03.2022

NATIONAL GEOGRAPHIC

INTO THE DEPTHS

Searching for shipwrecks from slavery's hidden past–
to help heal the present

PURINA®
PRO PLAN®

PRO PLAN IS
ALWAYS ADVANCING
NUTRITION

Purina trademarks are owned by Société des Produits Nestlé S.A.

GAME-CHANGING FORMULAS
deliver remarkable benefits to keep pets at their peak.

See how we're advancing digestive, immune and cognitive health at ProPlan.com.

ALWAYS ADVANCING

PURINA Your Pet, Our Passion.®

CONTENTS

On the Cover
National Geographic Explorer Tara Roberts, here in the Florida Keys, dives with a group that's reclaiming the stories and artifacts of African captives transported on slave ships.
PHOTO: WAYNE LAWRENCE

PROOF

EXPLORE

FEATURES


BORN FOR THIS
TOYOTA
THE ALL-NEW
TUNDRA
Prototype shown with options. Model shown available spring 2022; other models available December 2021. Off-roading is inherently dangerous. Abusive use may result in bodily harm or vehicle damage. Wear seatbelts at all times and do not allow passengers in cargo area. Payload includes the weight of occupants, cargo and options; limited by weight distribution. Trademarks shown are those of their respective owners. ©2022 Toyota Motor Sales, U.S.A., Inc.

Who Gets to Tell the Story Matters

BY **SUSAN GOLDBERG**
PHOTOGRAPH BY **WAYNE LAWRENCE**

In Edenton, North Carolina, National Geographic Explorer Tara Roberts visits her grandparents' former home, now empty. This issue's cover story was written by Roberts, whose research on the transatlantic slave trade inspired her to investigate her own roots. Among the facts she's unearthed: Her ancestor Jack Roberts fought in the Civil War in the U.S. Colored Troops and was a delegate to the 1865 North Carolina Freedmen's Convention.

Scan this QR code to listen to the podcast series *Into the Depths,* about Roberts's journey following Black divers exploring slavery's past.

THE ATLANTIC OCEAN, Tara Roberts writes, is full of "souls who have never been acknowledged or mourned. Dreamers, poets, artists, thinkers, scientists, farmers."

And so begins a powerful essay of discovery: this issue's cover story and a special six-part Nat Geo podcast called *Into the Depths.* Roberts, a National Geographic Explorer, has traveled coastal waters from the United States to South Africa to Costa Rica, searching for what remains of the ships that an estimated 12.5 million Africans were forced onto during four centuries of the transatlantic slave trade.

Roberts seeks signs not just of those captives who arrived on the Americas' shores—but also of the 1.8 million people who perished along the way from inhumane conditions in cargo holds or by drowning in shipwrecks.

Roberts participates in these searches with a group called Diving With a Purpose, which trains divers—most of them African American—to locate, document, and conserve artifacts they find in the water. They are looking for what remains of ships such as the *São José Paquete d'Africa,* a Portuguese vessel bound for Brazil that sank off Cape Town, South Africa, in 1794. Many of the 512 captives jammed in the ship's cargo hold were from the Makua ethnic group of northern Mozambique. Two hundred twelve went down with the ship, their stories lost to history.

"In some ways, there's so much we know about slavery," says Lonnie Bunch III, the secretary of the Smithsonian Institution and founding director of the National Museum of African American History and Culture in Washington, D.C. "But there's so much we still don't know. And I would argue the last frontier is what's under the water."

For Roberts and many other Americans whose ancestors were enslaved, deep dives into the past could provide both new information on the slave trade and a new perspective: Who gets to tell the story matters—in terms of which facts are included, what's emphasized, what's glossed over. And history, as most of us have read it over the years, largely has been shaped by an unrepresentative group of narrators.

As Roberts puts it, "We know very little about the people in the cargo hold, except the horrors. I wonder if Black divers would notice different details. If they would focus on finding artifacts that help us understand the full humanity of the captive Africans."

Ultimately, Roberts's journey into the past compels her to investigate her own roots. The last part of her story is set in Edenton, North Carolina, the home of her great-great-grandparents Jack and Mary Roberts, who were both born enslaved.

I cannot do justice to Roberts's moving history, neither will I reveal what she discovers. I'll let Roberts tell you herself, beginning on page 36. As in many of the most important stories, what she learns doesn't make itself apparent immediately; it is uncovered bit by bit.

Thank you for reading *National Geographic.* ◻

FREE Download Now!

Blackmagicdesign

Introducing DaVinci Resolve 17

Edit and color correct video with the same software used by Hollywood, for free!

DaVinci Resolve is Hollywood's most popular software! Now it's easy to create feature film quality videos by using professional color correction, editing, audio and visual effects. Because DaVinci Resolve is free, you're not locked into a cloud license so you won't lose your work if you stop paying a monthly fee. There's no monthly fee, no embedded ads and no user tracking.

Editing, Color, Audio and Effects!

DaVinci Resolve is the world's only solution that combines editing, color correction, visual effects, motion graphics and audio post production all in one software tool! You can work faster because you don't have to learn multiple apps or switch software for different tasks. For example, just click the color page for color, or the edit page for editing! It's so incredibly fast!

Professional Editing

DaVinci Resolve is perfect for editing sales or training videos! The familiar track layout makes it easy to learn, while being powerful enough for professional editors. You also get a library full of hundreds of titles, transitions and effects that you can add and animate! Plus, DaVinci Resolve is used on high end work, so you are learning advanced skills used in TV and film.

Creative Color Correction

DaVinci Resolve's color page is Hollywood's most advanced color corrector and has been used on more feature films and television shows than any other system! It has exciting new features to make it easier to get amazing results, even while learning the more advanced color correction tools. There's PowerWindows™, qualifiers, tracking, advanced HDR grading tools and more!

Designed to Grow With You

DaVinci Resolve is designed for collaboration so as you work on larger jobs you can add users and all work on the same projects, at the same time. You can also expand DaVinci Resolve by adding a range of color control panels that let you create unique looks that are impossible with a mouse and keyboard. There's also edit keyboards and Fairlight audio consoles for sound studios!

DaVinci Resolve 17 ..... **Free**

Optional Accessory
DaVinci Resolve Speed Editor ... **$395**

Learn more at www.blackmagicdesign.com

PROOF

NATIONAL GEOGRAPHIC
VOL. 241 NO. 3

THE SAMURAI SPIRIT

PHOTOGRAPHS BY
RYOTARO HORIUCHI

Portraits showcase the beauty and reverence associated with the warriors of old, still celebrated in the Japan of today.

LOOKING AT THE EARTH FROM EVERY POSSIBLE ANGLE

At Japan's Soma Nomaoi Festival, armor-clad participants, some of whom have samurai ancestry, parade and race on horseback. Here, Mitsuo Abe—in everyday life, a dealer in antique armor—dresses as a type of samurai called *go-taisho*, a battalion general.

For her portrait, Miwa Hosokawa is outfitted as a cavalry warrior, known as a *kiba*. During the festival, she cares for the participants' mounts, using skills she has developed through her work on a horse ranch.

A onetime civil servant, Yukio Imada acts as a samurai-taisho, a company commander who supports the general of a battalion. To intimidate opponents, his headdress features an *oni,* a fearsome creature in Japanese folklore.

Katsunao Kamo's training as an armorer helped him suit up properly for his role as a *gunja,* a samurai who aids the chief of staff and vice chief of staff. Kamo, now deceased, also managed the festival's general affairs.

Most days, Yuichi Takahashi leads a construction company. As a festival *osakinori,* he leads the samurai marching cavalry and festival spirits and oversees the safety of the route. The armor he wears dates from the late 1500s to early 1600s.

THE BACKSTORY

A PHOTOGRAPHER'S SEARCH FOR HIS JAPANESE IDENTITY LEADS HIM TO REDISCOVER THE PAST IN THE PRESENT.

AFTER YEARS OF making images outside of Japan, Ryotaro Horiuchi turned the camera toward his home country. As he questioned what constitutes Japanese identity—and his own identity as a Japanese person—he began looking into *matsuri,* the communal celebrations held in every region of Japan since ancient times.

When Horiuchi attended Fukushima Prefecture's Soma Nomaoi Festival, where samurai descendants and devotees dress in armor and compete on horseback each July, he was "overwhelmed and moved by the power and human aspect," he says.

The festival has been held for more than a thousand years; its origins lie in the military training of the lord of Soma's samurai, who dedicated their lives to protecting his. Today's participants take inspiration from the discipline, honor, and loyalty practiced by the samurai—values that have helped them persevere through life's adversities, including the devastating earthquake and tsunami that hit the Soma area of Fukushima in 2011 and caused a nuclear disaster.

