the last relatively unspoiled temperate ecosystems on Earth, Yellowstone offers a unique opportunity for scientists. Organisms from microbes to wolves can be studied in their natural habitats, mostly free from human contact.

Greater Yellowstone: More Than the Sum of Its Parts

The idea of a Greater Yellowstone Ecosystem, which gained traction in the 1980s, marked a giant leap forward in ecological thinking. Natural-resource managers came to recognize that biological processes within Yellowstone Park extend far beyond its borders and that activities in one place can have huge implications for the area next to it. The construct is now helping managers everywhere understand that a healthy, well-functioning bioregion—Greater Yellowstone encompasses 22.6 million acres—is worth far more than the sum of its parts. The system is the largest patch of contiguous public wild lands in the lower 48 states. But is it big enough to maintain the long-term health of its natural wonders?

Elevation
10,000 ft
8,000
6,000
4,000
2,000

Drawn from the map at left, the cross section below highlights a segment of Greater Yellowstone's diverse topography. The 72-mile stretch is bounded by Monument Mountain to the northwest and the Two Ocean Plateau to the southeast. This graphic shows elevations, along with state borders, park boundaries, hydrological features, and the region's geothermal giant: the volcanic Yellowstone Caldera.



MARTIN GAMACHE AND LAUREN C. TIERNEY, NGM STAFF. SOURCES: USGS; YELLOWSTONE NATIONAL PARK

A camera trap caught a grizzly reaching for fruit in the branches of an apple tree. Grizzlies are frequent visitors to yards like this one in front of a historic house along Yellowstone's northern boundary. Caution and attentiveness are necessities that come with dwelling safely in this wild-and-rural interface.

PHOTO: MICHAEL NICHOLS WITH RONAN DONOVAN AND THE NATIONAL PARK SERVICE

More than 700 grizzly bears now live in the Greater Yellowstone Ecosystem—at least triple the number from 40 years ago, when the species was listed as threatened. But the human population has soared too. Inevitably, bears and humans are meeting more often, sometimes violently. In 2015 wildlife managers killed 25 grizzlies—about 3 percent of the population—because the bears had harmed humans, their livestock, or other property.

Multiple surgeries restored Nic Patrick's face but couldn't erase the scars left by the grizzly that mauled him in 2013 at his Wyoming ranch, along the South Fork of the Shoshone River. A conservationist as well as a cattleman, Patrick holds no grudge: The mother bear was only protecting her cubs, he says.

Listen to Nic Patrick describe the bear attack at *natgeo.com/yellowstone.*

PHOTO: DAVID GUTTENFELDER

Yellowstone bison set the pace of traffic over the Highway 89 bridge in Gardiner, Montana, on the park's northern border. Winter pushes the bison out of the park to lower elevations in search of food, a migration that comes into conflict with agriculture and development.

PHOTO: MICHAEL NICHOLS

A century after Yellowstone rescued the species, bison are a living compromise, sort of thriving in the sort-of wild. They multiply freely, and with predators preferring to target elk, their population outpaces the park's ability to sustain them. Once they step beyond its borders, they are regarded by many ranchers as more of a pest than a paragon of the American West. Each year hundreds are culled by park and state authorities and Native American tribes.

A bison raised on the Flying D ranch near Bozeman, Montana, is put down after showing possible signs of brucellosis, a serious disease transmissible to cattle. Whether Yellowstone's wild bison pose a similar threat is a matter of heated controversy.

PHOTO: DAVID GUTTENFELDER

The Paradox of the Park

'One of the duties of the National Park Service is to present wild life "as a spectacle." This can only be accomplished where game is abundant and where it is tame.'

HORACE ALBRIGHT, *Park Service director 1929-1933*

DIORAMA IN BLOOD

On August 7, 2015, in Yellowstone National Park, a ranger found the chewed-upon body of a man near a hiking trail not far from one of the park's largest hotels. The deceased was soon identified as Lance Crosby, 63 years old, from Billings, Montana. He had worked seasonally as a nurse at a medical clinic in the park and been reported missing by co-workers that morning.

Investigation revealed that Crosby was hiking alone on the previous day, without bear spray, and ran afoul of a female grizzly with two cubs. The sow, after killing and partially eating him (not necessarily in that order), and allowing the cubs to eat too, cached his remains beneath dirt and pine duff, as grizzlies do when they intend to reclaim a piece of meat. Once trapped and persuasively linked to Crosby by DNA evidence, she was given a sedative and an anesthetic and then executed, on grounds that an adult grizzly bear that has eaten human flesh and cached a body is too dangerous to be spared, even if the fatal encounter wasn't her fault. "We are deeply saddened by this tragedy and our hearts go out to the family and friends of the victim," said Park Superintendent Dan Wenk, a reasonable man charged with a difficult task: keeping Yellowstone safe for both people and wildlife.

Lance Crosby's death was just the seventh bear-caused fatality in the park during the past hundred years. The next most recent occurred in the summer of 2011, when two people died in separate events, possibly killed by a single female grizzly. After the first killing, of a man named Brian Matayoshi, the bear had been spared by Wenk—with advice from bear managers—on grounds that she was defending her cubs and the attack on Matayoshi wasn't predatory. Because the Matayoshi killing occurred on the Wapiti Lake trail, she became known as the Wapiti sow. Later she turned up near the second victim, a man named John Wallace, who died eight miles away in what might have been a predatory attack. Wallace's body, like Lance Crosby's, had been partially eaten and then cached. Physical evidence didn't prove that the Wapiti sow had killed him but strongly suggested that she had at least fed on the body, and so she was put down. The sorry events of 2011, and that well-meant choice to give the Wapiti sow a reprieve after Matayoshi's death, help explain the decision to condemn the 2015 sow after one incident.

Grizzly bears, clearly, can be dangerous animals. But the danger they represent should be seen in perspective: In the 144 years since

What wilderness means to people has steadily changed since Yellowstone was founded. The Park Service no longer tries to make tame spectacles of wild animals. But today, as in 1972, when this photo was taken, most visitors to the park never get far from the road—and a black bear is still a reason to pull over.

PHOTO: JONATHAN BLAIR

This issue was funded in part by your National Geographic Society membership.

Yellowstone was established, more people have died there of drowning and of scalding in thermal pools, and of suicide, than have been killed by bears. Almost as many people have died from lightning strikes. Two people have been killed by bison.

The real lesson inherent in the death of Lance Crosby, and in the equally regrettable death of the bear that killed him, is a reminder of something too easily forgotten: Yellowstone is a wild place, constrained imperfectly within human-imposed limits. It's a wild place that we have embraced, surrounded, riddled with roads and hotels and souvenir shops, but not tamed, not conquered—a place we treasure because it still represents wildness. It's filled with wonders of nature—fierce animals, deep canyons, scalding waters—that are magnificent to behold but fretful to engage. Most of us, when we visit Yellowstone, see it as if through a Plexiglas window. We gaze from our cars at a roadside bear, we stand at an overlook above a great river, we stroll boardwalks amid the geyser basins, experiencing the park as a diorama. We remain safe and dry. Our shoes don't get muddy with sulfurous gunk. But the Plexiglas window doesn't exist, and the diorama is real. It's painted in blood—the blood of many wild creatures, dying violently in the natural course of relations with one another, predator and prey, and occasionally also the blood of humans. Walk just 200 yards off the road into a forested gully or a sagebrush flat, and you had better be carrying, as Lance Crosby wasn't, a canister of bear spray. Your park entrance receipt won't protect you. You can be killed and eaten. But if you are, despite the fact that you have freely made your own choices, there may be retribution.

This is the paradox of Yellowstone, and of most other national parks we have added since: wilderness contained, nature under management, wild animals obliged to abide by human rules. It's the paradox of the cultivated wild. At a national park in Africa—Serengeti in Tanzania, for instance, or Masai Mara game reserve in Kenya, Kruger in South Africa—you wouldn't face such ambiguity. You would view the dangerous beasts, the lions and elephants and leopards and buffalo, from the safety of your Land Rover or your safari van, seldom if ever strolling through their habitat on foot. But in America we've chosen to do things differently, and Yellowstone, because it's the first national park, an iconic place known throughout the world, which millions of people visit each year, is where the paradox is most powerfully played out.

Yellowstone is also the eponym of the biggest and richest complex of mostly untamed landscape and wildlife within the lower 48 states. The Greater Yellowstone Ecosystem is an amoeboid expanse encompassing two national parks (Grand Teton is the second) as well as national forests, wildlife refuges, and other public and private holdings, the whole shebang amounting to 22.6 million acres, an order of magnitude bigger than Yellowstone Park itself. Surrounding this great amoeba is a modest transition zone, where you will more likely find cattle than elk, more likely see a grain elevator than a grizzly bear, and more likely hear the bark of a black Labrador than the howl of a wolf. Bounding that buffer is 21st-century America: highways, towns, parking lots, malls, endlessly sprawling suburbs, golf courses, Starbucks.

This area, known simply as the Thorofare, is the most remote spot in the lower 48 states. 'Thirty miles from anything,' said pilot Roger Stradley.

Question: Can we hope to preserve, in the midst of modern America, any such remnant of our continent's primordial landscape, any such sample of true wildness—a gloriously inhospitable place, full of predators and prey, in which nature is still allowed to be red in tooth and claw? Can that sort of place be reconciled with human demands and human convenience? Time alone, and our choices, will tell. But if the answer is yes, the answer is Yellowstone.

THE BEAR THAT EATS FLOWERS

The best overview of Yellowstone Park comes from 300 feet airborne above the landscape itself. So on a clear summer morning, I met Roger Stradley at an airport near Bozeman, Montana, for an aerial tour of Yellowstone in his yellow 1956 Piper Super Cub. He issued me a flight suit and a helmet, then showed me how to insert myself into the rear seat, a cramped space directly behind the pilot's. I've been in kayaks with more legroom.

"You don't get into a Super Cub," he said. "You put it on." Small and light, the Super Cub is still favored by old-school bush pilots such as Stradley for its capacity to land on and take off from short strips, and to ride the thermals like a condor. Flying slow and low is especially useful for surveying wildlife, and Stradley is legendary among the biologists of Yellowstone Park who rely on overflights for their work. A robust, cheerful 76-year-old, he has flown in the mountains for 62 years, logging a mere 70,000 hours.

We rose up over Bozeman, crossed the Gallatin Range, and flew east along the gently sloped north side of Mount Everts, named for Truman Everts, an unlucky man who went missing from one of the first expeditions to Yellowstone in the late 19th century and survived a month of lonely misery before being rescued. We crossed the Blacktail Deer Plateau, a loaf of raised terrain, where Stradley alerted me through my helmet headphones to a wolf den, signaled by bare dirt and dig marks beneath the exposed roots of a large Douglas fir. Stradley saw, though I couldn't, a single black wolf lying there in the shade. That animal would be part of the old Eight Mile pack, he said, which had since fissioned, as wolf packs do when they get too large.

We traced the Yellowstone River upstream past Tower Fall, catching a flash of rainbow through the mist, and then crossed Antelope Creek toward Mount Washburn, passing over uplands patched with brown, dead trees burned in a recent fire. Good bear habitat, Stradley said. Elk to eat, plus lots of mushrooms—morels, sprouting up from the burn. "You don't want to go in there and pick them, because you're going to have competition with the grizzlies." Duly noted.

We swung back toward the Lamar Valley in the park's northeast corner, broad and grassy between sage-covered hillsides, punctuated with glacial erratics, large boulders from elsewhere left behind by the moving ice of the Pleistocene. We circled above Rose Creek, site of one of the acclimation pens from which Canadian wolves were

The Author's Flight

Writer David Quammen toured Yellowstone with pilot Roger Stradley. Their course took them east through wolf-rich Lamar Valley, then looped south to the isolated Thorofare region before heading west over geyser-studded basins.

ALL SPOT GRAPHICS AND MAPS: LAWSON PARKER; SHELLEY SPERRY; MARTIN GAMACHE AND LAUREN C. TIERNEY, NGM STAFF

released into the park back in 1995, after an absence of almost 70 years following their systematic extirpation early in the century. We could see yellow flowers peppered across the meadows of grass and sage—the rich yellow of balsamroot, the paler yellow of biscuit-root, which signals a tuber that bears eat. Lacking geysers and a great canyon, the Lamar Valley isn't for everyone, but to some eyes it's the most exquisite corner of Yellowstone.

We flew down the east shore of Yellowstone Lake into a roadless area, protected on one side by water and on another by the crest of the Absaroka Range. Near the south tip of the lake's Southeast Arm is the delta of the upper Yellowstone River, a broad bottomland of willows, grasses, and shrubs in five shades of green. This day the upper river was brownish olive, reflecting fast July runoff from melting snow, though I noticed one oxbow pond, its water a deep, tranquil blue. We buzzed upstream in stately progress, so low and slow that it felt as though we were riding a kite. We crossed the park boundary, an invisible line, and turned east to follow a tributary called Thorofare Creek toward its rocky headwaters, where the Yellowstone, which is America's longest undammed river (outside of Alaska), has one of its sources. This area, known simply as the Thorofare, is the most remote spot in the lower 48 states. "Thirty miles from anything," Stradley said.

After three hours of flying we pointed ourselves back toward the airport, but first we swung over the Norris Geyser Basin, getting a nice view of all the little hot springs and ponds dotting the area in shades of aquamarine, orange, yellow, and chartreuse. Ahead of us then was the Gallatin Range, not as lofty and jagged as the Absarokas though high enough to retain snow patches and cornices at this season. On one of those white patches we glimpsed a cluster of dark figures and, swooping closer, made out their forms: seven wolves plus a grizzly bear, sharing a little snowfield at uneasy proximity and 9,000 feet elevation.

Stradley pulled up his camera, wanting to get a photo of the animals as we circled back. Now he was flying the plane with his knees. "I don't know why they're up so high," he said. "What's the attraction?"

Before I knew it, we were two mountains along, looking down on another bear, a huge one. This grizzly was on a flat above Fan Creek, munching contentedly amid a patch of yellow balsamroot and other vegetation. Again we circled. Stradley seemed puzzled. Balsamroot is not usually mentioned as a grizzly food, although the bear's dietary choices in Yellowstone are formidably diverse, according to a recent authoritative paper. The list includes 266 kinds of plant, animal, and fungus, ranging from bison flesh to morels, from western waterweed to moose, and from chipmunks to 25 kinds of grass. Was the bear grazing? Didn't seem to be. Digging up tubers? No. "Might be eating the flowers," Stradley said. And it was possible: Kerry Gunther, the park's senior bear biologist, later told me that balsamroot flowers have indeed been found in grizzly scat. So that's what I took away, my last vivid impression from our eagle-view tour: a humongous grizzly bear alone on a hill above the Gallatin River, eating flowers.

Can we hope to preserve, in the midst of modern America, a remnant of our continent's primordial landscape? If the answer is yes, the answer is Yellowstone.

Glaciers in Grand Teton National Park are shrinking, as they are around the planet. Meanwhile tourism is growing: In 2015 record numbers visited both Grand Teton and Yellowstone, its neighbor to the north. The parks attract an increasingly diverse array of international travelers.

PHOTO: CHARLIE HAMILTON JAMES

A WORK IN PROGRESS

The park lies atop what geologists call the Yellowstone Plateau, with an average elevation of 8,000 feet. Dense stands of lodgepole pine cover this great uplift, and high meadows of grass and sage, as well as some lesser bulges such as Blacktail Deer Plateau and a network of gently undulant roads, all across ground that appears cold and static. Don't be fooled.

There's a dramatic geological reason for the height of the Yellowstone Plateau. Directly beneath it lies a vast volcanic hot spot, a gigantic channel in Earth's mantle and crust, through which magma rises, releasing heat that further melts the rocks, creating a massive plume. That thermal torrent comprises two magma chambers of partly molten rock, one atop the other, bulging the land surface into an enormous pustule. Around the bulge, like disorderly ramparts, loom mountains that are older and higher—most notably the Tetons, the Absarokas, the Gallatins. On the plateau itself, geologists have traced the evidence of three huge calderas, representing the scars left by three stupendous explosions over the past 2.1 million years. Those explosions, and the volcanic forces that powered them, have earned Yellowstone's hot spot the label "supervolcano." Ordinary volcanoes generally occur along the edges of tectonic plates; supervolcanoes blaze directly through those plates, like a stationary torch burning blisters through a sliding sheet of steel. And the Yellowstone torch, feeding heat toward preposterous eruptions, is likely the largest beneath any continent on Earth.

"It all starts with heat," according to Robert B. Smith of the University of Utah, who has studied Yellowstone's geology for more than five decades. While the North American plate has drifted southwestward

over the mantle plume during the past 16 million years, the hot spot has left its marks in a northeastward series of volcanic centers, 500 miles long, from what we now call southeastern Oregon and across Idaho to its current location. The most recent of the three giant upheavals at Yellowstone occurred about 640,000 years ago, spewing 240 cubic miles of volcanic ash into the atmosphere and leaving a rimmed crater that now encompasses Old Faithful, the Hayden Valley, and half of Yellowstone Lake. That one is known as the Yellowstone Caldera. There have also been many smaller volcanic eruptions in the millennia since.

The implications of these geological facts are fateful. After the ash settled and the land cooled, the Yellowstone Plateau remained a site of extraordinary volcanic activity, its relatively thin earthly crust floating above the hot spot's upper magma chamber, which heats the subterranean waters that emanate as geysers and fumaroles and mud pots and colorful hot springs, all penetrating the surface like whistles on a great calliope. Gradually the plateau's forests regrew, its animal populations recolonized. Meanwhile a combination of gouging and splitting forces, including ice, flowing water, and geological faulting, opened a notch along which the Yellowstone River carved its own Grand Canyon (big and impressive, though not nearly so vast as Arizona's), thundering over a pair of spectacular drops.