Hearing stories of these modern-day festivalgoers and seeing the strength of their conviction, Horiuchi knew that his next project would be an attempt to "capture their personalities and their identity as a samurai."

The past shapes the present for samurai admirers. Throughout the history of the festival, attendees have adapted to the evolving times without relinquishing their connection to the samurai. And through these portraits, Horiuchi has found his own sense of self—one that shifts with changes in time and place but preserves the spirit of tradition. –GAIL TSUKIYAMA

Gail Tsukiyama is a best-selling author whose novels include *The Samurai's Garden, Women of the Silk,* and *The Color of Air.*

Tradition meets modernity: Samurai descendant and festival follower Mitsukiyo Monma sometimes trades a horse for a Harley.

ILLUMINATING THE MYSTERIES—AND WONDERS—ALL AROUND US EVERY DAY
NATIONAL GEOGRAPHIC | VOL. 241 NO. 3

A Chance to 'Become a Fish'

JACQUES-YVES COUSTEAU'S CO-INVENTION OF THE AQUA-LUNG OPENED THE UNDERSEA REALM TO SCIENTISTS—AND A WONDERING PUBLIC.

BY **RACHEL HARTIGAN**

"LOOK," MY SON SAID.

We were bobbing in the shadow of a pier on Isla Vieques in Puerto Rico. Wooden slats a few feet above our heads sheltered us from the tropical sun. Weather-beaten pilings disappeared beneath the water's surface. It was cool there but barren—a human-made spot suitable only for a quick rest during our first foray into snorkeling.

Will pointed down. His eyes were wide behind his mask. He dipped his head underwater. I followed.

We entered another world. Above the water the pier was a dull structure of warped wood and chipped paint. Underwater it teemed with life—orange and yellow corals wrapping around the pilings, lush sea plants undulating in the current, darting schools of silvery fish. This narrow place beneath a dock built decades ago for U.S. warships was as fecund as any jungle—but unlike a jungle, we could float in the midst of it and examine it from every angle.

We had never imagined being surrounded by so much wildlife—and yet it wasn't enough for Will. "That was so cool," he said, as we drove back to the hotel in our guides' rattletrap pickup truck. "I want to try scuba diving." He didn't want to be tied to the surface by our rented snorkels. He dreamed of diving deeper, of seeing more of the ocean for himself.

Such a dream is possible—even ordinary—because of an extraordinarily simple device co-created by Jacques-Yves Cousteau, the French explorer known for his films, his TV shows, and marine conservation. Cousteau made his motto, *"Il faut aller voir*—We must go and see for ourselves." With his 1943 co-invention of the Aqua-Lung, the first safe self-contained underwater breathing apparatus (SCUBA), he invited ordinary people to take that motto as their own, to experience the undersea world for themselves.

Cousteau learned to swim when he was four, but his earliest ambitions aimed at the sky, not the sea. In 1930 he entered the French naval academy to become a pilot, a dream sidetracked by a nearly fatal car accident that fractured both his arms. Fellow naval officer Philippe Tailliez suggested Cousteau try ocean swimming to help his recovery. Tailliez loaned him a pair of goggles and took him spearfishing in the Mediterranean near Toulon, France.

Swimming with the goggles was a revelation: "As soon as I put my head underwater, I got it, a shock…I understood that from that day on, all my free time would be devoted to underwater exploration."

Eventually Cousteau could go as deep as 60 feet and stay there for up to 80 seconds. But that wasn't long enough or deep enough for him. "Always I rebelled against the limitations imposed by a single lungful of air," he wrote in a 1952 article for *National Geographic,* his first for the magazine.

IN THE 1930S THE OPTIONS for deepwater diving were few. Mobility in the diving suits the French called *pieds lourds* (heavy feet)—rubberized canvas suits with a copper helmet and lead-soled shoes—was restricted by the length of the hose supplying air from the surface. An autonomous breathing device created by Yves Le Prieur in 1925 freed divers from the cumbersome hose, but the air supply ran out quickly because of its continuous flow, limiting time underwater.

Cousteau had to come up with his own solution. "I became an inventor by necessity," he said.

To go deeper, he needed a device that would provide breathable air that also matched the pressure of the water: As a diver descends, the pressure increases, reducing the volume of air in the body and potentially causing the lungs to collapse. Cousteau's father-in-law put him in touch with engineer Émile Gagnan, an expert in high-pressure pneumatic design.

It was the middle of World War II, and Germany controlled most of France. Gagnan worked for France's largest commercial gas company, in Paris, where he'd designed a valve that regulated fuel flow, allowing cars to operate on cooking oil, an essential wartime adaptation when the Nazis had commandeered all the gasoline for motor vehicles.

"The best way to become a fish—or a reasonable facsimile thereof—is to don an underwater breathing device called the Aqualung," said Cousteau (left), the apparatus's co-inventor. In this *National Geographic* archival photo (right), Aqua-Lungers descend to Sha'ab Rumi, a Red Sea reef, to bag specimen fish.

When Cousteau traveled to Paris in 1942 to explain the air pressure problem to Gagnan, the engineer thought his gas regulator could be the solution. Together they tinkered until they had something they could test, a regulator attached by tubes to three canisters of compressed air. Cousteau took the prototype for a swim in the Marne River, east of Paris. "I took normal breaths in a slow rhythm," he said, "bowed my head, and swam smoothly down to 30 feet."

The device worked—while he was horizontal. When he was upright, it leaked air. Cousteau and Gagnan rearranged the intake and exhaust tubes to be at the same level. Eventually they had a version that Cousteau felt comfortable trying out in the sea.

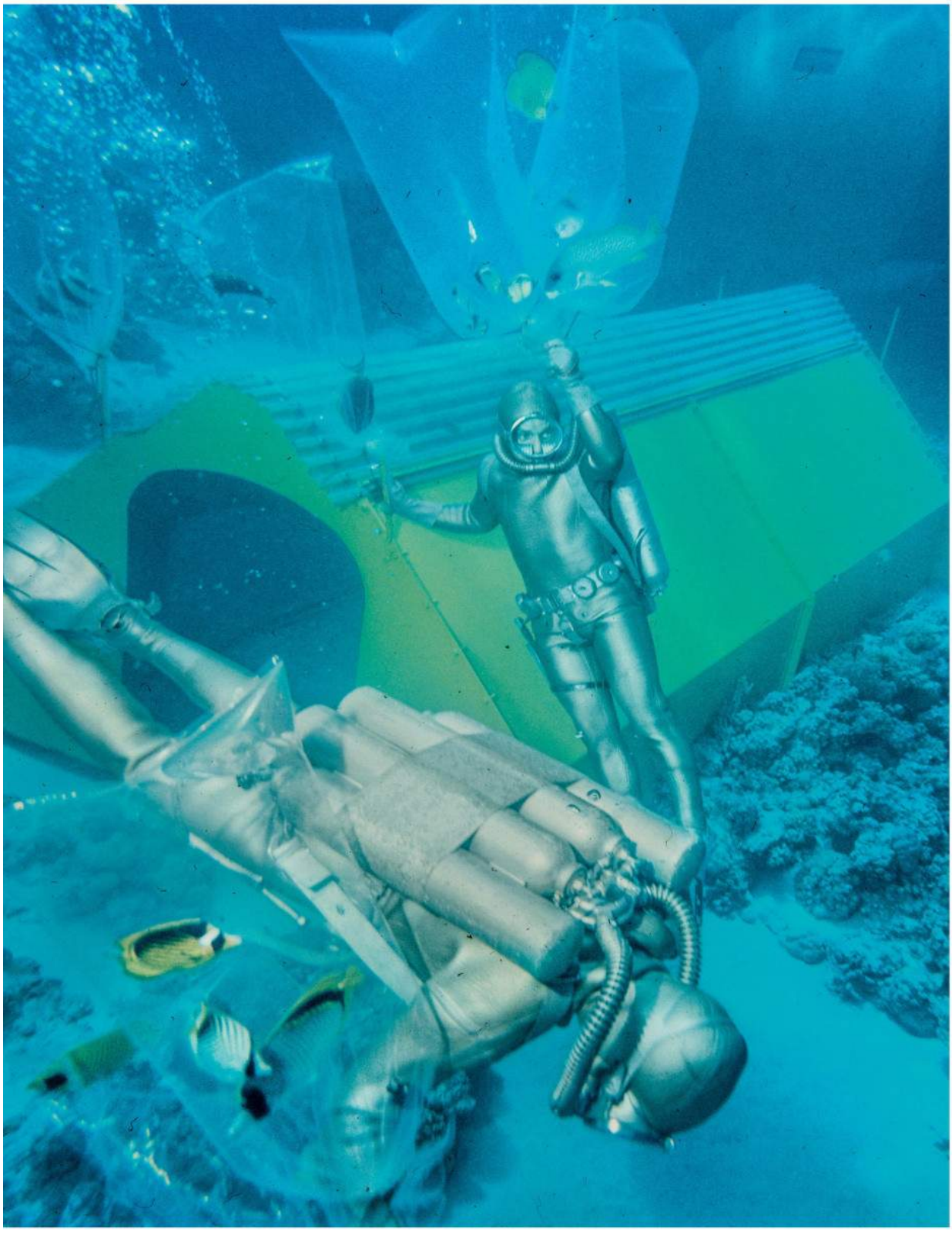
Over the course of many months in 1943, Cousteau, Tailliez, and their friend Frédéric Dumas cautiously tested the device they were calling the Aqualung. They made more than 500 dives in the Mediterranean, going a little deeper each time. By the onset of autumn they'd reached 130 feet. By October Dumas had descended 90 feet more.

"The best way to observe a fish is to become a fish," Cousteau wrote in that first *National Geographic* article. "And the best way to become a fish—or a reasonable facsimile thereof—is to don an underwater breathing device called the Aqualung. The Aqualung frees a man to glide, unhurried and unharmed, fathoms deep beneath the sea."

NEARLY 80 YEARS AFTER its invention, the same basic design is still in use. "It's as simple and elegant as a doorknob," says longtime *National Geographic* underwater photographer David Doubilet. "It doesn't fail. In 65 years of diving, I have never had a failure."

But the ability to plumb the depths exposed divers to other dangers. Although the Aqua-Lung made it easier to breathe by balancing ambient and internal pressure, it couldn't prevent what's known as rapture of the deep—nitrogen narcosis, when the nervous system becomes saturated with nitrogen as the diver descends. To Cousteau it was "an impression of euphoria, and then a gradual loss of reflex control, and then a loss of the self-preservation instinct." To Albert Falco, who sailed with Cousteau for nearly 40 years, "Air takes on a funny taste, and you get drunk on your own breath."

Nitrogen narcosis can be deadly. In 1947 Cousteau,



PHOTOS: THE COUSTEAU SOCIETY (COUSTEAU PORTRAIT); ROBERT B. GOODMAN, NATIONAL GEOGRAPHIC IMAGE COLLECTION

who was still in the French Navy as part of its underwater research group, organized autonomous diving tests in Toulon. He wanted to show that the Aqua-Lung would allow divers to go more than 100 meters (328 feet) deep. But the person to make the initial attempt, First Mate Maurice Fargues, died. After passing 120 meters (394 feet), he lost consciousness. He was frantically pulled to the surface but could not be resuscitated. Cousteau was devastated: "I start to wonder if what I'm undertaking makes sense."

To the French Navy it did. The diver group was deployed by the navy to clear the deadly aftermath of World War II from the Mediterranean, removing mines hidden near harbors and retrieving pilots' bodies from downed airplanes.

But Cousteau wanted to use his invention to explore, not just salvage. In 1949 he left the navy and soon acquired the *Calypso,* a former British minesweeper. Adventuring on the ship, he advanced underwater photography, discovering that there, "colors existed as brilliant and as beautiful as any at the surface." In 1956 Cousteau made the movie *The Silent World* with a young Louis Malle, who in time would become one of French cinema's top directors.

DAVID DOUBILET SAW the film, which won an Oscar, with an uncle and cousin when he was 10. "My eyes grew larger and larger and larger," Doubilet says. Cousteau became his hero. A year or two later, Doubilet learned to dive in a swimming pool at a beach club in New Jersey: In roughly a decade Cousteau's groundbreaking Aqua-Lung had been adopted by the public as a recreational pursuit.

"I put the thing on, and I went right to the bottom of the pool," Doubilet recalls. "I was plastered on the bottom, but I was breathing, and it was just heavenly."

Doubilet would go on to photograph the Sargasso Sea, the Great Barrier Reef, and other ocean marvels for more than 70 *National Geographic* feature stories. To him, "the Aqua-Lung regulator meant a passport to 70 percent of our planet"—and Cousteau stands as "a person whose importance to the planet can never, ever be forgotten or underestimated."

Photographer Laurent Ballesta, who grew up swimming, snorkeling, and scuba diving on France's Mediterranean coast, was influenced by Cousteau as well. When Ballesta was 16, he was out with friends on a boat when they were surrounded by sharks. Based on his passionate viewing of Cousteau's documentaries, he recognized them as harmless basking sharks and jumped into the water to swim with them.

When Ballesta told his parents what had happened and they didn't believe him, he says, "That was the point where I decided that I have to learn photography."

Jacques Cousteau remained active in undersea exploration until his death at age 87 in 1997. His job, he once wrote, "was to show what was in the sea—the beauties of it—so that people would get to know and love the sea." There's still much to explore: The National Oceanic and Atmospheric Administration estimates that more than 80 percent of the undersea world remains largely unknown.

In the 79 years since Cousteau and Gagnan invented the Aqua-Lung, more than 28 million people have followed them into the ocean and learned to scuba dive.

This spring my son and I will join them. It's what Will wanted for his 17th birthday—a passport to another world. □

Staff writer **Rachel Hartigan** has written recently for the magazine about the conflict in Ethiopia and the life of Explorer Robert Ballard. She's writing a book about the ongoing search for Amelia Earhart.

Advances such as this diving bell enabled Laurent Ballesta and his team to spend 28 days deep in the Mediterranean Sea in July 2019.

PHOTO: LAURENT BALLESTA

DISPATCHES FROM THE FRONT LINES OF SCIENCE AND INNOVATION

ECOSYSTEM SCIENCE

OTTER-LY BENE

WHEN SEA OTTERS DIG FOR MEALS GENETIC DIVERSITY IN THREATENE

SNUG IN THE ANIMAL KINGDOM'S thi live their whole lives in the ocean, feedi animals. In British Columbia they ofter eelgrass *(Zostera marina),* leaving divot of the aquatic vegetation. In meadows tha with those they don't, the eelgrasses are and the plants more resilient, accordin the journal *Science.* That's because by the seabed, otters prompt the plants to and their digging provides more space settle and germinate. Seagrasses such as a result of warming and pollution; th because they filter contaminants from th provide habitat and food for many ani is a powerful example of how predat ecosystems in unseen and little-known Erin Foster. –DOUGLAS MAIN

PHOTOS (FROM TOP): STEFANO MACCHETTA; RALPH PACE; F. D'E

Studies dwell on blue blooms

A review of 280 Alpine regional plant studies over 45 years shows that blue flowers got the most attention; yellow, white, or red/pink the next most, and green/brown blooms much less. Also popular: tall flowers (so scientists don't have to stoop?). The research bias has implications for which flowers get protection. –LORI CUTHBERT

FICIAL

, THEY ENCOURAGE D AQUATIC PLANTS.

ckest fur, sea otters can ing heavily upon seafloor dig clams out of fields of s in otherwise dense mats at otters inhabit compared more genetically diverse g to a study published in foraging and disturbing flower and produce seeds, and sunlight for seeds to as eelgrass are imperiled ey're vital to ecosystems e water, store carbon, and mals. The study's finding ors often influence their ways, says lead researcher