Humans arrived, distant ancestors of the Sheep Eater, Bannock, Crow, and other native peoples whose traditions still connect them to this place, moving on and off the plateau as their nomadism led them in search of food and furs and seasonally comfortable living. The place-name itself, Yellowstone, according to the late historian Aubrey L. Haines, may have come as translation of a Hidatsa phrase, *Mi tse a-da-zi*, referring to yellowish sandstone bluffs along a lower stretch of the river. In part because the plateau's high elevation made for especially severe winters, Yellowstone wasn't fought over, seized, and settled during the early waves of Euro-American invasion. Some mountain men and fur trappers saw a bit of it, including John Colter and Jim Bridger, who told

The Yellowstone region was used by indigenous people for thousands of years before Europeans arrived. The Sheep Eater, Crow, and Bannock (pictured in 1871) were among the tribes that most recently inhabited the area. When the park boundaries were established, Native Americans were actively discouraged from entering.

PHOTO: WILLIAM HENRY JACKSON, COURTESY NATIONAL PARK SERVICE, YELLOWSTONE NATIONAL PARK

President Grant signed a bill creating the world's first national park. The law, not surprisingly for its time, ignored any prior claims by the Sheep Eater or other native groups.

tales. Much later, in the years 1869 to 1871, three different expeditions of more citified white men, along with some military personnel, visited the area and were impressed, in particular, by the geysers and the canyon.

One of those men, Nathaniel Langford, was described by Haines as "a sickly St. Paul bank clerk" who made his timely exit from Minnesota and went west after a family-owned bank failed. While playing a catalytic role in the 1870 Yellowstone expedition, Langford was a paid publicist for the Northern Pacific Railroad. Another member of that 1870 expedition, Walter Trumbull, noted afterward in a magazine article that the plateau seemed promising as sheep pasture, but he predicted, "When, however, by means of the Northern Pacific Railroad, the falls of the Yellowstone and the geyser basin are rendered easy of access, probably no portion of America will be more popular as a watering place or summer resort." Langford and his cronies saw that such popularity would mean money in the tills of the Northern Pacific and of whoever else got a piece of the action, selling rail tickets, filling hotels.

The 1871 expedition, led by Ferdinand V. Hayden, head of the U.S. Geological Survey of the Territories, was more official—supported by a congressional appropriation—and included the photographer William Henry Jackson and the painter Thomas Moran, visual artists whose images subsequently helped people back East (most crucially, those in Congress) see and imagine Yellowstone. Moran created one especially thunderous painting in 1872, seven feet by twelve, "The Grand Canyon of the Yellowstone." An agent for the Northern Pacific then planted a suggestion that lawmakers protect the "Great Geyser Basin" as a public park. Hayden seized that idea and, along with Langford and other minions of the railroad, lobbied for it, as delineated in a bill encompassing not just the geyser basins but also the Grand Canyon of the Yellowstone, Mammoth Hot Springs, Yellowstone Lake, the Lamar Valley, and other terrain, altogether a rectangle of some two million acres.

The Yosemite Valley in California, which earlier had been granted to that state for protection as a state park, served as a rough precedent; Niagara Falls back in New York, on the other hand, stood as a negative paradigm. Niagara was infamous to anyone who cared about America's natural majesties, because private operators there had bought up the overlooks and blocked the views, turning that spectacle into a commercial peep show. Yellowstone, as a great public attraction promising to bring visitors and money westward, would be different.

Congress embraced what the Northern Pacific, Ferdinand Hayden, and others had proposed, and on March 1, 1872, President Ulysses S. Grant, compliant but no great advocate of scenic protection himself, signed a bill creating the world's first national park. That law, not surprisingly for its time, ignored any prior claims by the Sheep Eater or other native groups. It specified "a public park or pleasuring-ground for the benefit and enjoyment of the people," meaning implicitly non-Indian people. Within this park "wanton destruction of the fish and game," whatever "wanton" might mean, as well as commercial exploitation of such game, was prohibited. The boundaries were rectilinear, although ecology isn't. The paradox had been framed.

At a curio shop in Jackson, Wyoming, visitors pose with stuffed animals, including a brown bear—a Kodiak from Alaska, not a grizzly from Yellowstone. The desire to touch the wild, preferably without threat to life and limb, endures in many of us.

PHOTO: DAVID GUTTENFELDER

‘THIS MASSIVE SLAUGHTER’

At the outset, the park was an orphan idea with no clarity of purpose, no staff, no budget. Congress seemed to lose interest as soon as the ink of Grant’s signature dried. Yellowstone became a disaster zone, neglected and abused, for more than a decade. Nathaniel Langford, the failed bank clerk and railroad publicist, served as its first superintendent, at zero salary, and during his five years in the post he barely earned that, revisiting the park only two or three times. Market hunters established themselves brazenly in the park, killing elk, bison, bighorn sheep, and other ungulates in industrial quantities. By one account, a pair called the Bottler brothers shot about 2,000 elk near Mammoth Hot Springs in early 1875, generally taking only the tongue and the hide from each animal, leaving the carcasses to rot or be scavenged. That account doesn’t say how many grizzly bears the Bottlers killed over those carcasses, for convenience or profit, but undoubtedly the elk meat was a dangerous attractant that brought bears near guns. An elk hide was worth six to eight dollars, serious money, and a man might kill 25 to 50 elk in a day. “There was this massive slaughter that occurred here, from 1871 through at least 1881,” according to Lee Whittlesey, currently Yellowstone’s historian. Antlers littered the hillsides. Wagon tourists came and went unsupervised, at low numbers but with relatively high impact, some of them vandalizing geyser cones, carving their names on the scenery, killing a trumpeter swan or other wildlife for the hell of it. Ungulate populations fell, and then the carnage gradually petered out, Whittlesey told me, “until the Army arrived here in 1886.”

As an act of desperation, in the absence of any congressional appropriation for managing Yellowstone or any trained body of park police to enforce its rules, the secretary of the interior in 1886 asked the U.S. Army to take over. And with that event, an unlikely hero enters the story: Gen. Philip H. Sheridan.

Philip Sheridan is best known, and most infamously remembered, as a ruthless cavalry leader under Grant during the Civil War and, later, as commander of the horrific military campaigns against the Plains Indians. He advocated exterminating the buffalo as a means of crushing tribal cultures and resistance. But after he visited Yellowstone in 1882, a more appealing side of Sheridan’s character emerged. In this very different context, he deplored the slaughter of “our noble game,” evidently even the bison, and offered troops to prevent it. He also was appalled that a commercial monopoly on visitor services had been granted to the so-called Yellowstone Park Improvement Company, a new entity closely allied with the Northern Pacific Railroad. “I regretted exceedingly to learn,” he reported to Washington, “that the national park had been rented out to private parties.” And he made one radically percipient observation: Congress had made the park too small.

Returning to Washington, Sheridan led a campaign by sportsmen and sympathetic lawmakers to extend Yellowstone’s boundaries by 40 miles along the east side and 10 miles along the south. That would

Market hunters established themselves brazenly in the park, killing elk, bison, bighorn sheep, and other ungulates in industrial quantities.

have increased the park area by 2.1 million acres, almost doubling its size. More crucially, it would have added adjacent lowlands to which elk and other ungulates migrate in winter.

Carried into Congress by Senator George G. Vest of Missouri, the Sheridan proposal failed. The boundaries stood. Those boundaries were tweaked in the 1920s and 1930s, to reflect stream drainages rather than abstract linearity. But the need for safe winter range by big herbivores—especially elk and bison—remained a festering problem, and it still festers today.

THE UNTAMED

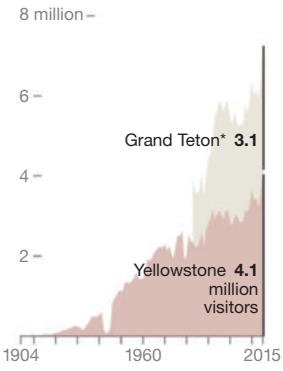
Yellowstone nowadays is a great sanctum for wild animals. The wolf is back. The grizzly bear population has rebounded since a perilous nadir in the 1970s, now filling areas of the ecosystem, including Grand Teton National Park, where it hadn't been seen in decades. The beaver has recovered from a long decline. The bison is secure, reproducing only too well, and spilling out beyond the park boundaries. Efforts have been made to protect the crucial migration corridors of the American pronghorn. Elk are abundant but not so overabundant as during the decades when they lived free of wolf predation. Bald eagles are doing well. By these measures, Yellowstone is a magnificently effective wildlife refuge.

It wasn't always so. During the late 19th and early 20th centuries, predatory animals suffered ruthless persecution within Yellowstone Park, both as a matter of neglect (while poaching was rampant) and as a matter of ill-conceived policy. The very idea that the park should protect wildlife as well as geysers and canyons was an afterthought, initially applied only to the "good" creatures, the game animals that hunters prized, the trout that fishermen wanted, the benign herbivores that visitors could comfortably admire, such as elk and deer, pronghorn and moose, bison and bighorn sheep. Although the U.S. Army had assumed custodianship of the park, it wasn't until passage of the Lacey Act in 1894—an act "to protect the birds and animals in Yellowstone National Park, and to punish crimes in said park"—that Yellowstone's caretakers had authority to arrest and prosecute poachers. The Lacey Act helped both the Army and then the National Park Service (established in 1916) protect Yellowstone wildlife, but it came almost too late for the bison.

By 1901 only a few hundred bison remained in America, about two dozen of which had found refuge in the Pelican Valley, a remote drainage northeast of Yellowstone Lake. Park officials managed to save those few, breed them with captive bison brought from ranches elsewhere, and eventually create a bison-ranching operation in the Lamar Valley—straightforwardly called the Buffalo Ranch—with its animals ranging free during summer and herded back in autumn, to spend winter in corrals eating hay. Another instance of the cultivated wild. The merits of the Buffalo Ranch were questionable from an ecological perspective, but as a reaction to the scare over bison extinction

Drawn to the Wild

Last year Yellowstone and Grand Teton National Parks together attracted more than seven million people. Visits occur year-round, though about 90 percent are from May through September.

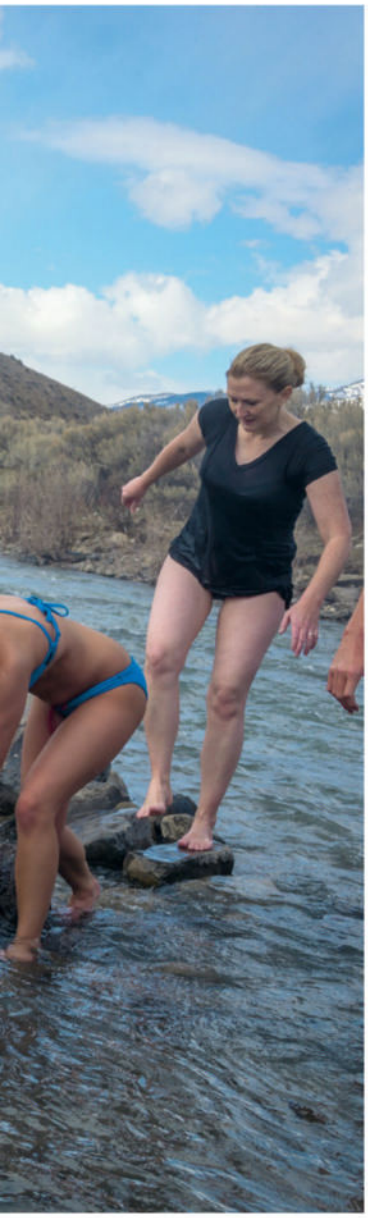


*Accurate Grand Teton data unavailable before 1983

SOURCE: NATIONAL PARK SERVICE (NPS)

The swim team from Santiago High School in Corona, California, could be horsing around in a motel pool. Instead, like legions of soakers before them, they're braving Boiling River, a kind of natural hot tub formed where water from some of Yellowstone's hot springs flows into the Gardner River. Elsewhere the park's springs can be dangerously hot: More park visitors have died in them than have been killed by bears.

PHOTO: MICHAEL NICHOLS



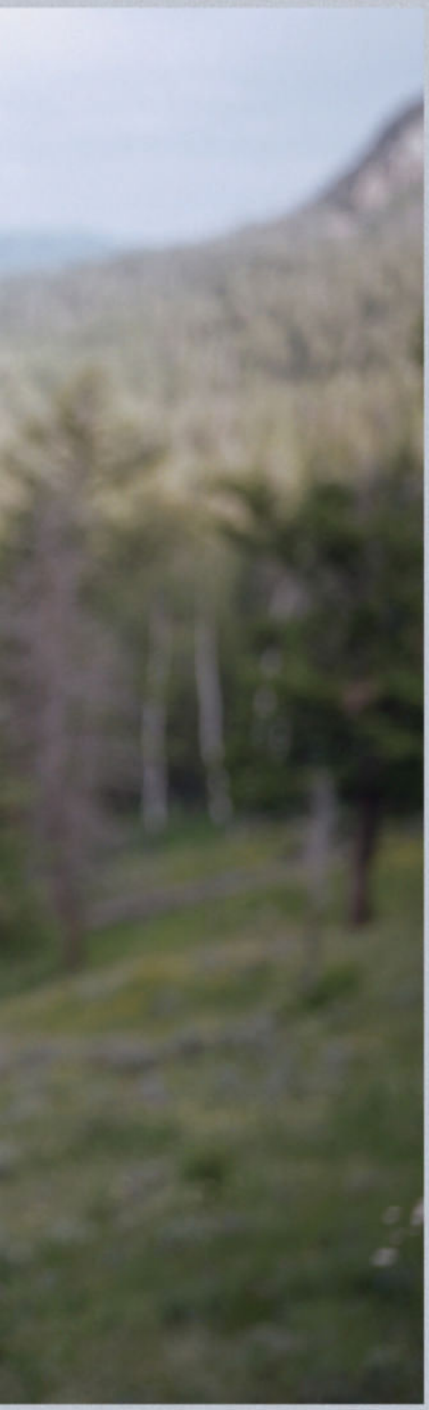
it was understandable. The ranch operated until 1952.

Horace Albright, superintendent of Yellowstone from 1919 to 1929, worried that America's elk might also face extinction, because of uncontrolled slaughter outside the park and the harsh winters they faced on the Yellowstone Plateau. Albright is remembered fondly, but his legacy, like Sheridan's, is ambivalent. He had served as a young assistant to Stephen Mather, the man chiefly responsible for creating the National Park Service, and he shared Mather's commitment to raising Yellowstone's value, and that of the national parks system generally, by increasing tourism. Large, visible herds of elk represented popular attractions, so Albright wanted them—even at the expense of other native Yellowstone animals. He instituted a program of feeding hay to elk during winter, hoping to keep them from migrating out of the park and into danger from hunters, and he encouraged his rangers to kill predators. Sport fishing was another visitor draw, so white pelicans, those nefarious trout-eaters, were suppressed by crushing eggs and killing hatchlings at their breeding colonies.

Persecution of the "bad" animals in Yellowstone dated back to well before Albright. Predators had been shot, trapped, and poisoned since the 1870s. One superintendent even encouraged commercial trappers to kill beavers by the hundreds, so that they wouldn't build dams and flood his park. Otters were classified as predatory, that damning label, and for a while there was a fatwa against skunks. During the Army years noncommissioned officers and civilian scouts were "authorized and directed to kill mountain lions, coyotes, and timber wolves," by order of the secretary of the interior. Wolf killing ended only when the wolves were all gone, not just from Yellowstone (by around 1930) but throughout the American West. Poisoning and shooting of coyotes continued until about 1935. But bears were different.

Bears were omnivorous and, as some people saw them, cute. They were also smart and opportunistic. Beginning as early as 1883, they adjusted to feeding on food refuse from garbage dumps near the park hotels, and that behavior made them easily visible and therefore a popular tourist attraction. They also learned to accept handouts from passing visitors, a trend that started in the stagecoach era and continued after private automobiles were allowed into the park, beginning in 1915. Albright himself encouraged the handouts game, leading people to think that bears—even grizzlies—were companionable, benign, and feckless. By the hotels at Old Faithful, on the lake, and near the Grand Canyon, the dumps became theaters where tourists sat on bleacher seats to watch the "bear show" on summer evenings. For 80 years Yellowstone's grizzlies and black bears consumed humans' garbage in enormous quantities, coming to depend on it unwholesomely, with the blessings of the park managers and to the amusement of the visiting public. "One of the duties of the National Park Service," Albright wrote, after succeeding Mather as head of the service in 1929, "is to present wild life 'as a spectacle.' This can only be accomplished where game is abundant and where it is tame."

But the grizzlies of Yellowstone were never tame.



Dan Wenk

SUPERINTENDENT,
YELLOWSTONE NATIONAL PARK

'All citizens of America, whether they realize it or not, are stewards of Yellowstone. It belongs to all of us... I believe we are rapidly coming to a point where one of two things is going to happen. Either we as a society agree to limit the number of visitors in order to protect resources that are incredibly sensitive to disturbance or we allow the number to grow unchecked—knowing that we are diminishing, perhaps irreparably, the very things that attract people worldwide to this one-of-a-kind national park.'

After four decades with the Park Service, Dan Wenk intends to end his career at Yellowstone. "There are few better jobs in civil service than this one," he says. "Few can ever say they got to look after the well-being of the first national park in the world. This, to me, represents the summit."

PHOTO: ERIKA LARSEN

It All Starts With Heat

The source of Yellowstone's geysers—and ultimately of the wildlife haven—lies hundreds of miles deep.

In winter Yellowstone can be a tough place for grazers; to find grass, bison sometimes use their massive heads to plow away deep snow. But along the Firehole River in the Upper Geyser Basin, snow melts faster, and green shoots grow all year in the warm soil.

PHOTO: MICHAEL NICHOLS

When producers of the first *Star Trek* movie needed a surreal backdrop to represent the fictional planet Vulcan, they chose travertine terraces near these at Mammoth Hot Springs, close to park headquarters in the northwest corner of Yellowstone. As mineral-laden water rises to the surface, new ornate layers of travertine are created, drip by drip.

PHOTO: MICHAEL NICHOLS

An Awesome Past, a Looming Presence

If you were to look only at Yellowstone's terraces of cool travertine (left) or at the geysers and hot springs that persuaded Congress to create the park, you'd get a misleadingly peaceful impression. It takes a geologist to reveal the hidden reality—to summon, for instance, the ghosts of the jagged, 12,000-foot, Teton-like peaks you would have seen if you'd stood in the park three million years ago. "They're gone because an eruption 2.1 million years ago blew them to smithereens," says Robert Smith of the University of Utah. Another massive eruption followed 640,000 years ago. It's not over, Smith says: The Yellowstone supervolcano is "living, breathing, shaking, baking."

Seismometers in the park record 1,000 to 3,000 earthquakes a year. Most are too small to be felt by humans (though a magnitude 7.3 temblor in 1959 killed 28 people). The giant caldera that Smith and other geologists have mapped—a crater left by ancient eruptions that pumped out epic volumes of lava and ash—occupies more than a third of the park's 2.2 million acres. But most visitors will drive right over the caldera's rim and never know it.

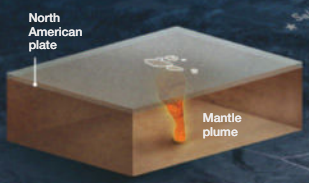
"I've long believed that when visitors come into the park they could be greeted with a sign that says, 'Welcome to Yellowstone—you're now entering a volcano,'" Smith says. "Yellowstone wouldn't be Yellowstone if not for this reality." *—Todd Wilkinson*

More than a third of Yellowstone, including Grand Prismatic Spring, sits within the caldera of a giant, ancient, yet still active volcano. Someday it will erupt again, catastrophically—but the odds of it going off anytime soon, scientists say, are extremely low.

PHOTO: MICHAEL NICHOLS

A Moveable Crust

The crust of the North American tectonic plate slides about an inch toward the southwest every year, dragging with it evidence of its time atop the plume. The plume's top layer spreads, but its base has remained in place over the millennia.



16 million years ago the plume's rising heat melted the Earth's crust, resulting in a first eruption on the surface.

12 million to 7 million years ago, as the North American plate drifted southwest, further eruptions shaped calderas that now can be found in Nevada and Oregon.

2.1 million years ago the Huckleberry Ridge eruption produced the Big Bend Ridge Caldera and with it 600 cubic miles of rock, lava, and ash. Wind spread the blast's dust around the globe.

North American plate movement

Salt Lake City

Great Salt Lake

UTAH

NEVADA

Yellowstone Calderas

Hardened lava and the sharp edges of surrounding mountains are visual reminders that the park sits on overlapping ancient calderas, the most recent 640,000 years old. Heat and escaping gases are also evidence of subterranean forces.

Picabo 10.3 million

Big Bend Ridge Caldera 2.1 million

YELLOWSTONE PLATEAU

Mallard Lake Dome

IDAHO

WYOMING

Yellowstone Lake

Yellowstone Caldera 0.64 million

YELLOWSTONE NATIONAL PARK

Sour Creek Dome

ABSAROKA RANGE

Rising gases

Upper crustal magma reservoir

1400°F

Lower crustal magma reservoir

1800°F

Mantle plume

2200°F

MAGMA RESERVOIRS

Two reservoirs lie above the mantle plume, or hot spot. The reservoirs and plume are superheated, spongelike rock holding pockets of molten material called magma. The reservoirs' heat, which originates in the plume, is what keeps Yellowstone's geysers boiling.

RESURGENT DOMES

After the formation of the Yellowstone Caldera, heat caused the crust to rise again, especially at high points known as the Sour Creek and Mallard Lake resurgent domes, formed by swelling magma beneath. Geologists measure the motion of the plateau and the domes as they rise and fall as much as three to five inches a year.

MANUEL CANALES, ANDREW UMENTUM, THEODORE A. SICKLEY, DAISY CHUNG, NGM STAFF; SHELLEY SPERRY. ART: HERNÁN CANELLAS

SOURCES: ROBERT B. SMITH AND JAMIE FARRELL, UNIVERSITY OF UTAH; DUNCAN FOLEY, PACIFIC LUTHERAN UNIVERSITY; HENRY HEASLER AND CHERYL JAWOROWSKI, NPS; JACOB LOWENSTERN, USGS; UNIVERSITY OF UTAH SEISMOLOGY AND ACTIVE TECTONICS RESEARCH GROUP (A MOVEABLE CRUST, INTO THE DEEP, MAGMA RESERVOIRS); DENNIS FEENEY, IDAHO GEOLOGICAL SURVEY (MAP FILES, LINE OF EVIDENCE, BASED ON DATA BY ROBERT B. SMITH); UNAVCO (RESURGENT DOMES)

The Fire Within

The massive, superheated plume of rock under Yellowstone has caused dozens of volcanic blasts, and fuels the Earth's largest collection of hydrothermal features. Eruptions of this supervolcano—so named for the violence and size of its explosions—expel so much material that the crust caves in, creating crater-like depressions called calderas. Evidence of past eruptions shifts with the Earth's crust, a migrating testament to the still active forces below.

Into the Deep: Supervolcano

Yellowstone's magma plume has been calculated at more than 600 miles deep, but geologic anomalies lead scientists to suspect it descends as far as 1,800 miles, all the way to Earth's outer core–mantle boundary.

A lone woman vanishes into the steam clouds billowing from Tardy Geyser in Yellowstone's Upper Geyser Basin. Geysers are formed when underground water meets superheated rock and blasts back out through a narrow hole.

PHOTO: MICHAEL NICHOLS

For the Benefit and Enjoyment of the People

The motto Congress gave Yellowstone, sometimes called the People's Park, sounds straightforward. It isn't.

A chairlift carries skiers up Snow King Mountain in Jackson, Wyoming. More than a vacation wonderland, the Yellowstone region has become a magnet for people fleeing cities for a life closer to nature. It's one of the fastest growing rural areas in the U.S.

PHOTO: CHARLIE HAMILTON JAMES

Capacity Crowds—Bigger Footprint

In 2015 the number of visitors to Yellowstone—including repeats—exceeded four million for the first time. Though the top destination remains Old Faithful, a recent study suggests visitors would be willing to pay significantly more to enter the park if they could count on seeing not just a geyser but also a bear along the road. Traffic jams generated by bear sightings can sometimes stretch for miles. All those visitors, to Grand Teton National Park as well as Yellowstone, pump an estimated billion dollars into the local economy.

Yellowstone Superintendent Dan Wenk worries that the crowds, increasingly international, need to understand more about such matters as safe interaction with wildlife. And he worries about youth. "We have to meet them where they live," he says. Millennials need to believe that it is important to preserve the park. And yet Wenk also worries that too many people come to the park already.

It's an old worry: In 1972 a *National Geographic* article commemorating the park's 100th anniversary was called "The Pitfalls of Success." Nearly twice as many visitors come to the park now as did then. The answer, Wenk thinks, isn't more hotels, roads, and parking lots. If anything, the human footprint needs to shrink to protect the wildlife the humans come to see. "What might work for Disneyland," Wenk says, "is not the antidote for Yellowstone." —*TW*

Almost like clockwork, every 60 to 110 minutes, Old Faithful shoots out a jet of steam and hot water up to 184 feet high. In summer the nearby parking lot fills and empties at about the same pace. “One of the great fears of every superintendent of Yellowstone,” says Dan Wenk, “is that Old Faithful will stop erupting when they’re superintendent.”

PHOTO: MICHAEL NICHOLS

Sports Illustrated **found an all-American setting to frame a shot for its swimsuit issue, posing model Jessica Gomes above the ageless beauty of the Grand Canyon of the Yellowstone.**

PHOTO: MICHAEL NICHOLS

In Yellowstone's Hayden Valley a classic car slows down to take in a classic scene: a bison resting in the sun by the side of the road. Large numbers of bison congregate in the area during the rut season in August.

PHOTO: DAVID GUTTENFELDER

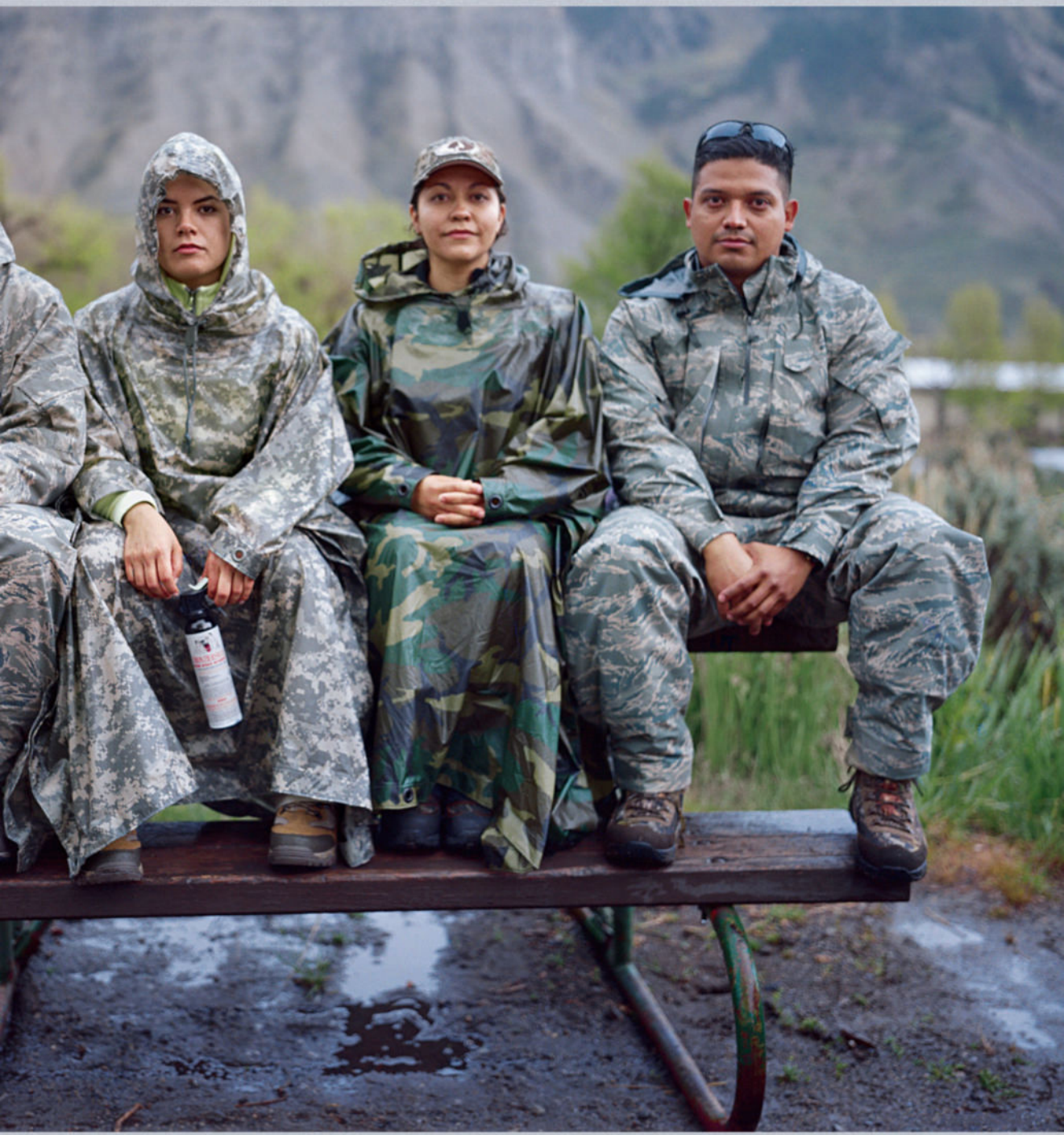
Marvin Reyes

TECHNICAL SERGEANT, U.S. AIR FORCE

'I've been deployed to Afghanistan multiple times. My wife and I had lived overseas in Germany for many years, and we had just been stationed in Wyoming in April. We went to Yellowstone as a respite from the stress of deployments and living abroad. We couldn't think of any better place to catch our breath than the cornerstone of national parks in America. What we didn't realize was that we would again have our breath taken away.'

On their first visit to Yellowstone, two Air Force men and their companions—from left, Julian Guerrero, Jennifer Meza, and Andi and Marvin Reyes—spent Memorial Day weekend camping in Yellowstone. "We saw several wild animals, which we were superexcited about," says Meza. "We hiked several beautiful trails—with my bear spray."

PHOTO: ERIKA LARSEN



Into the Backcountry

'This is what our world is trying to do away with. Right here, that look. We want to keep that look. That's what Yellowstone Park is all about.'

DOUG SMITH, *Yellowstone wolf biologist*

LOOK AT THOSE EYES

In 1995 and 1996, some 70 years after Yellowstone's last wolf howled its last howl, 31 wolves from western Canada were released from acclimation pens across the park. They took hold of the landscape, they proliferated, they thrived in the park, and spread throughout the region. Another 35 wolves were released in central Idaho at about the same time. Twenty years later roughly 500 wolves inhabit the Greater Yellowstone Ecosystem. Thirteen hundred more live elsewhere in the northern Rockies, and the gray wolf—that's the common name, although individuals vary in color from pale brindle to black—has been removed from endangered species listing in Idaho and Montana. Wolves can now be legally hunted and trapped there. (The Wyoming situation is more complicated.) Today about a hundred wolves, constituting ten packs, live primarily within Yellowstone National Park, where Doug Smith, head of the Yellowstone Wolf Project, leads the effort to monitor, manage, and protect them.

A lone member of the Phantom Springs wolf pack stands tall in Grand Teton National Park. After an absence of about 70 years, wolves returned to the park in 1998, when they moved down from Yellowstone.

PHOTO: CHARLIE HAMILTON JAMES

On a cold December morning at an airport near Gardiner, Montana, just north of the park, I buckled into the back of a cherry-red Hughes 500D helicopter beside Smith for a glimpse of the project in action. Smith has worked with wolves for 37 years, with Yellowstone's since their reintroduction, and has handled more than 500 individuals while they were tranquilized for collaring. He's a tall man with a gray handlebar mustache and crow's-feet that pinch around his smiling eyes. Seconds after we were securely aboard, the chopper levitated and then plunged toward the Yellowstone River under the touch of Jim Pope, a wildlife-capture pilot with an aerobatic flair. He leveled us off and then climbed again, sweeping south into the park, across the foothills, up over Sepulcher Mountain. Freezing wind ripped through our bubble as the treetops flashed by 200 feet below. Then we set down gently on a clear patch of snow behind Sepulcher. Pope's crew—a pair of "muggers," whose job was to fire a charge-propelled net, jump out, and tranquilize captured animals—had already immobilized two wolves.

Smith's colleague Dan Stahler was also there, working with two other biologists on the drugged wolves. Kneeling in the snow, Stahler had almost finished fitting a collar on the bigger animal, a handsome black male, maybe three years old, with a small injury over his right eye. The other was a young female, light gray with a reddish brown head. Wearing purple medical exam gloves on a day that asked for warmer

handwear, Stahler drew blood from the male's right leg, then took a small tissue sample from the right ear for DNA work, while Smith adjusted a collar on the female. Smith measured the male: right front paw, body length, upper canine tooth—a little over an inch for the last. Upper canines are the teeth that show so menacingly when a wolf snarls at an enemy. But Smith called my attention to the carnassials. "Those are shearing teeth," he said. "You don't even want to get your fingers in there when they're drugged," although that was almost precisely what he was doing. Carnassials are their key teeth, he said—edgy and powerful, for slicing meat, cracking bone.

Smith and the team moved quickly. They lifted the male in a sling to weigh him: 55 kilograms, more than 120 pounds. They grabbed a fecal sample and injected a microchip between his shoulder blades. They weighed and measured the female. They took a rectal thermometer reading. Her body temperature had gone a little low, so they put her on a plastic sheet, wrapped her in jackets, and placed chemical hand warmers in her groin area while they finished other work. When they had their data, Smith invited me to kneel in the snow beside the big male and hold up his head for a photo. Cradling the animal gingerly, I noticed that his black fur was highlighted with grizzled and silvery tips. His tongue hung out, limp as a sock. He was groggy and helpless for now, but he was magnificent.

"Look at those eyes," Smith said. They were wide open, blazing a coppery brown. "That's wild," he said. "This is what our world is trying to do away with. Right here, that look. We want to keep that look. That's what Yellowstone Park is all about."

DAZED AND CONFUSED

That's what Yellowstone's grizzlies are about too. Far from tame, as Horace Albright, that especially influential early park superintendent, wanted them, they are wild animals, powerful and well armed, jealous of their solitude, the females vehemently protective of their young. Lance Crosby's death in August 2015 serves as only the most recent reminder of that. They're also voracious—they've *got* to eat. Understanding the Yellowstone grizzly begins with considering its diet, and human flesh is an anomalous item, not even included with balsamroot and stink ant on the list of 266 items in the grizzlies' diet.

Kerry Gunther, who is Doug Smith's counterpart as bear-management biologist for the park, spoke about this one afternoon as I sat with him in the backcountry, overlooking a site that doesn't appear on the tourist maps: an odd, deep little spring that grizzlies sometimes use as a sort of bathtub. We had bushwhacked all morning to get there and eaten our lunches on a small knoll, talking of what Gunther had seen in 30 years of bear study and management in Yellowstone. He's a quiet man, judicious in his statements, confident in his science, content to let others think what they will think, and dispassionate

Wolves, Summed Up

0
Wolves in the Greater Yellowstone Ecosystem from 1927 to 1995

41
Wolves reintroduced to Yellowstone Park from 1995 to 1997

510
Minimum estimated number of wolves in Greater Yellowstone in 2014

162
Documented wolf deaths—natural and caused by humans—in the ecosystem in 2014

97
Known domestic animals—cattle, sheep, dogs—killed by wolves in the ecosystem in 2014

SOURCES: DOUG SMITH AND ERIN STAHLER, NPS

Smith called my attention to the carnassials. 'Those are shearing teeth,' he said—wolves' key teeth—edgy and powerful, for slicing meat, cracking bone.

enough to view bitter disputes in which he and other managers are stuck between critics on both flanks as "interesting."