ERRICO

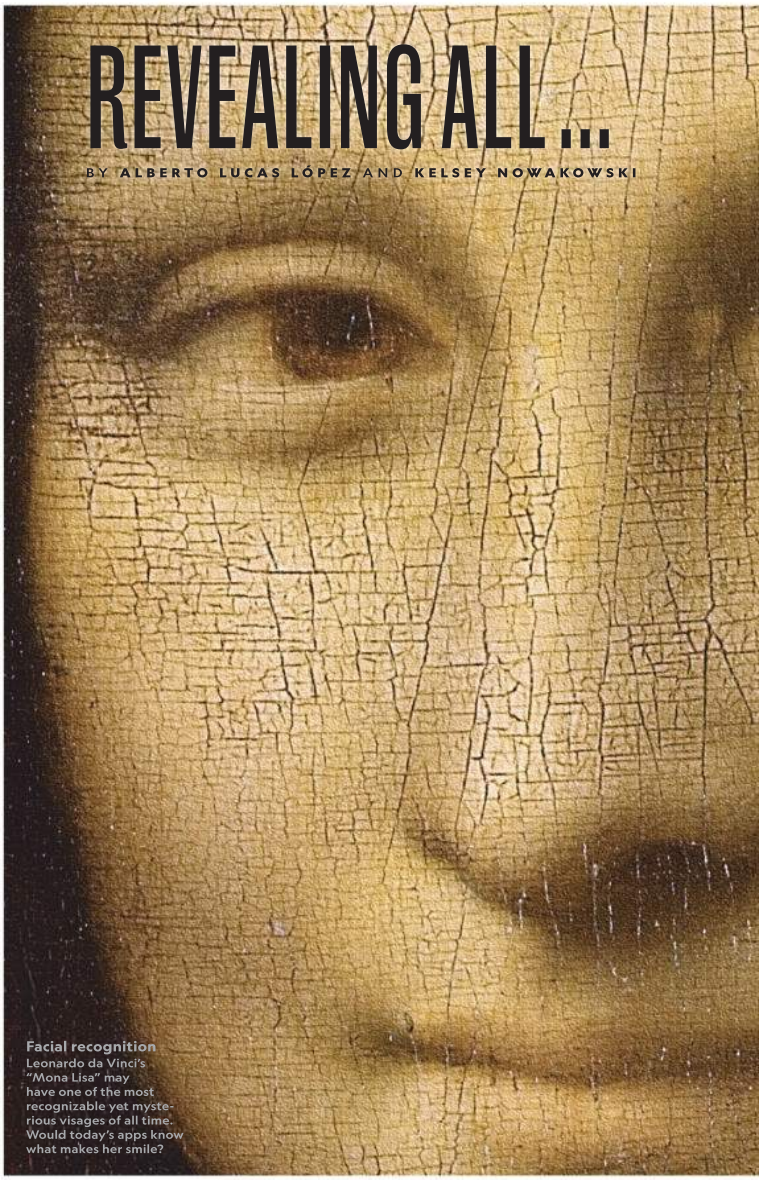
NUMERATION

Exploring the Origins of Counting

How did humans go from an innate, general sense of quantity—a pair, a few, many—to inventing numbers and arithmetic? Why are counting systems so diverse across global cultures? Answering these questions isn't as easy as one, two, three, so the European Research Council is funding QUANTA, a multi-year inquiry into counting's origins. QUANTA will pore over linguistic and ethnographic data, as well as artifacts such as this 60,000-year-old notched hyena femur, which may have served as a Neanderthal's scratch paper. –MICHAEL GRESHKO

REVEALING ALL...

BY ALBERTO LUCAS LÓPEZ AND KELSEY NOWAKOWSKI



Facial recognition
Leonardo da Vinci's "Mona Lisa" may have one of the most recognizable yet mysterious visages of all time. Would today's apps know what makes her smile?

...IN APPS

CLICKING "ACCEPT" without reading the fine print is the norm for many of us when first accessing a digital app. But what exactly are we accepting? Clario, an internet-security software company based in the United Arab Emirates, compiled 2021 data from some of the world's most used apps to assess which data they can collect and store once we tap that button. The information includes the basics such as name, date of birth, and email address. But it can quickly get more personal, from our pets and hobbies to height, weight, and sexual orientation. Many apps also can store bank information and connect to our social media accounts. Social media apps—increasingly under fire for privacy concerns—collect data from the broadest variety of sources.

Top collectors

29 *of 37* | 24 | 23 | 22 | 19

Apps for social networking (Facebook and Instagram), dating (Tinder and Grindr), and transportation (Uber) are data collection leaders. For example, Facebook can mine information from 29 of the 37 personal data variables examined in the study.

Top collectors owned by Meta

29 *of 37* | 19 | 17 | 10 | 8

In 2021 an ex-employee of Facebook (now named Meta) leaked documents about privacy and misinformation abuses within the company. The Facebook app can access the most data directly; all other Meta apps can gather data from the Facebook app if accounts are linked.