In the 1980s, Gunther said, "every adult female bear seemed critical to the population. We were still at low population numbers." Numbers were low because the grizzly population had crashed in the 1970s, after a change in management emphasis away from Albright's yen for spectacle and toward greater attention to ecology. One signal event influencing that change was the Leopold Report of 1963, a landmark in the evolution of ideas about Yellowstone's purposes and policies, which came from a review committee chaired by Aldo Leopold's son Starker, a respected biologist in his own right. The Leopold Report, formally titled "Wildlife Management in the National Parks," wasn't the first voice to suggest an ecological approach to parks management—that idea went back to a foresighted animal ecologist named Charles C. Adams in the 1920s—but as a special advisory paper commissioned by the secretary of the interior, Stewart Udall, it carried considerable force. The report stated that conditions in each national park should be "maintained, or where necessary recreated," so as to represent "a vignette of primitive America," thereby affirming, but without untangling, the paradox of the cultivated wild. That and other factors—notably the public reaction to two grizzly-caused human fatalities, seemingly unrelated but shockingly coincidental, in a single night in Glacier National Park in August 1967—led to the closure of all Yellowstone dumps.

Shutting down that garbage buffet left the bears hungry, dazed by the sudden deprivation, confused, and reckless. They got into trouble, they suffered the consequences, their reproductive rate fell, and their population shrank drastically, to perhaps fewer than 140 throughout the ecosystem. During 1971 alone, more than 40 grizzlies were killed outside the park in various conflicts and mishaps, including bears that had been captured, marked, and released. The Yellowstone grizzly might have died out completely if the decline had continued for a decade.

But in 1975 the grizzly bear in the lower 48 was listed as threatened under the Endangered Species Act. Hunting of grizzlies ceased, at least as a legal sporting activity in the Greater Yellowstone Ecosystem, and the park adopted new policies to protect people from bears and vice versa. "We spent a lot of time managing individual bears, especially females, working really hard to try to keep them alive," said Gunther, who came to Yellowstone in 1983. That meant forestalling bear-human conflict, by practical measures such as bear-proofing garbage cans and Dumpsters, patrolling campgrounds, educating visitors not to feed bears intentionally and not to allow them to pilfer human foods. The point was to keep humans and grizzlies at a respectful distance from each other and to encourage bear reliance on the natural foods they'd begun rediscovering after the closure of the dumps. It worked. More females survived, they produced more cubs, "and the population has really turned around," Gunther said. Grizzly numbers increased within the park, and their distributional

range increased too, with bears now turning up in peripheral parts of the ecosystem where they hadn't been seen in decades. Grizzly bears are hard to count, but the latest estimate from the Interagency Grizzly Bear Study Team, in just the core area of the ecosystem (they call it the Demographic Monitoring Area), and using an arcane mathematical model to extrapolate, puts that population at 717 bears. In the entire ecosystem, Gunther said, "I think we could easily be up around a thousand." Based on such numbers, on the trend over recent decades, and on their belief that the Greater Yellowstone Ecosystem is now about as full of grizzly bears as it can be, many of the state and federal bear biologists suggest that it's time to remove the Yellowstone grizzly from the list of threatened species.

This is controversial. Everything about the grizzly is controversial. Some conservationists outside the agency circle have challenged the population estimates, the positive prognosis, and the advisability of delisting. They're concerned about the likely effects of renewed sport hunting and the long-term food security of the Yellowstone population.

Although that list of grizzly food items is extensive and diverse, just a few of the 266 deliver far more caloric intake than any others: cutthroat trout from Yellowstone Lake at spawning time, ungulate meat, whitebark pine nuts, and an unusual insect that aggregates in Yellowstone's high country, the army cutworm moth *(Euxoa auxiliaris)*. Each of those is an intricate story within the big saga.

Bears on the Rebound

After grizzlies gained federal protection as a threatened species in 1975, their numbers in and around the park grew, as did their distribution. Annual counts of females with cubs (offspring under a year old) are used to estimate the total population—now large enough that the bears may lose their protected status. The Greater Yellowstone Ecosystem is the southern limit of the bears' range, which once extended as far as Mexico.

THE OMNIVORE'S DILEMMA

The cutthroat trout is the only trout native to Yellowstone waters. Rainbow trout, browns, brookies, and lake trout are all exotics, brought in since the park was established. Yellowstone Lake was a stronghold for the Yellowstone subspecies of cutthroat, the lake's feeder streams offering shallow, well-oxygenated waters where it could spawn. Kerry Gunther's first job at Yellowstone, as a fishery technician, involved monitoring cutthroat spawners in Clear Creek, one of the major lake tributaries, where he remembers a count of around 32,000 cutthroat spawners in one spring and early summer, all clambering into the shallows to mix their sperm and eggs in gravelly spawning beds. Grizzlies, black bears, coyotes, and other predators made good use of this easy food source. The first grizzly that Gunther ever saw was a big, dark-colored bear he encountered while snowshoeing in at the start of May 1983 to count spawning cutthroat. Being on snowshoes was no doubt a good reminder that you should never try to run from a grizzly. By 2006 the season's count at Clear Creek had declined to 489 fish, less than a hundredth of the former number—therefore less than a hundredth the fat and protein available to bears fishing there. The decline continued, and spawning-fish counts in other tributaries around the lake have fallen almost to zero. Three factors, in deadly combination, account for this collapse: prolonged drought, especially affecting the

tributaries; an ailment called whirling disease, caused by a parasite new to the system; and most important, the presence of lake trout, brought originally from the Midwest.

Lake trout arrived in Yellowstone Lake some decades ago, secretly introduced, presumably by a witless sportsman meaning to enhance the park fishery. They survived, they spawned, their population grew, but the alarm bell didn't ring until 1994, when a fisherman on Yellowstone Lake caught a 17-inch lake trout. "Then everybody kind of had heart attacks," said Pat Bigelow, a fishery biologist at Yellowstone. "Because it was pretty well known that the lake trout is a voracious predator."

And a tough competitor. The big, adult lake trout in Yellowstone ate the smaller cutthroat trout and fingerlings, and before long the cutthroat population was a ghost of its former self. This was not just a trade of one trout kind for another, but a drastic shift in where the trout flesh resides. Whereas cutthroat trout hang shallow, often eating winged insects from the water's surface or leeches and other small invertebrates in those shallows, lake trout tend to lurk in the deep, feeding on invertebrates also, or other fish, and usually doing their spawning down there, rather than running up into the tributaries. So they are far less available to bears, and their replacement of cutthroat trout represents a severe loss for those grizzlies that once feasted at spawning streams.

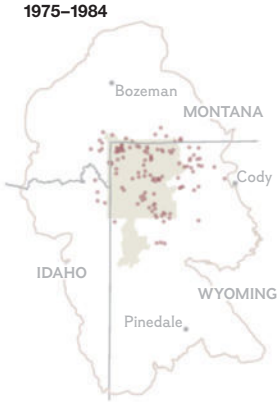
Bigelow came to Yellowstone from Vermont in 1979, as a member of the Young Adult Conservation Corps, and she remembers seeing fishermen on Yellowstone Lake catch and release 50 cutthroat in a day. That doesn't happen anymore. The catch for cutthroat is down, and if you fish there today and catch a lake trout, park regulations require that you kill it.

But sportsmen will never solve this problem. Bigelow showed me, during a long, fishy morning aboard a large, steel boat on Yellowstone Lake, how the park is trying to cope with it wholesale: by contracting a company from Baileys Harbor, Wisconsin, on Lake Michigan, to bring Great Lakes–style commercial fishing methods to the task of exterminating lake trout. For most of five hours I stood beside her, wearing orange vinyl overalls, rubber boots, and a life jacket, like everyone else. The gill nets coming up held large, greenish gray fish—four pounds, five pounds, two feet long—that could be considered beautiful animals if only they weren't exotics causing such harm to an ecosystem. I watched Bigelow and the boat crewmen wrestle these fish from the nets, measure them, count them, then slit them open with sharp knives, check for eggs, puncture the air bladders, toss them gasping and dying into plastic tubs, and eventually dump them all back into the lake, allowing the nutrients to remain in the system. Our boat had killed and dumped 238 fish by lunchtime, amounting to half a ton of lake trout. Meanwhile three other boats were inflicting similar carnage. The work was gruesome and heartless—and justified, for the sake of not just the Yellowstone cutthroat but also the grizzly.

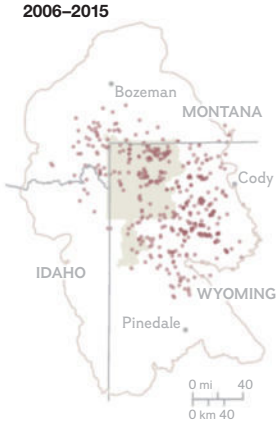
FEMALE GRIZZLIES WITH CUBS

- Initial sighting
- National Park Service
- Greater Yellowstone Ecosystem

1975–1984



2006–2015



SOURCE: INTERAGENCY GRIZZLY BEAR STUDY TEAM

A moose fords Buffalo Fork River near Grand Teton. An increase in natural wildfires and the return of wolves and grizzlies to the region have dramatically reduced the moose population. Climate change may be a contributing factor as well.

PHOTO: CHARLIE HAMILTON JAMES

These commercial boats have been working a long season each summer since 2011, and the cutthroat have begun showing modest signs of recovery. But the lake trout may never be extirpated, and so the suppression effort can probably never end. "If it fails," Bigelow said, "it'll be because we didn't try hard enough."

The loss of whitebark pine nuts from the grizzly bear menu is a more complicated concern, lying further beyond human fixing. These fat-rich little morsels—they're called nuts but are really pine seeds—come to ripeness within cones on the trees, which inhabit the Yellowstone ecosystem only at high elevations, above 8,500 feet. Whitebark pines grow slowly, reaching cone-bearing maturity after 50 years. Grizzly bears get the nuts mainly by raiding cone middens of red squirrels, which store them for winter. Clark's nutcrackers, gray-and-black birds in the crow family, also harvest the nuts and hoard them buried in little caches of several seeds each, and most new whitebark pines grow from nutcracker caches that have gone unrecovered by the birds.

The greatest enemy of the whitebark pine is the mountain pine beetle, a tiny bullet-shaped insect that burrows tunnels in a tree's living tissue, which can interrupt nutrient flow and kill the tree. Whitebark forests have always suffered episodic attacks by mountain pine beetles, but in recent years the beetle kill has gotten much worse, probably because of climate change. Severely cold weather, especially deep cold snaps that occur early in winter or late in spring, can knock down the beetle population. But that sort of weather is now rare, and since 2003 a vast beetle outbreak in the Yellowstone ecosystem has resulted in unprecedented killing of whitebark pines.

"The whole defensive strategy of the whitebark is escape," said Jesse Logan, a forest entomologist, as we stood amid a grove of whitebarks in the Absaroka Range. "It's a hell of a survivor. But it's not much of a competitor." At high elevations, in cold and harsh conditions, it largely escapes competition from other conifers—ponderosa pine, lodgepole, Douglas fir. But it doesn't escape the beetle, not anymore.

Logan's aerial surveys, done with William Macfarlane, a colleague from Utah State University, suggest that almost half the whitebark distribution in the Greater Yellowstone Ecosystem has now suffered severe mortality from the mountain pine beetle, and 82 percent has suffered at least moderate die-offs. Logan pulled some bark off a dead tree to show me the beetles' tunnels, vertical and crisscrossing, like a subway map of New York City. "My sense is that the loss of this food resource is really important to grizzlies," he said. He's not a bear biologist, and others disagree, but the issue is serious.

Army cutworm moths are more unexpected, more fortuitous in the grizzly bear's diet, because unlike whitebark nuts and cutthroat trout, they come from elsewhere. These little gray creatures migrate hundreds of miles in early summer from lowland farming areas—on the Great Plains and in the intermountain West, where in the larval stage they're crop pests—to high elevations in the Absarokas and

Bear Fare

Grizzlies are omnivores, feeding on more than 260 species of plants, animals, and fungi. Depending on location and season, their diet may include berries, grasses, thistles, fireweed, dandelions, and ants as well as trash from humans. Their highest quality meals consist of army cutworm moths, whitebark pine nuts, Yellowstone cutthroat trout, small mammals, and the carcasses of grazers such as elk and bison.

elsewhere. They spend the hot days hunkering in cool, moist recesses amid scree slopes (fields of broken, tumbled rocks) above 9,000 feet, and at night they fly out to drink nectar from wildflowers in alpine meadows. Metabolizing the nectar, they lay on rich stores of fat, enough to see them through their arduous return migration in the fall back to crop fields in Kansas, Nebraska, or wherever. A moth that arrives in the mountains in late June, having 40 percent body fat or less, can increase to 65 percent fat or possibly more by the end of the summer. Lapping up such creatures from amid the scree, for a grizzly bear, is like eating pill capsules filled with olive oil by the handful. A grizzly can consume about 40,000 moths in a day, representing about 20,000 calories, which makes the moths ideal food during the hyperphagia period of the bear's year, when it's fattening itself for winter hibernation. At that rate a grizzly feeding for 30 days on army cutworm moths can satisfy almost half its yearly energy needs.

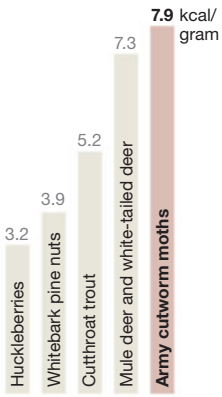
One of those moth sites lies on the northwest face of a mountain high above a beautiful little basin near the headwaters of the North Fork of the Shoshone River. On a cool day in late August, Mark Bruscino, formerly chief of large-carnivore management for the Wyoming Game and Fish Department, led a small group of us to the site, seven hours by horse into the North Absaroka Wilderness. Our packtrain had been assembled by Lee Livingston, an outfitter and county commissioner out of Cody, who rode caboose. We made camp in a glade, drank some whiskey, ate well, and awoke the next morning to find that a small, late summer storm had covered the higher slopes with a thin blanket of snow. We stood at spotting scopes all morning, watching seven grizzlies work their way across the whiteness of a scree slope far above. The bears were burly and dark, their paths turning scree brown against the white as each bear tossed aside 40-pound rocks, digging down, slurping moths, moving slowly on. For a while I watched one grizzly, his huge butt protruding in the air as he dug, rummaged, snarfed, and then occasionally lifted his head, as though to take a breath and swallow. Not far from him, a female and two cubs also fed, tolerating the male at what would be unacceptably close proximity (because male grizzlies sometimes kill cubs and eat them) under other circumstances. But they were all preoccupied now, gobbling moths, acquiring fat.

So far this year, Bruscino told me, his old colleagues had counted about 200 individual grizzlies working dozens of moth sites. That's about a fifth or a quarter of the ecosystem's grizzly population, he reckoned, all feeding on moths while they're available. His arithmetic assumed, as did Gunther's, about a thousand grizzly bears—a huge rise since the nadir of the 1970s. "To me," he said, "this is one of the greatest wildlife-restoration stories ever."

The grizzly still faces threats, Bruscino noted, but the worst is not the loss of whitebark pines nor of cutthroat trout. It's not that the moths might disappear or become poisonous if farmers in Kansas decide to use more pesticides. "The biggest long-term threat to this bear population is private-lands development," he said.

FOOD ON THE WING

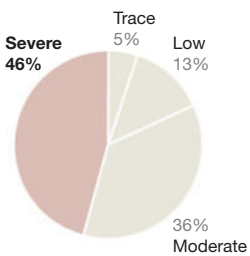
Grizzly bears get more energy—kilocalories per gram—from army cutworm moths than from any other food. The moths appear only in summer and early fall, when they fatten on nectar from wildflowers.



DYING PINES

Mountain pine beetles are killing whitebark pine trees across the Greater Yellowstone Ecosystem. Warmer temperatures have allowed the beetles to invade higher elevations, where the iconic pines grow.

Whitebark mortality



Based on a 2009 tree-mortality survey

SOURCES: KERRY GUNTHER, NPS; WILLIAM W. MACFARLANE, UTAH STATE UNIVERSITY

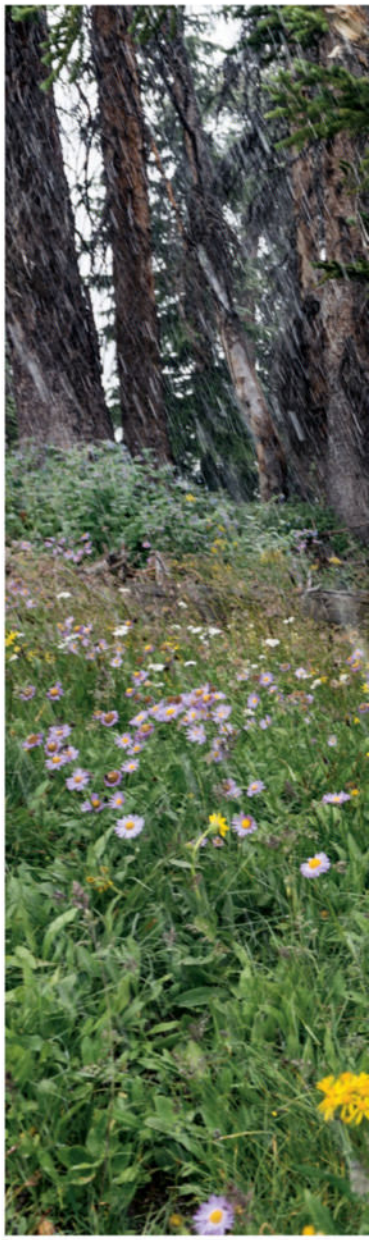
A month earlier I had ridden over a pass elsewhere in the Absarokas, southwest of Cody, to meet a young ecologist named Arthur Middleton, who was hard at work in the remote Thorofare area outside the park's southern boundary, tracing the intricate migrations of Yellowstone elk. My guide this time was Wes Livingston, Lee's brother, another backcountry horseman who grew up in these mountains and knew every creek and trail. Livingston wore a camo T-shirt, a droopy mustache, an elk-tooth necklace, a weathered felt hat that didn't even bother to look cowboy, and a titanium .44 Magnum on his belt, in case he needed to shoot an injured horse or mule. He led a string of five pack mules and an extra horse, as I followed him up a long switchback trail toward Deer Creek Pass.

It was late July, but nearing the top, we faced a dicey stretch where the narrow trail still lay buried beneath a drift of old snow. Off the left side was a steep plunge toward Deer Creek far below. Livingston stampeded his animals across, their hooves postholing into the snow, their momentum carrying them through. As I tried to follow, my horse—a steady buckskin named Jimbo—balked, floundered, and got himself turned. "Get off!" Livingston hollered, then coached me to grab Jimbo's lead rope and walk him back onto the dirt to regain his footing. I followed instructions, and eventually we all got across.

At the top of the pass we noticed a scoop shovel, stashed there for the use of snowbound hunters. Then the trail tipped down gently into a wide, meadowy valley on the Thorofare side, and Livingston laconically declared, out loud but to himself, "Didn't roll any donkeys down the mountain." I wasn't sure whether "any donkeys" referred to the mules, the horses, or me.

We joined Middleton at his camp near the mouth of Open Creek, from which he would range up into the high meadows in search of summering elk. The following morning, over a campfire breakfast, he talked of elk dynamics. The northern herd in Yellowstone Park is famous, he said, for its fluctuations between excessive abundance and relative scarcity, due partly to natural factors, including now again wolf predation, and increased bear predation, and partly to direct human actions. That's the herd most familiar to visitors, thanks to its conspicuousness along roadsides from the Hayden Valley to the grassy lawns around Yellowstone's headquarters buildings at Mammoth Hot Springs. The other herds probably haven't experienced such drastic fluctuations, for reasons that vary by herd and might include open terrain, long sight lines against predators, strong winds that blow away snow, and the animosity of private landowners toward wolves.

There was history behind this. The massive slaughter in the late 19th century took elk numbers way down, but then came an elk boom that increased under Horace Albright's protection, and then a policy reversal after elk seemed too abundant, especially on the northern range of the park, resulting in an active elk-reduction program



Trapped by an advancing high-country snowstorm in late July, elk researcher Arthur Middleton and outfitter Wes Livingston huddle next to a campfire with their dogs. The two men were traveling by horseback up Woodard Canyon in the southeastern corner of Yellowstone—a major crossroads for migratory elk herds and one of the most remote backcountry areas in the lower 48.

PHOTO: JOE RIIS

that lasted from 1934 to 1967. Whipsaw changes. During that long elk-reduction regime, park rangers shot 13,753 elk from the northern herd, private hunters killed 41,400 when the animals migrated out of the park, and almost 7,000 were trapped and shipped away to forests and zoos elsewhere. In the late 1960s the park superintendent and his chief biologist, influenced by the Leopold Report and some fashionable new thinking in ecology, embraced a policy called natural regulation. But what were the limits of "natural" in the service of "regulation"? Was it more natural to let elk starve than to hunt them? Was it more natural to haze bison back into Yellowstone with helicopters, trucks, and rangers on horseback than to ship them to slaughter so that the meat could go to Native American tribes? Hard to say. That fancy phrase "natural regulation" served to codify in two words—but not solve—the paradox of the cultivated wild.

As for wolves, reintroducing them was a bold act of management that did restore some "natural" conditions. But how far do those conditions ramify?

Attitudes toward the wolf are more bitterly polarized and complex than those around any other creature in Yellowstone. Beyond the wolf-haters-versus-wolf-lovers tussle, scientists disagree about how and to what degree wolves are reshaping the Yellowstone ecosystem. Do they reduce reproductive success among elk simply by creating a landscape of fear, wherein the great bulls and cows are too nervous to eat and procreate? Have wolves killed enough elk to curtail elk browsing on aspen and willow shoots? Has that reduced browsing allowed aspen and willow stands in Yellowstone to recover and renew themselves for the first time in decades? Has such aspen and willow recovery enabled the return of beavers and songbirds? Or is reality a little more intricate? Some scientists and wolf advocates tell this story in happy, simplistic terms. "But it's an unproven theory that gets undue attention," Middleton said, "in the quest to have wolves shine rainbows out of their asses."

Middleton is an improbable fit for the role of Wyoming elk maven: a South Carolina kid, a graduate of the Yale School of Forestry and Environmental Studies, who came west nine years ago, having landed work on a study of elk-wolf interactions commissioned by Wyoming Game and Fish. After arriving in Cody to meet his new collaborator, he admitted that he'd never *seen* a wolf or an elk. But he learned fast, and he loved the mountains. He put GPS collars on elk, clarifying poorly understood patterns in their movements between summer and winter ranges. He collated similar data from other researchers and made eye-opening digital maps. Look where these animals go. "Most of Yellowstone's elk," he said later, "are not in Yellowstone for most of the year." They're off the plateau, down on winter range, where the snow isn't so deep and the temperatures aren't so brutal, largely on private ranches. By this time Middleton had a Ph.D. from the University of Wyoming and a postdoc position back at Yale. His hair was long, his speech was slow and considered, his brow scrinched when he pondered something carefully. Within

Great Migrations

As many as 25,000 elk spend summers grazing in the region's high pastures, but fewer than 5,000 stay for the winter. The herds shown at right make up most of the elk that roam in and out of the park, representing a vital shift of resources. The elk provide food for predators such as wolves, and their own feeding affects soil fertility, the diversity of plants, and the behavior of other grazers competing for grass.

a short time at least one Cody-based game warden began referring to him as “the elk hippie.”

Middleton’s mapping of the elk data showed at least nine distinct migratory herds, each moving seasonally in a different direction. Many of Grand Teton’s elk winter in the National Elk Refuge, just north of Jackson, Wyoming. Thousands from the other herds move down onto ranches. Along the South Fork of the Shoshone River and in the upper Greybull River Basin, southeast of Cody, many of them winter on historic spreads such as the Pitchfork Ranch and the T E Ranch. From there, in summer, they migrate 50 miles across two difficult passes to reach the verdant highlands above Thorofare Creek, just outside Yellowstone’s southeast corner. That’s why Middleton was here: to find them on their summer range.

Several days into our Thorofare trip we rode up out of the valley and camped high, at about 9,200 feet, atop the Thorofare Plateau. The next morning Middleton and I went higher, picking our way through a jackstraw mess of downed timber from the great fires of 1988, our horses stepping carefully over the logs, then onto the easier footing of a meadow, amid the short grasses, the Indian paintbrush, the purple asters. Cresting a ridge, we saw about 150 elk—bulls and cows, some calves—grazing and resting on a green slope in the near distance. From the Cody herd, Middleton said. Part of what he wanted to do here, he explained, was gauge the cow-calf ratio. If 80 percent of the cows had calves in spring, and only 40 percent did now, where did those other calves go? How many had been eaten by grizzlies, how many by wolves?

And where would they go in winter if the Pitchfork and the T E and the other big ranches wouldn’t tolerate them? When the alpine grasses go brown, when the frosts hit, when the snow flies, the elk have got to come down from these highlands and all the others to find more clement conditions. But those migrations are in some danger of being choked off—as Mark Bruscino too had warned me—by private land development that turns winter range into vacation homes for the wealthy, sprawling suburbs for the middle class, and commercial areas that serve all sectors of the Greater Yellowstone Ecosystem’s growing human population. Many people understand this, at least dimly, but want to own a piece of the scenery anyway. Wes Livingston made the point pungently, as we sat drinking coffee: “It’s called the last-son-of-a-bitch clause. ‘Let me in, and then close the gate.’” Blocking the migration corridors, by settlement on lands just outside Yellowstone and Grand Teton, will interrupt an essential flow of ungulates and all the values—nutritional, ecological, aesthetic, financial—they carry.

It’s the same basic truth that Gen. Philip Sheridan recognized back in 1882, further illuminated by research such as Middleton’s: Yellowstone’s elk need the Greater Yellowstone Ecosystem, all of it, and the ecosystem needs Yellowstone’s elk.

Livingston had a piece of advice, he told me, for the righteous, out-of-state, vacation-home-owning greenies he sometimes met. If you really want to help Yellowstone wildlife, he would say, “burn your house down and go back to California.”

SOURCES: ARTHUR MIDDLETON, YALE UNIVERSITY (SEE POSTER FOR A FULL LIST OF SOURCES)

John Craighead

WILDLIFE BIOLOGIST, PIONEER OF GRIZZLY MANAGEMENT

'My God, I'd never seen anything like it. Frank and I had seen plenty of beautiful mountains in Pennsylvania, but the day our '28 Chevy topped this hill in Wyoming and we spotted the Tetons, it was like our souls got sucked right into the Rocky Mountains. We knew right then and there that our calling was out West, and that any professional endeavor would have to somehow be centered in those mountains.'

JOHN CRAIGHEAD, 2004

from *Grizzlies and Grizzled Old Men*
by Mike Lapinski

Tracking grizzly bears with radio collars in the 1950s and '60s, John Craighead and his twin brother, Frank, discovered just how far bears roamed beyond the boundaries of Yellowstone and Grand Teton. The two championed the idea that the parks should be managed as part of a Greater Yellowstone Ecosystem—an idea that took decades to catch on. Now 99, Craighead spends a lot of time in a tepee outside his house in Missoula, Montana. Frank died in 2001.

PHOTO: ERIKA LARSEN

The Carnivore Comeback

Cougars, wolves, and bears are all thriving again in Yellowstone. The whole ecosystem benefits.

Notoriously elusive, cougars vary their range in response to their prey, mostly elk and deer. In winter they favor the shallow snow in the northern reaches of Yellowstone. This cougar was caught on the prowl by a camera trap set behind an elk rack on a cliff.

PHOTO: DREW RUSH WITH THE NATIONAL PARK SERVICE

The Struggle Has Been Worth It

In the early 20th century cougars and wolves were both eliminated from Yellowstone (and wolves were practically eradicated from the lower 48 states). Now both have returned: cougars on their own, wolves reintroduced from Canada by the National Park Service and U.S. Fish and Wildlife Service. Grizzlies never vanished, but there were times in the 1970s and '80s when the Greater Yellowstone Ecosystem held as few as perhaps 140 and the population seemed doomed, says Chris Servheen, a U.S. Fish and Wildlife Service official who coordinates grizzly recovery. Today 700 to 1,000 live there, including these two hulks tangling near the Firehole River.

What saved the grizzlies, says Servheen, was the vigilance of believers—and the federal protection that came when they were listed as a threatened species in 1975. The bears' recovery has triggered a raging debate. Wolves have been taken off the list in Montana and Idaho. Should grizzlies be delisted too? Should states be allowed to manage them and perhaps permit them to be hunted for trophies?

Servheen believes younger generations, including that of his own millennial sons, will be up to defending the bears. "Grizzlies have the magical ability to burn into your memory," he says. "Most people can describe in great detail everything that happened every time they have seen a grizzly. It's a powerful, wonderful magic." *—TW*

PHOTO: MICHAEL NICHOLS

The carcass of a bison that drowned in the Yellowstone River became a feast for an alpha female (at right) of the Mollie's wolf pack and her two year-old offspring. Bringing down a live bison is dangerous; Yellowstone wolves far more often target elk, which make up 85 percent of their winter diet.

PHOTO: RONAN DONOVAN

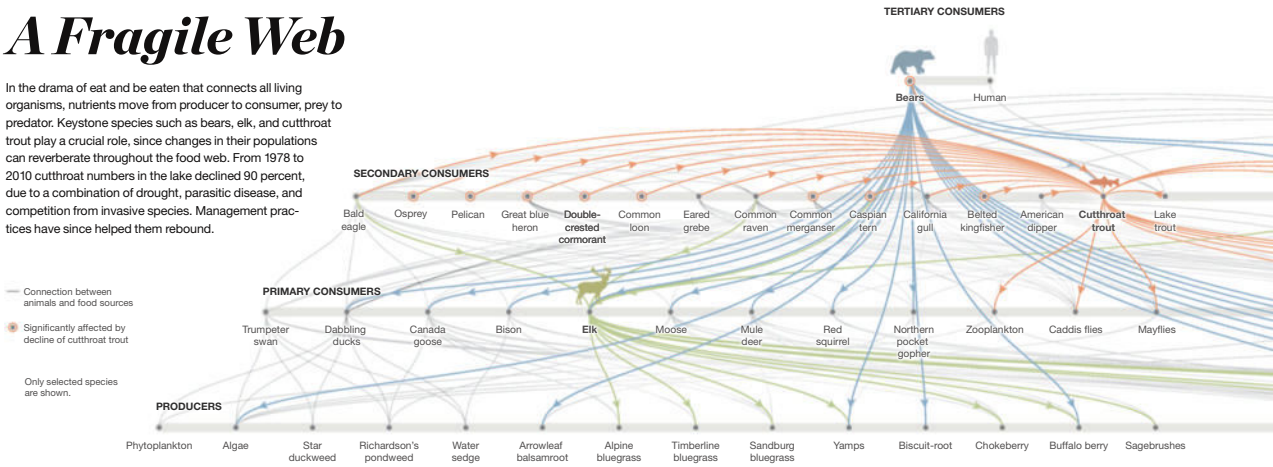
After being nearly eradicated by trappers in the mid-1800s, beavers (left) are making a comeback in the West, including in Grand Teton National Park. As climate change creates more variable weather, these wetland engineers are holding more water in the landscape, thereby bolstering biodiversity. The two-way traffic captured by a camera trap along a busy game trail above the Buffalo Fork River near Grand Teton (right) includes a cougar, a black bear, and a mule deer.

PHOTOS:
CHARLIE HAMILTON JAMES

THE CASE OF YELLOWSTONE LAKE

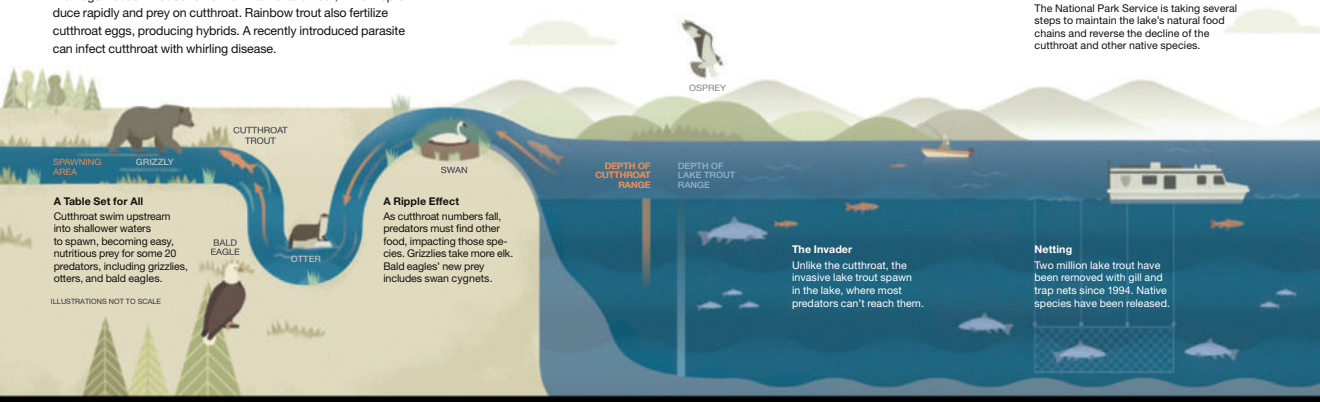
A Fragile Web

In the drama of eat and be eaten that connects all living organisms, nutrients move from producer to consumer, prey to predator. Keystone species such as bears, elk, and cutthroat trout play a crucial role, since changes in their populations can reverberate throughout the food web. From 1978 to 2010 cutthroat numbers in the lake declined 90 percent, due to a combination of drought, parasitic disease, and competition from invasive species. Management practices have since helped them rebound.



A Fight for Survival

Yellowstone cutthroat trout populations have yet to recover from the illegal 1980s introduction of non-native lake trout, which reproduce rapidly and prey on cutthroat. Rainbow trout also fertilize cutthroat eggs, producing hybrids. A recently introduced parasite can infect cutthroat with whirling disease.



A Table Set for All
Cutthroat swim upstream into shallower waters to spawn, becoming easy, nutritious prey for some 20 predators, including grizzlies, otters, and bald eagles.

A Ripple Effect
As cutthroat numbers fall, predators must find other food, impacting those species. Grizzlies take more elk. Bald eagles' new prey includes swan cygnets.

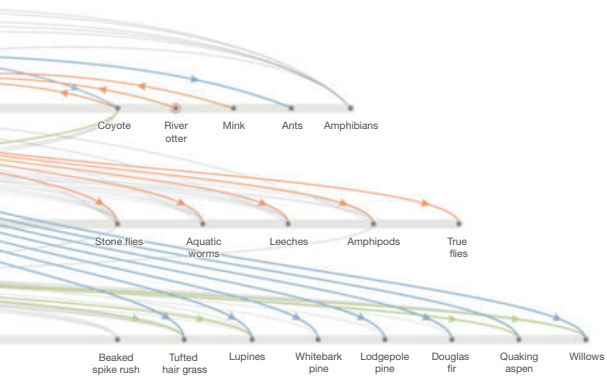
The Invader
Unlike the cutthroat, the invasive lake trout spawn in the lake, where most predators can't reach them.

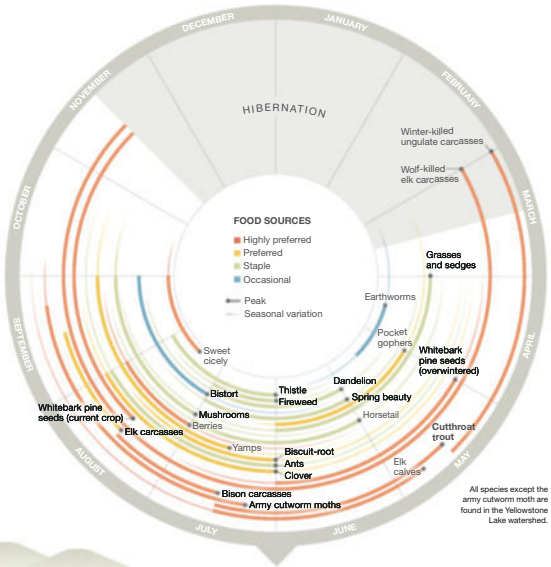
FIGHTING THE DECLINE
The National Park Service is taking several steps to maintain the lake's natural food chains and reverse the decline of the cutthroat and other native species.

Netting
Two million lake trout have been removed with gill and trap nets since 1994. Native species have been released.