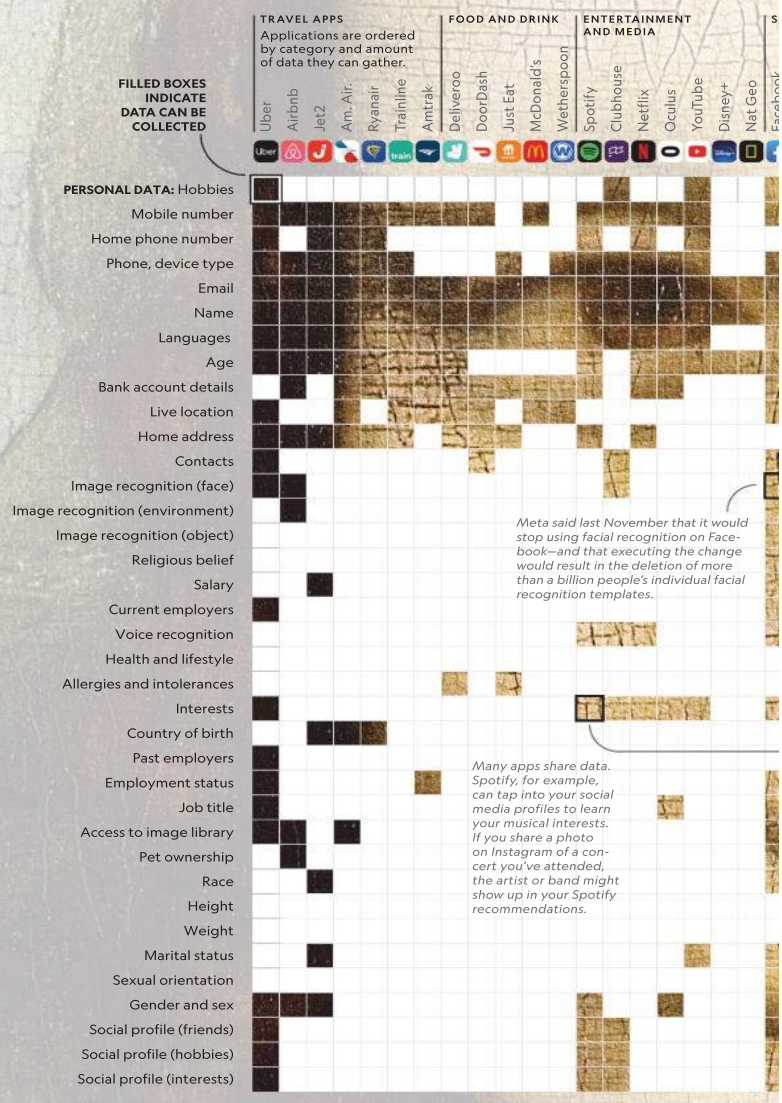
Types of imaging

Facial: *Recognizes people and their key features*

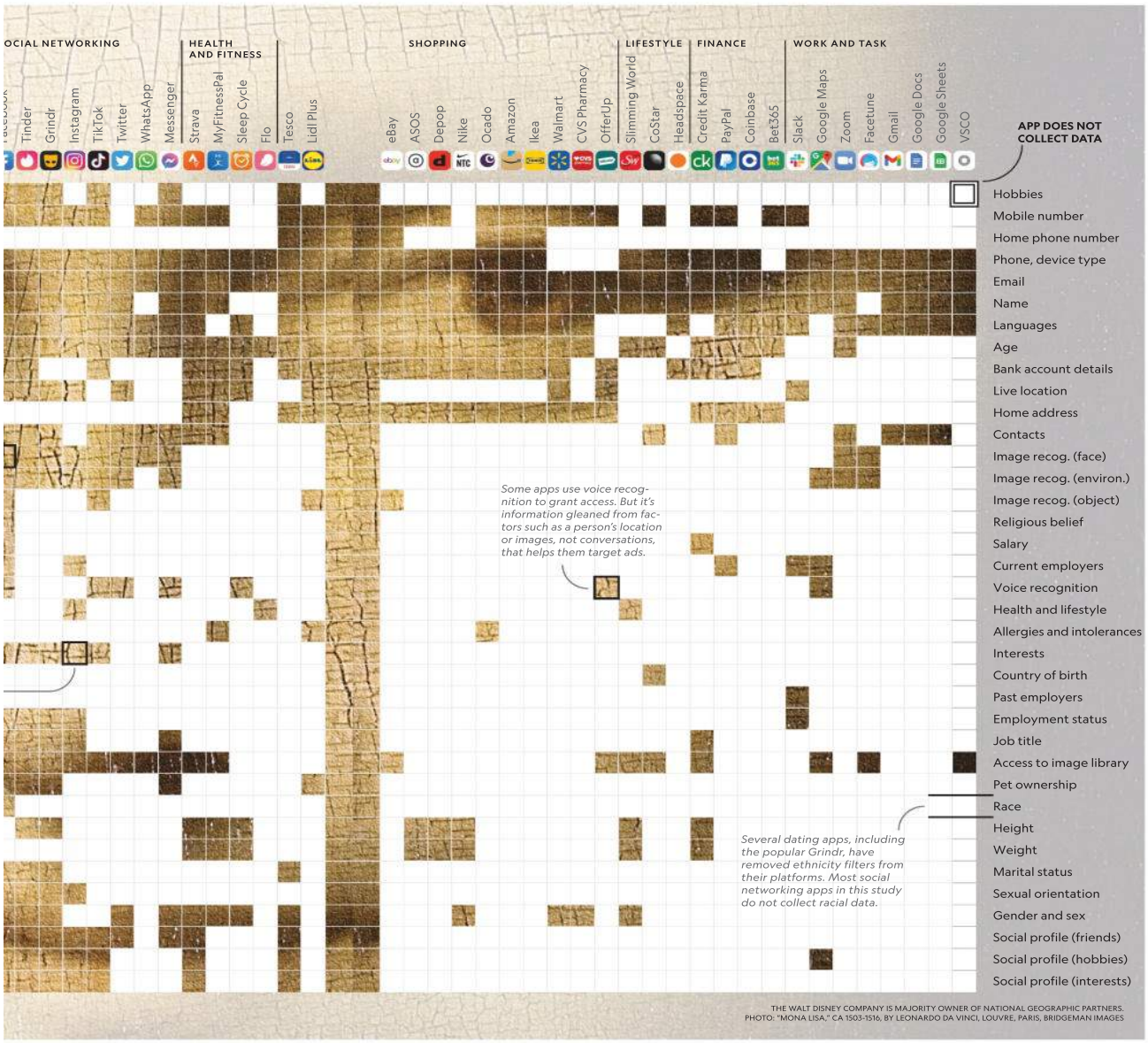
Background: *Detects elements in the environment*

Object: *Identifies an object or product within an image*

Image recognition helps companies study an app user's appearance and surroundings to tailor ads to that person's needs and interests. Of the 58 apps in this study, 16 use some form of image recognition.



SOURCE: CLARIO.CO. DATA ARE FROM JULY AND NOVEMBER 2021 AND INCLUDE DATA A COMPANY CAN COLLECT AND STORE ONLY AFTER SECURING USER PERMISSION.



THE WALT DISNEY COMPANY IS MAJORITY OWNER OF NATIONAL GEOGRAPHIC PARTNERS.
PHOTO: "MONA LISA," CA 1503-1516, BY LEONARDO DA VINCI, LOUVRE, PARIS, BRIDGEMAN IMAGES

PLANET POSSIBLE

For more stories about how to help the planet, go to *natgeo.com/planet*.

2

In spring, help wild things and their offspring thrive with hands-on projects—and by keeping hands off.

BY **ANNIE ROTH**

1

BIRD-SAFE WINDOWS

Transparent, reflective glass confuses birds. Up to a billion a year in the U.S. die from collisions with glass—nearly half from hitting home windows. These DIY fixes discourage birds from trying to fly through windows: Mark glass with tempera paint, stickers, or tape, making gaps in the pattern no larger than 2 inches tall by 4 inches wide—or 2 inches by 2 inches for greater deterrence. The American Bird Conservancy has more ideas at *abcbirds.org/glass-collisions*.

CAREFUL SPRING CLEANING

BEFORE FIRING UP THE MOWER OR HEDGE TRIMMER, CHECK GROUNDS AND SHRUBS FOR SMALL ANIMALS, BIRDS, AND NESTS. IF YOU FIND A CREATURE NEEDING RELOCATION OR HELP, SEARCH FOR A NEARBY ANIMAL RESCUE/REHAB EXPERT AT *AHNOW.ORG*.

3

BUILD AN INSECT ABODE

WE NEED INSECTS to pollinate plants, remove waste from ecosystems, and feed other animals; insects need safe places to rest and to lay their eggs. Stores sell bug hotels to put in your yard—but for an all-ages project, why not create one? **1.** Find a cardboard box with one open side. **2.** Fit toilet tissue tubes and smaller tubes of rolled paper into the box. **3.** Fill the tubes with sticks, grasses, and leaves, and place the box in an undisturbed corner of the yard. Voilà: an insect inn.

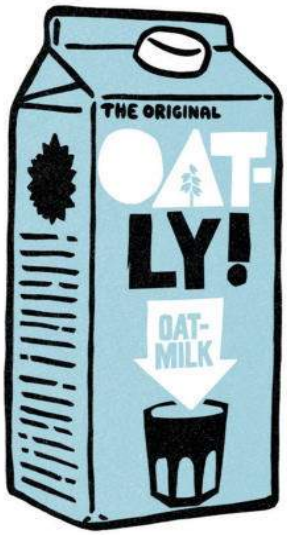
4

WATCHING THE BABIES

Do you assume a young animal is in peril if its mother isn't around? Don't, says urban wildlife expert Jim Monsma. Some babies (ducks, opossums) are always with mom; others (rabbits, deer) spend hours a day with no mother in sight. When in doubt, don't touch the animal; first, seek a rehabber's advice (see #2), Monsma says.

PHOTOS: REBECCA HALE, NGM STAFF (WINDOW, BUG HOTEL); JOEL SARTORE, NATIONAL GEOGRAPHIC PHOTO ARK (SQUIRREL); ROLF KOPFLE, ALAMY STOCK PHOTO (FAWN)

"IF OATMILK REALLY HELPS THE PLANET, CAN I JUST POUR IT DIRECTLY INTO THE EARTH?"



Honestly, there's nothing stopping you, except logic and reason and common sense and maybe a friend who understands how climate change works or even this very ad cautioning you that just because you can do something doesn't mean you should. Allow us to explain. If you're a first-time reader of these oatmilk ads, typically the ratio of Serious Oatmilk Messaging to Totally Random Nonsense is somewhere in the range of 1 to 378, give or take. That seems like a healthy balance to us, but since we're a company that's always looking to improve, here's some important-sounding stuff about how oatmilk actually can and does help the planet, since you appear to be curious.

In general, oatmilk is better for the climate compared to cow milk because it has a lower climate impact. So if you want to lower your personal climate footprint, shifting more toward a plant-based diet will do that. Also, oatmilk can be used to power the hyperdrives on interstellar spaceships we humans use to time-warp across the universe in search of alien life to play tennis with. That last one is patently false, but we included it just to see if you're still reading this, which we can't assume you are. However, should you end up deciding to pour your oatmilk directly into the earth, absolutely nothing will happen aside from onlookers questioning if you understand what sustainability is.

Oatly.com/InfrequentlyAskedQuestions

MEET A HERMAPHRODITIC SEA SLUG THAT WIELDS A NEEDLE

IN ITS NATIVE PACIFIC WATERS, the sea slug *Siphopteron makisig* looks tiny and delicate, like a bud of colored glass. But in reality this slug is a mirror-image mating machine, as modeled by the pair in the photograph below.

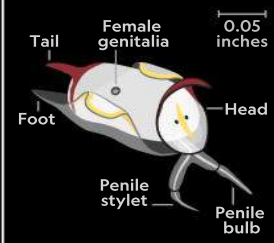
Like most sea slug species, *S. makisig* is a hermaphrodite, endowed with both male and female reproductive organs that it uses at the same time during mating. But unlike other sea slugs, it tops off trysts with unusually targeted stabbing.

The sex starts normally enough. To fertilize eggs developing in each slug's female parts, the other slug deposits sperm with its penis. Actually, only *half* of its penis, which has two prongs: one that delivers sperm with its bulbous end, and the other tipped with a syringe-like stylet (and sometimes called hypodermic genitalia). During the sex act, each slug stabs the other with the stylet, which delivers prostate fluid likely bearing hormones. Evolutionary biologist Rolanda Lange says the fluid may "increase the fecundity of a sea slug's own sperm, or inhibit that deposited by previous partners."