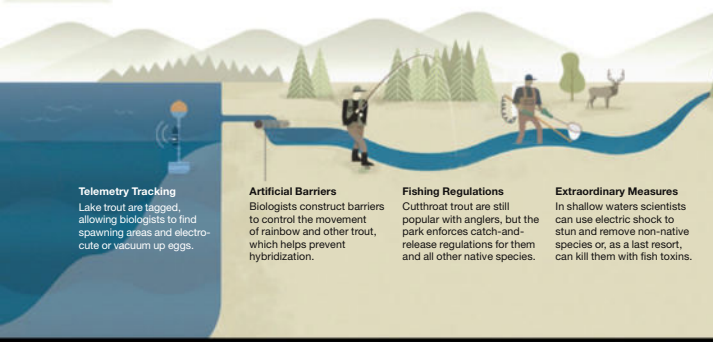
Grizzly Bear: The Opportunist

Grizzlies eat fatty cutthroat trout to regain body mass after hibernation. But bears are adaptable omnivores with highly diverse diets. Their eclectic menu makes them less vulnerable to changes in the larger ecosystem caused by factors such as climate change or invasive species.





All species except the army cutworm moth are found in the Yellowstone Lake watershed.



Telemetry Tracking
Lake trout are tagged, allowing biologists to find spawning areas and electrocute or vacuum up eggs.

Artificial Barriers
Biologists construct barriers to control the movement of rainbow and other trout, which helps prevent hybridization.

Fishing Regulations
Cutthroat trout are still popular with anglers, but the park enforces catch-and-release regulations for them and all other native species.

Extraordinary Measures
In shallow waters scientists can use electric shock to stun and remove non-native species or, as a last resort, can kill them with fish toxins.

Species known to be consumed by grizzlies in Greater Yellowstone

162	36	26	26	7	4	3	1	1
Plants	Invertebrates	Mammals	Cultivated plants and domestic animals	Mushrooms	Fish	Birds	Alga	Amphibian

MÓNICA SERRANO, NGM STAFF. RESEARCH: SHELLEY SPERRY
SOURCES: LISA BARIL, PAT BIGELOW, PHILIP DOEPKE, BRIAN ERTEL, SARAH HAAS, KERRY GUNTHER, TODD KOEL, ROY RENKIN, AND TAMMY WERT, NATIONAL PARK SERVICE

A weasel (left) blends into snow in Grand Teton. In spring it will molt and turn light brown. Cutthroat trout, seen here spawning in the Gros Ventre River, are highly prized by anglers. Adapted to cold water, they're threatened by a warming climate—and in Yellowstone Lake, by non-native lake trout.

PHOTOS: CHARLIE HAMILTON JAMES

Tracking the Wildlife Highways

The Serengeti isn't the only place on Earth to witness mass migrations of hoofed animals.

On their first migration to their summer range in southeastern Yellowstone, three-week-old calves of the Cody elk herd follow their mothers up a 4,600-foot slope. A few hours earlier they swam the swollen South Fork of the Shoshone River.

PHOTO: JOE RIIS

Members of the Cody herd traverse Thorofare Plateau—the most remote area in the lower 48—just outside the southeast corner of Yellowstone. The elk bands graze there until early autumn, when snow pushes them out of the mountains.

PHOTO: JOE RIIS

The Hoof Is the Heart

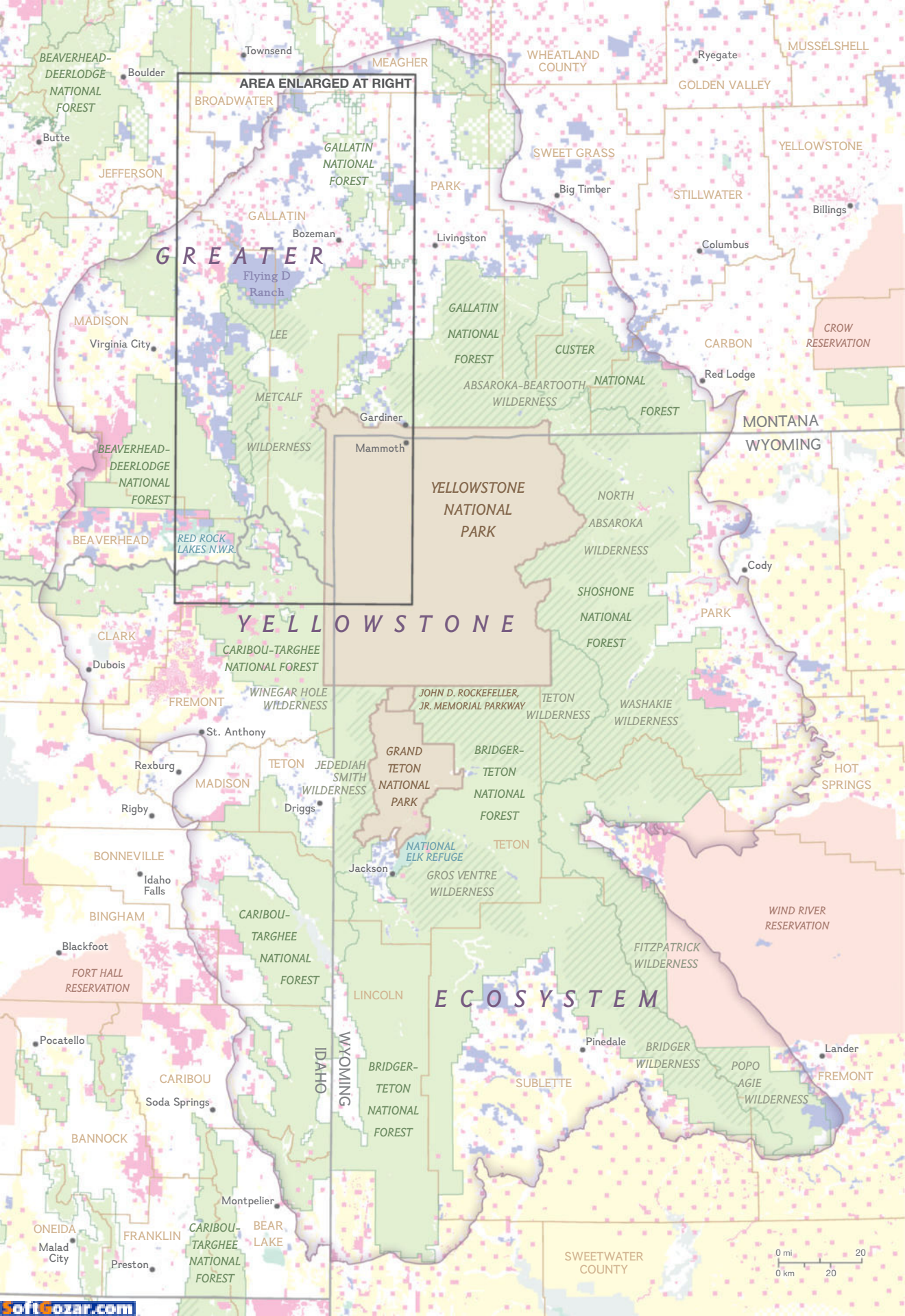
In spring hoofbeats return to the mountains of the Greater Yellowstone Ecosystem. Pronghorn, North America's land-speed champions, migrate more than a hundred miles from the Green River Valley into Grand Teton National Park. Mule deer mosey 150 miles north from the Red Desert Basin to the mountains around Hoback Basin, just south of the park. Herds of elk stream into Yellowstone Park along a web of migration routes; in October they fan back out again. Tanzania's Serengeti Plain, with its thunderous migrations, comes to mind—except these are happening in the western United States, in an expanding modern economy. And that's the challenge.

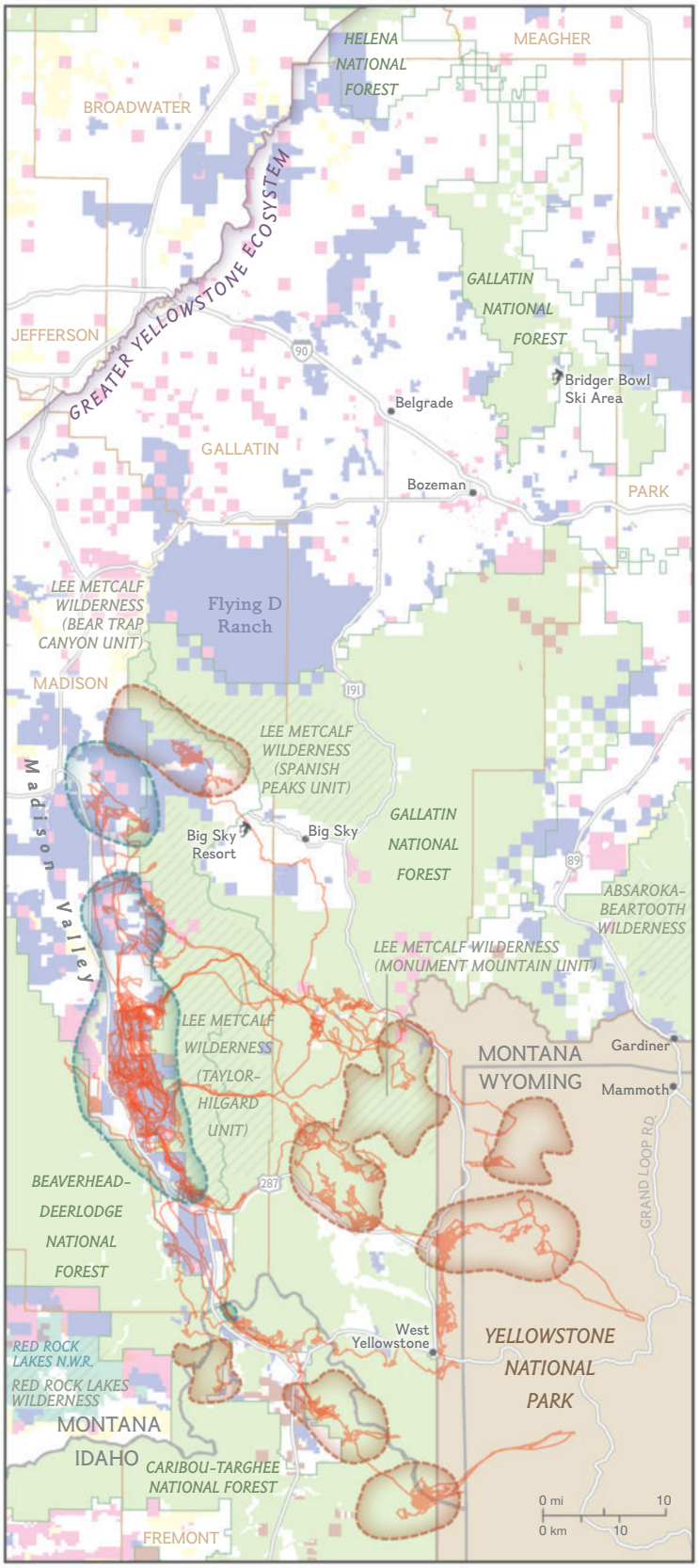
The circulation of the ungulates is like a heartbeat that pumps life into the ecosystem and "gives animation to the spirit of this amazing place," says Arthur Middleton, an ecologist at Yale. "But there is a risk of cardiac arrest." If the migration corridors are the arteries of the ecosystem, he adds, in some cases they're being constricted and blocked by myriad human developments: oil fields, subdivisions, highways, fences.

An initiative to preserve the migratory path of the pronghorn offers hope by uniting government land managers, landowners, conservationists, and hunters. Middleton and his colleagues are compiling an atlas of migrations to guide policymakers. All share the aim of allowing pronghorn to follow the paths their ancestors have followed for millennia—and even cut loose at 55 miles an hour now and then. —*TW*

Pronghorn headed to Grand Teton for the summer ford the Green River (above left). A fence stops them (above right)—but since it's wildlife friendly, with a smooth bottom wire 16 inches off the ground, they can crawl under it. Photographer Joe Riis met a doe that had leaped an unfriendly fence (right). "Luckily I was there to pull the fence apart," he says. "A lot of pronghorn die this way."

PHOTOS: JOE RIIS





Who Owns This Land?

The Greater Yellowstone Ecosystem is divided among federal, state, private, and tribal lands. Conflicting interests create a huge challenge for conservation managers. On unprotected private land—in such places as Bozeman, Montana, in Madison Valley on the western edge of Yellowstone National Park—unsustainable development is altering wildlife habitat, including elk migration routes. Yet elsewhere in the valley, private land is being protected. Ted Turner's Flying D ranch—one of more than 1,500 conservation easements in Greater Yellowstone—has safeguarded 114,600 acres.

Madison Valley Elk Herd

- Summer range
- Winter range
- Migration route

Lines represent seasonal migrations between summer and winter ranges for 11 elk in the Madison Valley herd. GPS collars collected data on their locations every 30 minutes.

Landownership

- National Park Service
- Wilderness
- U.S. Forest Service
- Private protected
- Fish and Wildlife Service
- Bureau of Land Management
- Tribal
- State and local government
- Private
- Other

MARTIN GAMACHE AND LAUREN C. TIERNEY, NGM STAFF. SOURCES: BLM; ANDREW J. HANSEN, MONTANA STATE UNIVERSITY; MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS; MONTANA DEPARTMENT OF REVENUE; NATIONAL CONSERVATION EASEMENT DATABASE; THE NATURE CONSERVANCY; USGS

Living With the Wild

'We go around telling everybody this is the most intact ecosystem in the lower 48. Well, if it's that important, it's time for us to do a lot better when it comes to protecting it.'

DAVE HALLAC, *Yellowstone chief scientist, 2011-2014*

THE CREEPING CRISIS

Dave Hallac stood in his office at the Yellowstone Center for Resources, the park body charged with science and resource management, in a rambling old clapboard building amid the formidable stone structures of Mammoth Hot Springs. A candid man with an oval face and thinning hair, Hallac was serving his last day as chief of the center—and head scientist at Yellowstone Park—before departing to a promotion elsewhere. His office had the look of farewell when I found him there, between final tasks, his shelves and desk already bare, his books and reports and photographs packed into boxes awaiting removal. He closed the door, which was a little unusual on that open-doored corridor, and as we sat amid the boxes, he repeated to me something he had said passingly a couple months earlier, something so arrestingly blunt that I had asked him to elaborate. "I think we're losing this place," he said. "Slowly. Incrementally. In a cumulative fashion." He hesitated. "I call it a sort of creeping crisis."

Kids having fun with guns, just north of Yellowstone National Park, or a sign of the times? The Yellowstone region, like much of the West, is uneasily divided over a fundamental question: Who should manage the land and its wildlife, and how, and to what end?

PHOTO: DAVID GUTTENFELDER

Hallac ticked through a list of interrelated concerns, nagging issues in Yellowstone familiar to us both: bison management, elk migration, grizzly bear conservation, private land development in the region surrounding the park, human population growth driving that development, invasive species and their impacts on native species, water use, climate change, and finally the overarching problem that exacerbates all these others—an absence of coordinated, transboundary management. "We go around telling everybody this is the most intact ecosystem in the lower 48," Hallac said. "Well, if it's that important, that special, it's time for us to do a lot better when it comes to protecting it."

This concern about the broader wholeness of the Yellowstone ecosystem, which others share (though not enough others to leverage vigorous action), is now urgent but has been a long time coming. The word "ecosystem" itself didn't appear in the 1872 act establishing the park, and probably not, either, in any of the emendations or directives about Yellowstone Park that followed for much of a century. The phrase "Greater Yellowstone Ecosystem" may have been first used in Frank Craighead's 1979 book *Track of the Grizzly,* an account of the pathbreaking 12-year field study of bears led by him and his twin brother, John. The Craigheads had absorbed, and stated pointedly, a crucial fact: that Yellowstone's grizzlies live not only within the park's

boundaries (which are unfenced and, throughout most of the landscape, unmarked) but also across a wider terrain that includes Grand Teton National Park, parts of adjacent national forests, and other surrounding lands.

Two years later the superintendent of Yellowstone, a percipient man named John Townsley, used that phrase during a friendly chat with Rick Reese, a young mountaineer and educator. "He told me that to treat Yellowstone Park as a box on a map, with no regard for threats to the park from neighboring national forest lands, was absurd," Reese later wrote. The park and its animal populations, its plants, its waters, even its thermal features, would be affected by what happened outside that box. Paraphrasing Townsley, Reese wrote that the American people "must be educated about these interrelationships and must begin to think in terms of a 'Greater Yellowstone Ecosystem.'"

Reese served as first president of a new organization, the Greater Yellowstone Coalition, an alliance of individuals and groups dedicated to conserving the broader wholeness of Yellowstone. Soon afterward, in 1984, he published a book graced with pretty photographs but made influential by serious words, titled *Greater Yellowstone: The National Park and Adjacent Wildlands*. For a while some of the government people resisted this new term, favoring instead "the Greater Yellowstone Area"—a pusillanimous compromise—possibly because "ecosystem" invoked an interconnectedness that ran against bureaucratic compartmentalization and discomfited those with a jealous sense of turf. But in the years since, even they, except the most cautious, have adopted it.

"Yellowstone National Park is not an island," Reese wrote in that 1984 book, and he was right. But it's also important to realize that the ecosystem itself *is* an island in many respects—an ecological island, surrounded by a sea of human impact. It's isolated landscape. Ravens and eagles may come and go at will, but crossing from the Greater Yellowstone Ecosystem to safe habitat elsewhere is far more problematic for the likes of grizzly bears, elk, and bison. When they step off the island, they generally die.

Who's in charge of the Greater Yellowstone Ecosystem? Everybody and nobody. There is a deliberative body, the Greater Yellowstone Coordinating Committee, but full membership includes representatives of only the federal agencies (the states, county officials, and private interests participate in subcommittees), and its powers are modest even when its consensus is firm. That's why Hallac bemoaned the absence of transboundary management in the face of the creeping crisis. "I'm not suggesting in any way that the ecosystem is falling apart," Hallac told me. "Because it's not. But it has the potential to. And there are a lot of incremental changes that, I think, are beginning to negatively affect the system."

After half an hour of such conversation, someone knocked on Hallac's door and peeked in, reminding him that he was due at his own farewell party. He invited me along, but I didn't want to intrude, preferring to skulk away and consider what he had said. Park managers come and go, even the best of them, but the problems abide.