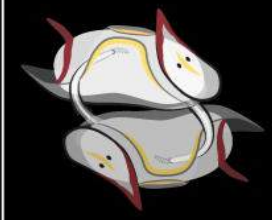
When other animals stab partners during sex (aka traumatic insemination), they spear various body parts. But in a study Lange co-authored, she identifies *S. makisig* as "the first known instance" of an animal stabbing its partner between the eyes—perhaps the better to influence the central nervous system. –EVA VAN DEN BERG

BIZARRE PAIRING

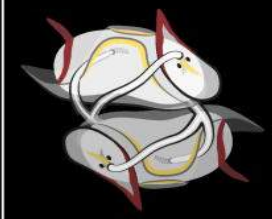
Siphopteron makisig **sea slugs have both female genitalia and a double-ended penis.**



Intertwined for mating, they reciprocate sperm delivery by extending the bulb into the female genitalia.



Then each pokes the stylet into the other's forehead, injecting fluid that may affect neural function.



DESCRIPTION

S. makisig, **a marine gastropod, is less than a quarter inch long, with yellow and red markings on its translucent white exterior. (The blue seen here is water in the image background.)**

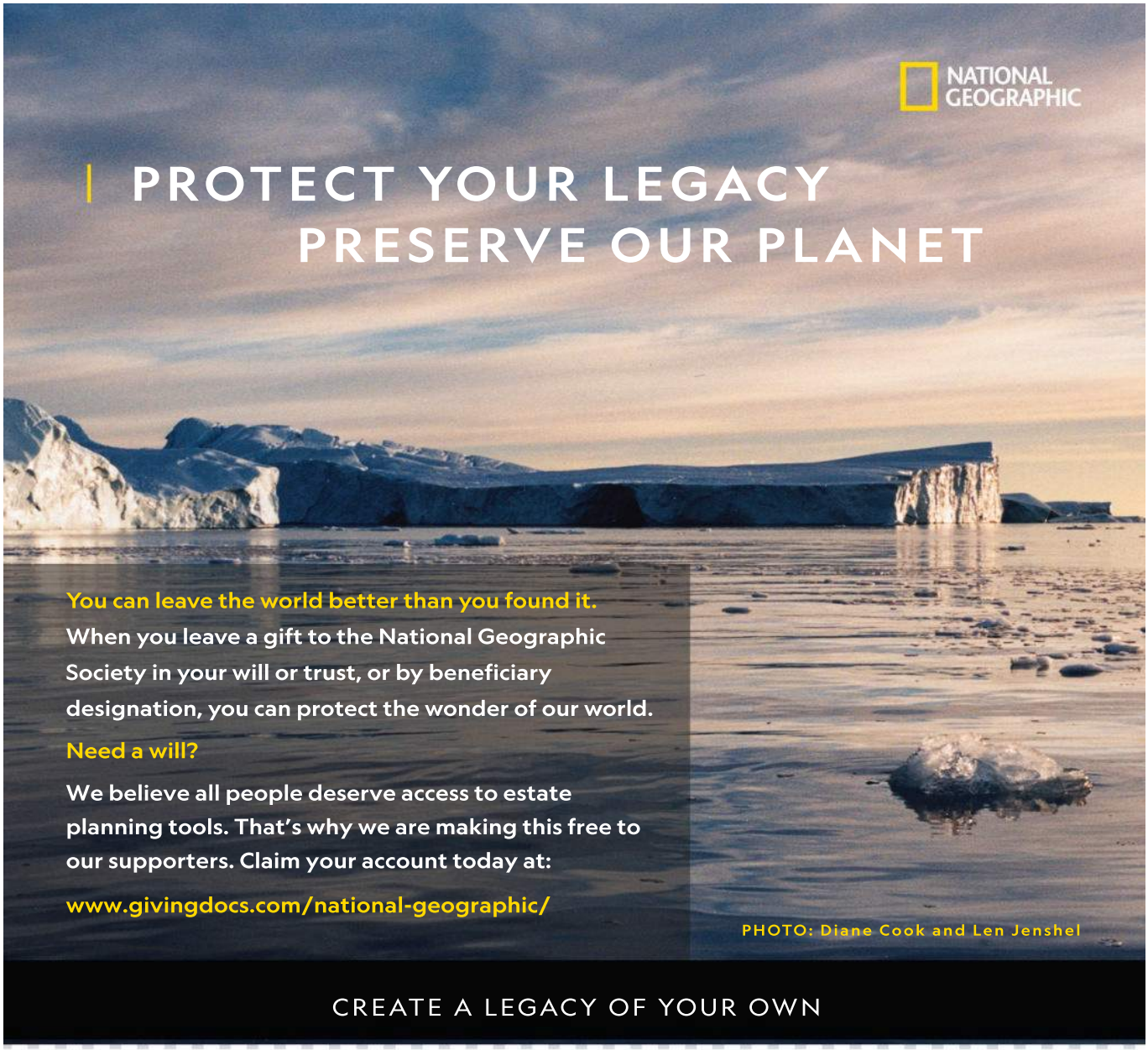
HABITAT

The sea slug lives on sand beds at ocean depths from about 20 feet to about 90 feet and commonly nestles within microalgal formations.

RANGE

The mollusk has been identified in waters off the Philippines, Australia, and Indonesia.

DIANA MARQUES, NGM STAFF. PHOTO: NILS ANTHES AND ROLANDA LANGE, UNIVERSITY OF TUEBINGEN



CREATE A LEGACY OF YOUR OWN

- ☐ Yes! Please send me information on leaving a gift to the National Geographic Society.
- ☐ The National Geographic Society has already been included in my estate plans.
- ☐ I would like to speak to someone about making a gift. Please call me.

Mail to: National Geographic Society
Office of Planned Giving
1145 17th Street, N.W.
Washington, D.C. 20036-4688

Contact: legacy@ngs.org
(800) 226-4438
natgeo.org/give/future-gifts

NAME

ADDRESS

PHONE EMAIL

The National Geographic Society is a 501(c)(3) non-profit organization. Our federal tax ID number is 53-0193519.

22PGAD03

POTTERY OF THE NIGHT

IN MEXICO, AN ANCIENT ART IS EMERGING AS A SUSTAINABLE ALTERNATIVE TO PLASTICS.

BY **RACHNA SACHASINH**

PHOTOGRAPHS BY **MARICEU ERTHAL GARCÍA**

Beautiful and functional, the Bartolo jug by Colectivo 1050° is a return to the traditional roots of black pottery.

ACCORDING TO LEGEND, the clay in San Bartolo Coyotepec village is blessed. Artisans who use it to make Oaxaca's famous *barro negro,* black clay pottery, are reluctant to reveal its secrets.

But 66-year-old Amando Pedro Martínez is an exception. Sparks crackle from the earthen oven in his studio as I watch him reach, with cloth-covered hands, into the still cooling kiln and pull out smooth ebony plates one by one.

Made from clay mined on the slopes of the Sierra Madre across the valley, these pieces started out the color of wet mud. Impregnated by heat and smoke, they transformed into sleek grays and blacks evocative of twilight. It's no wonder Zapotec folktales call barro negro "pottery of the night."

Pedro Martínez is upholding an artisanal tradition that dates back more than 2,500 years. Just beyond his studio, the town's tidy, broad avenues are lined with home workshops where extended families labor side by side turning clay into pots and figurines. Travelers arrive in tour buses to buy the distinctive black pottery—but what tourists see isn't exactly traditional.

When tin, aluminum, and plastics began to replace watertight black clay vessels, artisans adapted to a changing market by introducing new shapes, offering decorative pieces, and incorporating different techniques, such as etched patterns and plastic molds. While these changes have helped

Chloé

black pottery survive, and some might say prosper, they have also compromised the village's historic relationship to clay.

However, a talented new generation, including the cooperative Colectivo 1050°, which counts Pedro Martínez as a member, is steering black pottery back to its utilitarian roots. In the process, the artisans are bringing attention to the craft's sophisticated design and inherent sustainability, an antidote to single-use plastic.

"Barro negro is the megafauna of Oaxacan pottery," says Eric Mindling, documentary photographer and author of *Fire and Clay: The Art of Oaxacan Pottery*. "It's the most recognizable, but its rise is dependent on a rich pottery ecosystem." Mindling has visited more than 70 villages across Oaxaca and encountered at least as many variations in pottery style.

The earliest examples of black pottery were found in Monte Albán, a Mesoamerican Zapotec and Mixtec stronghold dating to 500 B.C. Situated roughly five miles southwest of Oaxaca City, Monte Albán rises at the vital junction of Oaxaca's three main valleys. This heaving landscape, with its sinuous valleys, mountain passes, and trading routes, harbors at least 16 distinct ethnic groups. They still practice the milpa farming system of cultivating corn, beans, and squash together.

Oaxaca's pottery evolved to perform tasks related to milpa, such as cooking, storing, and irrigation. While the majority of the region's pottery was made to absorb the thermal shock of cooking on top of a hot flame, San Bartolo Coyotepec's was different. Fired in sealed underground ovens at high temperatures, barro negro combines the color and impervious clay body that result from intense carbonization. It's suited to holding and transporting liquids—but not for cooking, as traditional red pottery is.

"In Oaxaca, clay represents a way of living," says industrial designer Kythzia Barrera, co-founder of Colectivo 1050°, which collaborates with Indigenous potters to spotlight the craft's ancient system of producing and consuming in balance with the Earth—what Barrera calls the "artisan mindset."

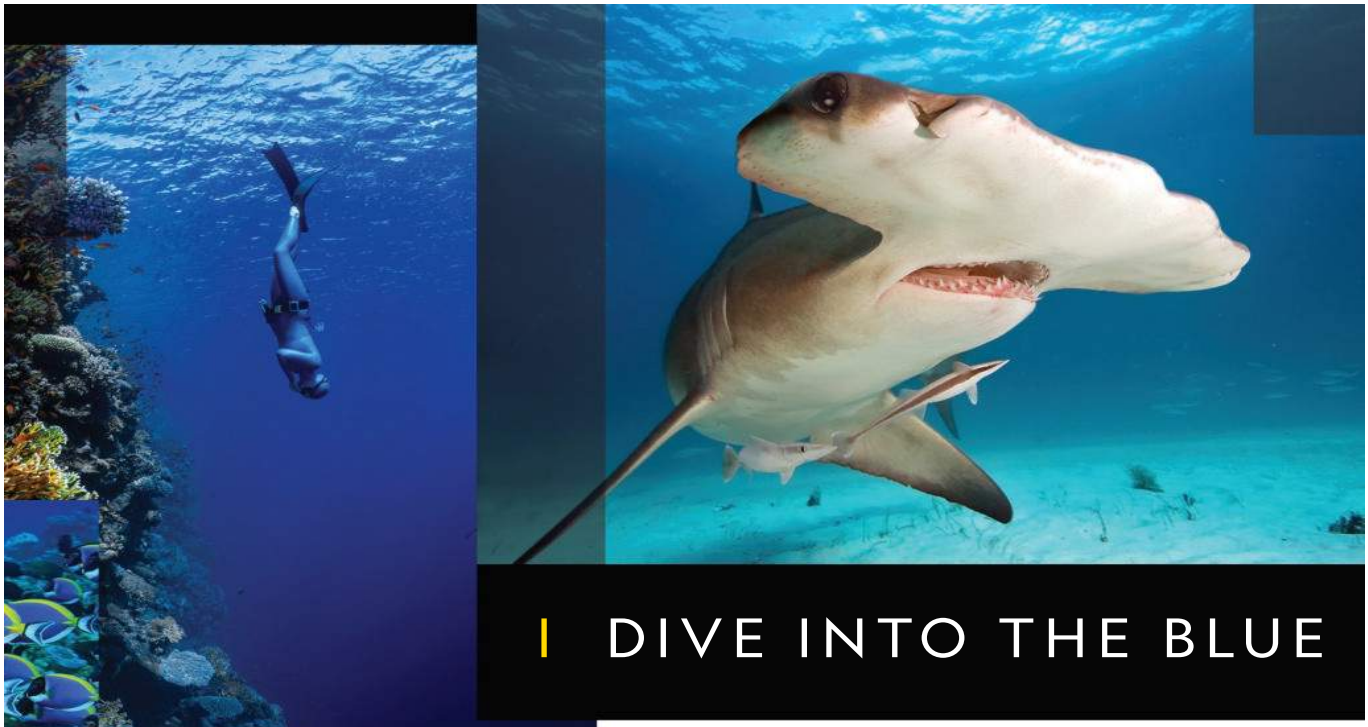
"Take the well jug, for instance," says Barrera. "It's got a short neck for tying the rope to lower it into a well. The round, egg-shaped body is ergonomically designed to tilt when it hits water. The mouth scoops the water and keeps it in without spilling. This is good design, perfectly suited to the task with no waste. It's a design that no doubt was worked out by the whole community, over time."

In Oaxaca, where traditional communities struggle with marginalization, clay is an integral part of identity. "So we will continue to make and use clay," says Barrera. "We must." □

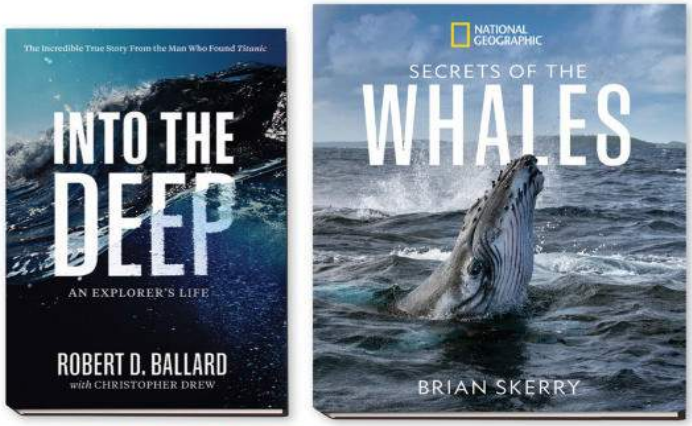
Rachna Sachasinh writes about travel and culture and has worked with artisan groups, including those in Oaxaca. **Mariceu Erthal García** is a Mexican photographer based in Querétaro.

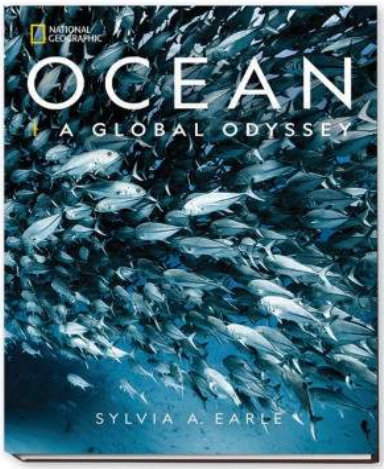
In San Marcos Tlapazola, an Indigenous Zapotec village known for its red clay pottery tradition, María Cruz López begins the process of molding a comal, or griddle. Oaxaca's diverse earthenware includes black, red, and green pottery.