The Greater Yellowstone Ecosystem is an island in many respects—an ecological island, surrounded by a sea of human impact. Who's in charge? Everybody and nobody.

Near Livingston, Montana, a rancher shows state wolf biologist Abby Nelson the skull of a wolf he killed. In Montana wolves have now recovered, and hunting them is legal. But hunters are required to bring in skulls so officials can keep tabs on the population numbers and set appropriate hunting quotas.

PHOTO: DAVID GUTTENFELDER

BIGGER THAN ITSELF

The Greater Yellowstone Ecosystem is bigger than any other park complex in the lower 48 states. And size matters. A resonant study published in the journal *Nature* back in 1987, by a young ecologist named William Newmark, revealed that among 12 national parks and park complexes in the western United States, all except two had lost mammal species in the years since they had been established, but that Greater Yellowstone, as the largest, had lost fewer species than almost all others. Most of those local extinctions had resulted not from direct human persecution—as the wolves of Yellowstone had been persecuted to oblivion—but from the natural processes of extinction characteristic of islands: When habitat is constrained within a limited area, animal populations remain small, and small populations tend to wink out, over time, because of accidental factors such as disease, fire, hard weather, and bad luck. Greater Yellowstone had lost less of its mammal diversity by natural attrition than had small parks such as Zion, Bryce Canyon, and Mount Rainier. Its size, evidently, had served it well.

Newmark's original work has been challenged in some particulars during the decades since, but its basic conclusion remains sound: Size matters. The size of the Yellowstone complex helped preserve big, fearsome, wide-ranging, combative animals such as the grizzly, each one of which demands a large territory. No other park in the lower 48, apart from Glacier National Park along Montana's Canadian border, now supports robust populations of the three greatest living North American carnivores—the grizzly, the wolf, the mountain lion—as well

as such other predaceous animals as the wolverine, the coyote, the bobcat, and the red fox. Yellowstone is our wildest park south of the border complex that includes Glacier, in part because it's our biggest.

The other good thing about geographical bigness is that, besides giving space to large predators with broad territorial needs, it usually encompasses habitat diversity as well as sheer space, thereby sheltering a greater variety of creatures at all levels of size, living all modes of life. That truth was reaffirmed to me by an elk hunter one December morning in Jackson Hole, Wyoming.

This hunter had killed an elk on the National Elk Refuge, which is legal by special permit (though, given the name of the place, paradoxical) and with stipulations, such as only limited-range weapons allowed on the South Unit of the refuge. "Limited range" means muzzle-loader or bow and arrow or other old-fashioned weapons, so as to demand more of the hunters and give an element of fair chase. When I spotted this fellow from a nearby road, his dead elk lay on a one-wheeled game cart and with two friends he was rolling it slowly across the bottomland toward his truck. I went striding out to talk with him—committing exactly the sort of nosy intrusion that hunters with freshly killed animals seldom welcome. Once I had introduced myself and explained the basis of my nosiness, he answered my questions genially. His name was Mitch Bock, he said, "like the beer, not the composer." He lived in Fort Collins, Colorado. He had gotten his elk—a nice cow, six or eight years old, just the sort that the refuge managers hoped to see taken—with a black-powder rifle. He had killed a cow yesterday too, under another permit. That hunt had required a four-hour belly crawl through the soggy meadowland to get near her.

I thanked him for the information and was about to leave. But wait, he said, you're from *National Geographic*? Yes. And you all are doing a special issue on Greater Yellowstone? Yes.

"Don't forget the little boreal toad," he said. It's native to Yellowstone, he explained, but like so many amphibians, isn't doing well in the modern age.

PARTS OF ONE WHOLE

Everything is connected. That's the first lesson not just of ecology but also of resource politics. The wolf is connected to the grizzly bear by way of their competition for ungulate prey, especially elk calves and adult elk that have been weakened by winter or the rigors of the autumn rut. Whitebark pine are connected to mountain pine beetles, whose population outbreaks are connected to climate change. Bison are connected to Montana livestock policy by way of a disease, brucellosis, probably brought to America in cattle. Elk are connected to the boreal toad by way of Mitch Bock.

Elk are also connected to cutthroat trout. In this case it's by way of grizzly predation, taking a bigger toll on elk—some evidence suggests—since the crash of the Yellowstone Lake cutthroat. Aspen trees and

We wanted a landscape full of living creatures as well as geysers and canyons, and by a long series of mistakes, corrections, and happy accidents, we have it in 2016.

willows are connected to wolves and grizzlies by way of the heavier elk predation, which does seem to have helped aspen and willow stands recover (notwithstanding Arthur Middleton's scorn for the simplistic version of this story) from decades of heavy browsing. Then again, decades of drought and the absence of beaver, whose "habitat engineering" raises the water table, may also have contributed to the historic aspen and willow suppression. Trumpeter swans, rare in Yellowstone, are connected to cutthroat trout by way of bald eagles, which now fly from Yellowstone Lake (where cutthroat, their favored prey, have so declined) to nearby Riddle Lake, where they feed not just on trout but also on the cygnets of nesting swans. Moose are connected to beaver because moose eat willows, but they're connected also to mule deer by way of a parasitic nematode worm *(Elaeophora schneideri),* for which mule deer are the usual host. Horseflies carry the worm from deer to deer—or from deer to moose, brokering that connection. The worm is innocuous in mule deer, but in moose it can restrict blood flow to the head, sometimes causing brain damage, blindness, and death. Grizzly bears are connected to corn farmers in Kansas and their decisions on pesticide use by way of army cutworm moths.

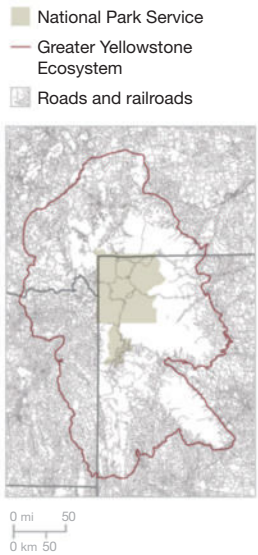
The changes that ricochet through these networks of connection, from animal to plant, predator to prey, one level of the food web to another, are known to ecologists as trophic cascades. They are a focus of interest, and disagreement, among scientists who study the wildlife and vegetation of Yellowstone, including Doug Smith and Arthur Middleton. The details of those disagreements become almost Talmudic in complexity, but what's important to keep in mind is that disturbances have secondary effects, usually unforeseen, and that sometimes those effects are irreversible. Restoring wolves to Yellowstone, for example, does not necessarily fix all the problems that removing wolves from Yellowstone caused.

Such interconnections underscore the truth of a truism: that the Greater Yellowstone Ecosystem is an intricate, interactive compoundment of living creatures, relationships, physical factors, geological circumstances, historical accidents, and biological processes. As an ecosystem, in all its glories and its troubles, its fractured relationships and the consequences of those fractures, it can teach us a lot about how nature works. Its greatest value, its fullest purpose, is not simply to freeze a picturesque place "in the condition that prevailed when the area was first visited by the white man," as the Leopold Report proposed. Why measure time from the arrival of white men? Ecosystems are continually subject to change, both from human-delivered disturbances (including those caused by indigenous peoples) and from natural ones. The long outline of the Yellowstone Caldera, nicely visible from the top of Mount Washburn, should be enough to remind us of that. In its aboriginal condition 640,000 years ago, the whole place was just a vast smoking hole.

Instead of a smoking hole, we wanted a landscape full of living creatures as well as geysers and canyons, and by a long series of visionary

The Impact of Development

Since the 1970s the human population in the Greater Yellowstone Ecosystem has boomed, bringing residential and commercial development and new roads. On private land more than 50 percent of natural habitat has been lost.



SOURCES: USGS; ANDREW HANSEN, MONTANA STATE UNIVERSITY

Bill Hoppe

RANCHER, WOLF-RELEASE CRITIC

'My great-grandfather was the first white man born in the Montana Territory. We have always lived in this area, even before there was a national park. We love this area, and we love the park. It is really when they started calling it an ecosystem that all the problems began. People from all over the world having an opinion on how this area should be managed and how we should be ranching, hunting, and living our lives. People that have never once had a grizzly at their front door when their wife walks out to go to work in the morning.'

Bill Hoppe's Montana ranch overlooks the park. Elk, bison, wolves, and grizzlies migrate across his land, and he makes part of his living guiding elk hunts. He protested the reintroduction of wolves, claiming they would devastate elk herds. Elk populations have gone down since then, and wolves have attacked his livestock. "I'm done being controversial about it," he says. "I just want to be left alone to live the way my family has lived for the past few hundred years."

PHOTO: ERIKA LARSEN

A state wildlife manager in Cody, Wyoming, checks on a problem grizzly that's been tranquilized so it can be relocated away from people. Wyoming and other states around Yellowstone argue that grizzlies have recovered enough for trophy hunting to be allowed.

PHOTO: DAVID GUTTENFELDER

acts, heroic efforts, mistakes, corrections, happy accidents, and good decisions, we have it in 2016. Superintendent Dan Wenk told me that he thinks Yellowstone National Park, for all its problems, might be in better overall shape now than at any time since 1975, the year the grizzly bear's decline was recognized with federal protection. Hallac, notwithstanding his concern with the creeping crisis, agreed.

Whether the same can be said of the Greater Yellowstone Ecosystem—that it's in better shape now than for many decades past—is more questionable. Have we vastly improved this great area since the bad old days of commercial poaching and vandalism, governmental neglect, Wild West brigandage, and railroad dreams—or have we already gone a long way toward making it a big, boring suburb with antler-motif doorknobs?

The Greater Yellowstone Ecosystem is a focus of many angers, in part because it contains so many different expectations governed by different interests. Some hunters are angry that there aren't enough elk. Some ranchers are angry that there are too many. Some wolf lovers are angry that wolves, including those that spend much of their year within Yellowstone Park, now may be hunted or trapped when they roam beyond the park boundaries. Some landowners in Gardiner, Montana, are angry that bison migrate out of the park in winter and into their yards. Some stockmen are angry that migrating bison carry brucellosis, which might be passed to their cows, although not a single case of bison-to-cow transmission has been documented. Some wildlife activists, including those of the Buffalo Field Campaign, are angry that bison from the park, once they migrate out, may be corralled and shipped to slaughter. Some range scientists are angry about overgrazed grasslands in the two parks, resulting from too many bison and elk. Some fishermen are angry about the slaughter of lake trout. Somebody somewhere is probably angry about coyotes. Scarcely a season passes, in the gateway towns of Cody and Jackson and Bozeman, without several public meetings, called by the various agencies, at which people express these angers.

One such meeting occurred this past December in a hotel conference room at Jackson's ski resort. Roughly a hundred people crowded in, interested citizens filling rows of chairs, some standing at the back, to hear scientists and managers deliver updates to an interagency committee charged with overseeing the Yellowstone grizzly bear. The atmosphere was tense and adversarial. Many people in the room had fought one another over this issue for decades. The crowd heard Chris Servheen, coordinator of grizzly recovery under the U.S. Fish and Wildlife Service (a position he has held for 35 years), explain that the Yellowstone population had reached its benchmarks—"We consider the bear recovered"—and that his agency soon would propose removing it from the "threatened" list under the Endangered Species Act.

How soon? Very, but indefinite. Delisting means that the states of Wyoming, Montana, and Idaho would be free to issue licenses to hunt grizzlies for the first time since 1975. Frank van Manen, head of an interagency science team that studies the bear, made a dispassionate presentation, which included encouraging data on current grizzly numbers and their distribution throughout the ecosystem, and

Fish and Game Rack Up the Bucks

Hunting is prohibited within Yellowstone, but it's big business in the areas that host animals such as elk when they migrate outside the park. Montana, for instance, charges out-of-state residents $1,001 for a yearly license to hunt elk, deer, and certain birds, and to fish. Anglers come from around the world to cast for trout in the region's pristine rivers. The park does allow fishing in some areas, for a fee.

Servheen discussed those data, all to a largely skeptical crowd. Other scientists and managers took their turns, answering polite questions from the committee, edgier ones from the audience. Toward the end of the afternoon, the floor was opened for public comment from any people who had entered their names on a list.

A man named Reuben Fast Horse, representing the Oglala Sioux tribe, walked to the podium carrying a small drum. His longish dark hair was pushed back behind his ears. He adjusted the microphone, took off his glasses, and began speaking in Lakota, one of the Sioux dialects. All the white people listened raptly. Occasionally we caught a word—"Europeans." Fast Horse spoke for three minutes, his speech musical but utterly incomprehensible to most of us, then came to an end point and said: "Don't worry, the rest will be in English."

He read a statement from the president of the tribe, expressing strong opposition by the Oglala Sioux Tribal Council to delisting the grizzly. This statement noted a relationship with the bear "that has existed from time immemorial," and stressed that the tribe "recognizes the grizzly as a relative, a healer and a teacher of our people, as exemplified in narratives related to our ancestors." Fast Horse added some words of his own, explaining that his Lakota people "never ate or hunted bear" anymore because, when they originally had, "the skeletal remains looked too human, too close to ourselves." Then he lifted his drum and his stick, played a strong cadence, and sang a bear song in Lakota.

Imagine you're a federal manager, like Wenk, seated at the committee table. How do you reconcile that with the metrics of population biology?

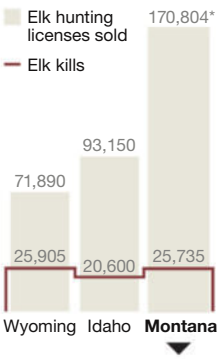
Wenk himself has concerns about grizzly delisting—not that the bear population hasn't robustly recovered, but that the negotiating process doesn't directly include the National Park Service. That process is "owned by the Fish and Wildlife Service," he told me later, with park voices left "peripheral." Will the new management regime weigh the interests of Yellowstone and Grand Teton visitors, who want to see bears, equally with the interests of hunters? Will the sheer economics of bear-watching be duly considered? What happens if a grizzly is wounded in Montana, then comes roaring back across the boundary to suffer its agonies in Yellowstone? What about visitor safety? What about perceptions? Who puts the animal out of its miseries? Who takes the heat? Does that bear count in the hunting limits?

I asked Wenk whether he had gotten satisfactory answers to these questions. He's a patient man, and a professional. He said: "Not yet."

OWNERSHIP

Wenk's concern reflects an important truth: that the people who live and work and hunt and fish and hike within the Greater Yellowstone Ecosystem—even people such as Reuben Fast Horse, whose local ancestry goes back millennia—are not the sole possessors of legitimate interest. This is America's place, and the world's. Animal lovers at the far

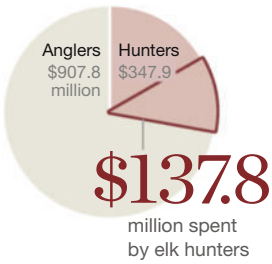
LICENSES SOLD, 2014



TOTAL ESTIMATED HUNTING/FISHING REVENUE IN MONTANA

$13.1
million in 2014 elk hunting licenses**

Estimated 2014 hunting and fishing expenditures (transportation, food, lodging, and equipment)



$137.8
million spent by elk hunters

*Includes combination licenses (elk and other game)
**In the case of combination licenses, only the elk portion is counted.

SOURCES: BRUCE B. ACKERMAN, IDAHO DEPARTMENT OF FISH AND GAME; RON AASHEIM AND NEAL WHITNEY, MONTANA FISH, WILDLIFE & PARKS; RENNY MACKAY, WYOMING GAME AND FISH DEPARTMENT

reaches of Twitter, people who have never given ten minutes' thought to grizzly bear conservation, who could never tell you the Lakota word for grizzly nor the bear's key foods in Yellowstone, are angry at Wenk for ordering the death of the sow that killed Lance Crosby in the summer of 2015. Yellowstone National Park received more than four million visitors that year; Grand Teton National Park received over three million; and having set foot in these places, such visitors feel invested—which is good. As the superintendent of Grand Teton, David Vela, said last July to a group of Latino schoolkids from Jackson who were spending a week in that park as part of an outreach program: "You own this national park. This is part of your heritage as Americans."

Wes Livingston, the mountain guide, the inveterate hunter and antler collector, the detester of government regulation, the despiser of fatuous liberals and whiny cattlemen, captured much the same spirit one evening in camp up in the Thorofare. Livingston views the park as a single big ranch, managed for desirable animals. In other words: the cultivated wild.

"Who owns this ranch?" I asked.

"We do," he said.

"Who is 'we'?"

"The United States of America. The citizens of America, the taxpayers."

"Does an outfitter in Cody own it more than a wolf hugger in New Jersey?"

"Absolutely not," Livingston said.

If the wolves provoke varied angers, and the ownership matter is more consensual, other issues stir quiet worries. Agency biologists such as Mark Bruscino worry that the loss of big private ranches to subdivisions will destroy migration routes and winter ranges of public wildlife. Some grizzly bear advocates worry that, with declines in certain major bear foods, delisting and the hunting to follow will doom the Yellowstone grizzly. Others worry that *failure* to delist the bear, despite its robust recovery, will only further inflame resentment against the grizzly among people with whom it shares habitat and will undermine the Endangered Species Act itself. Bird lovers worry that the trumpeter swan may be eradicated from Yellowstone. Some herpetologists, along with Mitch Bock, worry that an exotic fungus or climate change, or both, may kill off the boreal toad. Wildlife veterinarians worry about the approach of chronic wasting disease, a bizarre affliction similar to mad cow disease, spreading northward toward Greater Yellowstone among mule deer. Tourists worry that, amid the summer crowding, they won't get a room at Lake Hotel or the Old Faithful Inn. Rangers worry that still another clueless tourist will be gored while taking a selfie in front of a bison. Hallac worries about the crisis creeping across Yellowstone and whether it will slowly ruin the park.

As if that weren't enough, some people worry (despite reassurances from experts such as Robert Smith) that the Yellowstone supervolcano

Consequences of Climate Change

Warmer temperatures are affecting the park in two critical ways. More days above 32°F mean a longer growing season, which influences the blooming of plants, the arrival of pollinators, and the length of the fire season. In many areas warmer winters have resulted in less snowpack, measured by the amount of water the snow holds. Monitoring stations with more than three decades of data have recorded fewer days with snow each year and a decline in the peak amount of snow.

will explode again soon, incinerating everything and everyone within 200 miles.

And me? My concerns focus on the grizzly bear, because I consider this the highest and best purpose of Yellowstone Park and the Greater Yellowstone Ecosystem: to preserve a viable population of that great, terrible animal at the center of the American West into the indefinite future. But I no longer share the extreme pessimism of bear-advocate friends of mine, like Doug Peacock and Dave Mattson, nor their distrust of Kerry Gunther, Mark Bruscino, Chris Servheen, and the other conscientious agency biologists I've met, who believe that the bear's intelligence and flexibility of behavior will keep it robust and numerous despite changes in the landscape that require greater reliance on some different foods.

After all, they say, the grizzly is an omnivore, and three major dietary items—the trout, the pine nuts, the moths—have never been available to all of Yellowstone's bears every year, nor even to many bears during some years. Whitebark pine nuts come and go in cycles. Spawning cutthroat offered nothing to bears on the west side of Yellowstone, distant from the lake. Likewise with army cutworm moths: Many grizzlies exploit them, but not all grizzlies.

Change may come, these scientists say, but the bear will adapt to the challenge. Dan Wenk is right, though, that the devil could be in the details—that the opaque process of delisting and the return of responsibility to the states contain potential harm to the grizzlies, and to the public's interest in them, against which there must be guarantees.

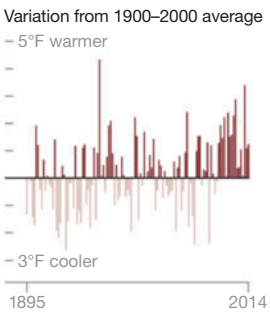
Meanwhile we the owners of Yellowstone National Park, and of Grand Teton, and of the national forests and other federal lands of the ecosystem, face some new challenges of our own. The parks need more funding for the impossible work they do; only a fraction of their operating and improvement funds comes from Congress, whereas crucial initiatives such as the Yellowstone Wolf Project are supported by private money, through "friends" organizations such as the Yellowstone Park Foundation. The parks need political support for hard decisions, such as the one that may come when, because of overcrowding, private automobiles are no longer allowed to enter. Sorry: Get on the shuttle.

The most heated wildlife issues, notably grizzly and bison and wolf, need collaborative solutions, not continuing warfare. Passionately dedicated people need to recognize that righteous intransigence is not a strategy; it's just a satisfying attitude. The various agency members of the Greater Yellowstone Coordinating Committee need to add private groups as partners and to make bold decisions that transcend turf politics. Climate change seems to be hurting Yellowstone—by way of temperature ranges, insect cycles, drought, who knows what else—and we all need to do better on fixing that.

Ha, easier said than done. But if the Yellowstone grizzly bear is expected to adapt, modify its behavior, and cope with new realities, shouldn't we be expected to do that too?

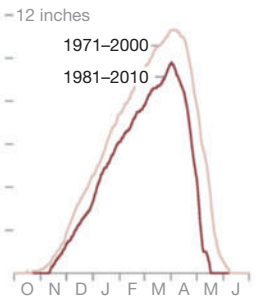
WARMING CLIMATE

Deviation from average annual temperature in the Greater Yellowstone Ecosystem



DECLINING SNOWPACK

Snow's water equivalent, 30-year averages*



*Measured at Northeast Entrance

SOURCES: TONY CHANG, MONTANA STATE UNIVERSITY (PRISM DATA SUMMARY); USDA SNOW TELEMETRY (SNOTEL); MIKE TERCEK, WALKING SHADOW ECOLOGY

Leo Teton

MEMBER OF THE SHOSHONE-BANNOCK TRIBES
FORT HALL RESERVATION, IDAHO

'What does the buffalo mean to me? In the 1800s the buffalo was almost extinct due to the killing by the white men. But today we still use the buffalo in all our ceremonies. As a sweat lodge owner, I use the buffalo skull in my lodge. I place the buffalo skull in front of my doorway on a dirt mound. This altar represents strength and good, long, healthy life to all those who enter. I got this buffalo skull in a hunt we had in Wyoming in the winter. Once the buffalo was down, we gave the buffalo a good blessing with tobacco and drank the blood from the heart for blessings and strength to the hunters. We pray for the buffalo to have a good travel to the other side, the animal spirit world.'

At Fort Hall, Idaho, outside a sweat lodge where Shoshone-Bannock tribe members gather for purification ceremonies, Leo Teton stands next to a pole ornamented with bison skulls. The animals were taken near Yellowstone in hunts that express their spiritual connection to the animal and affirm long-standing treaty rights. Bison loom large as sacred animals in traditional Native American customs and rituals.

PHOTO: ERIKA LARSEN

The Dance of the Bison and Elk

Two magnificent grazers are thriving inside Yellowstone—but their fates diverge outside the park.

At a ranch in southwestern Montana, Robbie Magnan and other Fort Peck tribe members ceremoniously butcher a Yellowstone bison, removing its heart. Surplus park bison were kept at the ranch before going to the Fort Peck Reservation. This male was too dangerous to transport.

PHOTO: DAVID GUTTENFELDER

Bison and elk share winter ranges in Greater Yellowstone—these are in the National Elk Refuge near Jackson, Wyoming. Both can carry brucellosis, a threat to cattle. But elk are prized as game, whereas thousands of Yellowstone bison have been slaughtered in Montana because some consider them a menace.

PHOTO: CHARLIE HAMILTON JAMES

A Disease Becomes a Stigma

Among the obstacles to allowing Yellowstone bison to migrate freely in and out of the park, as they would do naturally, is that some exhibit evidence of exposure to brucellosis, a bacterial disease that can cause pregnant cows to abort their calves. Cattle ranchers in Montana worry that their own herds, now disease free, could become infected if they mixed with Yellowstone bison on public grazing lands. The irony is that bison originally contracted brucellosis from domestic cattle—but in the past 30 years there have been no documented cases of Yellowstone bison directly transmitting the disease back to livestock.

After decades of conflict over the issue, Governor Steve Bullock announced in December that Montana would allow about 600 bison to migrate out of the park onto public lands—and that some 200 would be able to remain there year-round. In the meantime state and federal agencies have been reducing Yellowstone bison numbers by consigning some to slaughter. Native Americans are allowed to hunt bison just outside the park, and some bison that tested negative for brucellosis were shipped to the Fort Peck Reservation in northern Montana, where tribal officials are working, under established testing protocols, toward re-creating a wild herd.

Unlike bison, elk are allowed to migrate freely, despite the fact that they also carry brucellosis. That's because big game hunting in nearby states is big business. —*TW*

Bison are herded single file into a chute (above left) on Ted Turner's Flying D ranch. A Yellowstone bison held temporarily at the ranch is retested for brucellosis (above right). When two of the ranch's own commercial bison recently tested positive—infected by wild elk grazing the same pastures—they were euthanized and then necropsied at a lab in Bozeman. A fetus was removed from one (right).

PHOTOS: DAVID GUTTENFELDER

The side of a harvested bull elk and its prized antlers are transported the old-fashioned way—by mule. More than 72,000 hunters came to the lands around Yellowstone and Grand Teton in 2014, many enlisting guides to equip them and lead them to their quarry.

PHOTO: DAVID GUTTENFELDER

A few feet outside Yellowstone—the snowy trail is the park boundary—a hunter from Australia lies in wait for elk returning toward the safety of the park. Hunters flock from around the globe to Greater Yellowstone for the autumn elk season, pumping millions of dollars into the economy. For many locals the hunt is also a cherished tradition—and a chance to fill their freezers.

PHOTO: DAVID GUTTENFELDER

A Reservoir for Big Game

"No sportsman can ever feel much keener pleasure and self-satisfaction than when, after a successful stalk and good shot, he walks up to a grand elk lying dead in the cool shade of the great evergreens," Teddy Roosevelt wrote in 1885 of a hunting trip to the region, one of the few left in the West where big game hadn't been decimated. Since then the park has served as the wild heart of the ecosystem and as a summer range for wildlife from adjacent lands. The "North American model of wildlife conservation," as some call it, established wildlife as a public trust.

Hunting-license tax revenues bolster the model. Tens of thousands of elk inhabit the larger ecosystem; up to 25,000 spend summers in high pastures. "The quality and diversity of hunting opportunities in Greater Yellowstone today is a testament to a still functioning natural landscape," says Randy Newberg, the Bozeman, Montana-based host of a popular television hunting program. When locals benefit from wildlife on the landscape, he notes, they're more passionate about protecting it.

Roosevelt was passionate. "Every believer in manliness…every man who appreciates the majesty and beauty of the wilderness and of wild life," he wrote, "should strike hands with the far-sighted men who wish to preserve our material resources… from wanton destruction." —*TW*

Land of the People

Old and new ways of living with the wild come together in the Yellowstone region. They make uneasy neighbors.

In a rodeo parade at the Teton County Fair—a highlight of the summer in Jackson, Wyoming—cowgirl queens carry the flag. In addition to the rodeo, beloved by tourists and old-timers alike, the fair features traditional pastimes such as 4-H shows, pie-eating contests, and pig wrestling.

PHOTO: DAVID GUTTENFELDER

WEST YELLOWSTONE, MONTANA

A Region in Transition

You can still catch a rodeo in the region around Yellowstone. Ranchers still gather at saloons to two-step on Saturday night. And the sight of a pickup with a dog and a rifle in the back may never go away.

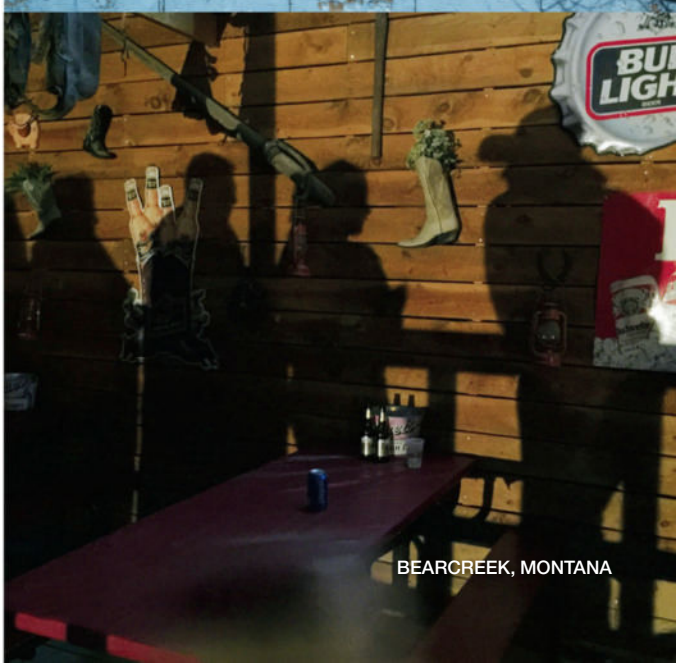
But the economy and culture of the region are changing fast. "Greater Yellowstone's growth is all about the 'new economy,'" says Randy Carpenter of Future West, a conservation organization in Bozeman. "The Old West economies, defined by mining, forestry, and ranching, are stagnating, while Bozeman and Jackson are growing like weeds."

For the "lifestyle pilgrims" moving to those boomtowns, remoteness is no longer an obstacle; they can telecommute in the morning and fly-fish, hunt, or ski in the afternoon. "People want to live and recreate next to spectacular, largely unspoiled landscapes," says economist Ray Rasker of Headwaters Economics. "The thing we need to figure out is how to deal with an unprecedented wave of newcomers and not turn Greater Yellowstone into the places they fled from." Rather than resist inevitable change, the key to success may lie in embracing the future and staying smart. —*TW*

PHOTOS: DAVID GUTTENFELDER

LIVINGSTON, MONTANA

VICTOR, IDAHO



BEARCREEK, MONTANA

WEST YELLOWSTONE, MONTANA

GALLATIN NATIONAL FOREST, MONTANA

CORWIN SPRINGS, MONTANA

Hilary Anderson cuts a classic figure as she rides the range above the Anderson Ranch in the Tom Miner Basin, north of Yellowstone. But her purpose is practical: to deter predators by keeping cattle bunched and by showing a human presence on the land.

PHOTO: CORY RICHARDS

Becky Weed

RANCHER, BELGRADE, MONTANA

'We can pick our poison. Castle-building landowners who are busily resurrecting a feudal society while chopping up habitat. Ranchers and politicians who are too quick to put wildlife in the crosshairs as a scapegoat for deeper ills in our agricultural economic system. Energy companies' boom-and-bust frenzies. The press of all the rest of humanity. It's hard to condemn any one sector without acknowledging the warts and complicity of any other, but collectively we're degrading the magic that makes this region unique. Can we slow down, scale back, and proceed with less of an air of entitlement? The carnivores that seem the most threatening these days are the two-legged kind.'

Becky Weed and her husband, David Tyler, raise sheep on pastures not treated with chemicals. They ranch with a guard dog to ward off coyotes, bears, and mountain lions. Their customers pay a premium for organic lamb, and they sell "predator-friendly" wool products made in the fiber mill on their farm. Weed and Tyler strive to make old ways new—and are not alone in their effort to live peacefully with predators.

PHOTO: ERIKA LARSEN

This band of 1,400 sheep spends the summer grazing season in the Gravelly Range of Montana. They're tended by three ranchers along with a sheepherder and two Akbash guard dogs. Constant vigilance replaces bullets as a way of deterring predators.

PHOTO: DAVID GUTTENFELDER

Four-year-old Elle Anderson chases a ball and a future near her family's house on J Bar L Ranch in Montana. "A hundred years from now," says Hilary Anderson, "I hope this place is a thriving ecosystem full of everything that should be here—wolves, bears, humans, livestock."

PHOTO: LOUISE JOHNS

THE VIEW FROM THE BEGINNING

Any backcountry trip in the Greater Yellowstone Ecosystem is a rare privilege,

and mine to the Thorofare with Arthur Middleton and Wes Livingston had moments of pure savor beyond the science. With his elk calves counted, Arthur and I rode still higher on the Thorofare Plateau, above our camp, above the summering elk, until the rising swell of land crested as a narrow ridge at about 10,300 feet. I was amazed that backcountry horses could climb so high and keep their balance on such footing, but I tried not to think about that. Gnarled whitebark pine, much of it dead but some alive, formed a thin windbreak along the ridge. We crossed rocky ground, and meadows enlivened by Indian paintbrush, and then patches of mud, just melted out from beneath last winter's snow, where in a week or two fresh alpine grasses might grow. The vista around us, through 360 degrees, was epic.

I turned in my saddle, trying to see it all: the Absaroka Range to the northeast, the Trident Plateau just across Thorofare Creek, Yellowstone Lake in the distance beyond that, and even farther, the Gallatin Range. I cranked around. Westward was Two Ocean Plateau, then the Grand Tetons to our southwest, with the Grand itself rising to 13,775 feet, unmistakable in height and profile above the Snake River and Grand Teton National Park. Coming toward us from the south: the highest reaches of the upper Yellowstone River. Arthur pointed across the Castle Creek cirque to where, along a north-facing rim, sizable cornices and couloirs of snow still lingered, shedding their melt to the streams below. This was late July. Look at all that water, he said. It drains to the big river. It grows the grass to feed the elk.

To feed the whole thing, I thought: all the processes, all the players. The photosynthesis and the herbivory and the predation and the competition and the migration and the parasitism and the decomposition, everything downstream, everything that moves into Yellowstone and across it and back out. Seems almost like this is where the ecosystem begins, I said.

"If an ecosystem 'begins' anywhere," Arthur agreed, "this would be it."

For every beginning in the natural world, there is an ending, and then a beginning again. Does that robust cyclicity hold true even when nature's wildness is cultivated by people? Maybe. If the cultivation is judicious, humble, and wise. We're up so high here, atop the Thorofare Plateau, you and I and Arthur Middleton, that a person can almost see the future. □

Old Faithful throws a tower of steam into a moonlit sky. Americans rely on the geyser's steadfast eruptions the way they've come to rely on the park itself, as an enduring image of what the continent once was and still can be.

PHOTO: MICHAEL NICHOLS

natgeo.com/yellowstone

Extend your park stay with online videos, interactives, and behind-the-scenes tales.

A camera trap captured this Yellowstone grizzly taking a dip with her cubs, in a backcountry swimming hole frequented by both grizzlies and black bears.

Bathe With the Bears

Get a rare glimpse—caught by hidden cameras—of grizzlies and black bears cooling off in a remote Yellowstone pool.

Roam Free

Experience the park from a different perspective, where animal migrations push through boundaries and fences don't apply.

Follow the Elk

GPS information from radio-collared elk was used to map seasonal migrations of nine herds to and from the Yellowstone high country.

Relive an Attack

Rancher Nic Patrick shares the story of the grizzly attack he survived near his Cody, Wyoming, home.

Explore the Supervolcano

When glacial waters flowing under ancient rocks get close to reservoirs of magma, the heat powers geysers, including Old Faithful.

Be the Bear

Track hungry bears across the Greater Yellowstone Ecosystem, and see what video collars reveal about these omnivores' diet.

Go Behind the Camera

You've seen the pictures. Now meet the photographers who took them, and find out what it's like to be on assignment in Yellowstone.

NATIONAL GEOGRAPHIC TRAVELER

Join a Parks Odyssey Take the ultimate U.S. road trip with photographer Jonathan Irish as he visits all 59 national parks in 52 weeks.

PHOTO: MICHAEL NICHOLS WITH RONAN DONOVAN AND THE NATIONAL PARK SERVICE

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THERE IS NO AWAY.

If only there were a magical place we could send all our garbage, where it would never come back to haunt us. Sadly, this "away" doesn't exist. Nobody understands this better than our National Parks. Each year, visitors add over 100 million pounds of trash to our nation's landfills. Despite this, there is reason to celebrate. Over a decade ago, Subaru became the first U.S. auto manufacturer to become zero landfill, and now, in collaboration with the National Park Service and the National Parks Conservation Association, Subaru is leveraging that same environmental expertise to help the parks get to zero, too. It won't be easy, but with your help, we believe we can make sure these crown jewels of America are gleaming for generations to come.

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