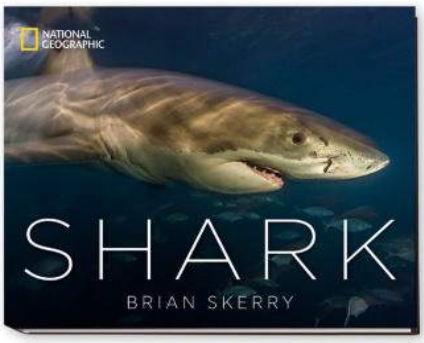
NGM MAPS

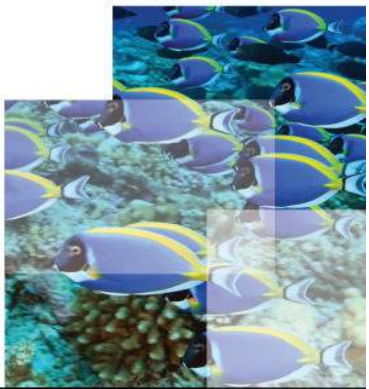


I DIVE INTO THE BLUE









NATIONAL GEOGRAPHIC

AVAILABLE WHEREVER BOOKS ARE SOLD

NatGeoBooks @NatGeoBooks

FEATURES

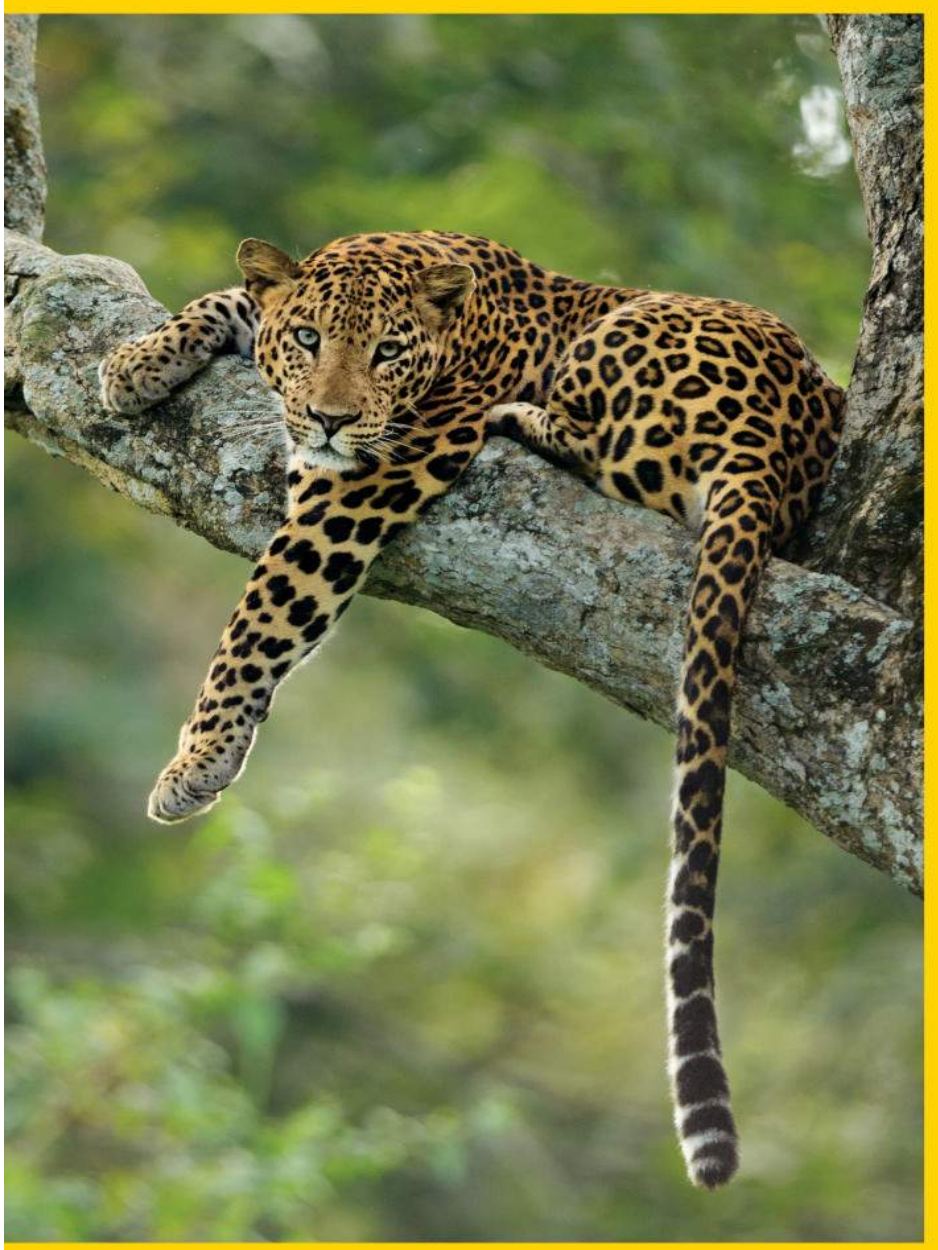


PHOTO: SHAAZ JUNG

86

THE CHANCES OF SEEING BIG CATS SUCH AS LEOPARDS AND TIGERS IN INDIA HAVE GONE UP SIGNIFICANTLY DURING THE PAST DECADE, THANKS TO SUCCESSFUL CONSERVATION EFFORTS THAT INCLUDE WILDLIFE RESERVES.

BY **TARA ROBERTS**

PHOTOGRAPHS BY **WAYNE LAWRENCE**

HIDDEN NO MORE

A diver's quest for the stories of those lost on slave ships reveals the human side of a tragic era—and helps her connect with her family's rich history.

Diving With a Purpose (DWP) lead dive instructor Jay Haigler cradles a stone from a ballast pile in Coral Bay, St. John, in the U.S. Virgin Islands. The stones have been key to identifying slave ships; they often were used to balance the weight of captives in a ship's cargo hold.
DAVID DOUBILET

THE WATER IS COOL AGAINST MY SKIN, the silence absolute, and as I hover over the remains, I feel peaceful, thankful, a sense of coming home.

Descend underwater with me—not too deep, maybe only 20 feet or so—and you'll see about 30 other divers, paired in sets of two. They calmly float in place, despite strong currents off the coast of Key Largo, Florida, sketching images of coral-encrusted artifacts or taking measurements. For the first time, I am helping map the remains of a shipwreck.

Most of the divers are African American. We're training as underwater archaeology advocates, gaining the skills necessary to join expeditions and help document the wreckage of slave ships being found around the world, ships such as the *São José Paquete d'Africa* in South Africa, the *Fredericus Quartus* and *Christianus Quintus* in Costa Rica, and the *Clotilda* in the United States. An estimated 12.5 million Africans were forced onto ships like these during the transatlantic slave trade from the 16th to the 19th centuries,

Storyteller and diver Tara Roberts is helping document some of the thousand slave ships that wrecked in the Atlantic Ocean. She is working to tell the story of DWP and the complex history of the global slave trade in an inclusive way that amplifies Black voices.

according to Nafees Khan, a professor in the College of Education at Clemson University and adviser to the Trans-Atlantic Slave Trade Database.

"It took at least 36,000 voyages," he says. One thousand or so ships likely sank.

Enter Diving With a Purpose, a group that trains divers to find and conserve historical and cultural artifacts buried deep in the waters. Since its founding in 2003, DWP has trained some 500 divers to help archaeologists and historians search for and document such ships. The group's goal is to help Black folks, in particular, find their own history and tell their own stories.

"When you are African American and you're diving on a slave ship, that's a whole lot different from somebody else doing it," says legendary diver Albert José Jones, a co-founder of the National Association of Black Scuba Divers and board member of DWP. "Every time you go down, you realize basically two things: One is that maybe your ancestors were on the ship. The other thing you realize is that you have a history. Your history didn't start on the shores of the United States. It didn't start with slavery. Your history started [in] Africa at the beginning of time, the beginning of civilization."

The National Museum of African American History and Culture, in Washington, D.C., showcases DWP's work as part of the Slave Wrecks Project, a network of groups that uncover and document the remnants of slave ships and work to tell a more inclusive history of the slave trade.

Diving With a Purpose members are "using their skills to dive to help us find the stories that are buried under the water," says Lonnie Bunch III, the museum's founding director and the secretary of the Smithsonian Institution. "In some ways, there's so much we know about slavery. But there's so much we still don't know. And I would argue the last frontier is what's under the water."

Under the water. Out here in the deep. It is magic feeling the ocean breeze on my skin and the spray of seawater as the boat races home after a day's work. It is soul-lifting to look at the tired faces of those around me and know these ordinary people—teachers, civil servants, engineers, students—are here despite their busy schedules, volunteering because they love to dive and believe in this important work.

Lounging on a return trip, you might hear lead instructor Jay Haigler's booming voice and his trademark cackle—and you might see the twinkle in his eye and his infectious joy when he says, quietly before nodding off, "This is what I live for."

And it just might touch you.

ILLUSTRATION BY JOE MCKENDRY

MAYBE BY STARTING at the start—at the beginning of the voyages from those shores to these shores, and inside the ships—we can find clues to a history little discussed, to stories that have been lost in the depths. We can begin to assemble long-lost threads that help us better understand our obligation to the past and to each other, and change the way we think about who we are as a society and how we arrived at where we are today.

We are deeply connected to those who made the crossing. And we are connected to the estimated 1.8 million souls who perished along the way. The Atlantic Ocean is full of forgotten people, churning with the spirits of folks whose names we may never know. Souls who have never been acknowledged or mourned. Dreamers, poets, artists, thinkers, scientists, farmers. More than just cargo or bodies packed in a hold. More than faceless statistics. More than people bound for enslavement.

And their day of reckoning is at hand. It is time for their stories to rise from the depths, to be told in their fullness, in their wonder—and with love, with honor, with respect. Finally helping heal a wound that has festered for far too long. That is the dream. That is the promise. That is the possibility of this work, of this watery resurrection that DWP has taken on.

These ships "allow us to honor those that didn't make it," Bunch says. "They allow us to sort of almost touch sacred spaces that are not just spaces of death, but spaces of memory. And that as long as we find those spaces, as long as we dive for these ships, as long as we learn as much as we can, those people whose names we'll never know are not lost. They're remembered."

But there is a truth, an obstacle, in the way:

The wrecks are notoriously hard to find. Ships from that time were primarily made of wood, and they have disintegrated over time and been absorbed by the sea. Searchers today use equipment such as magnetometers and side-scan sonars to detect unnatural, manufactured materials in murky water. The work can take place amid treacherous conditions or at sites teeming with marine life that should not be disturbed.

"Once you disturb a site, there's no making that site how it was before it's been disturbed," says Ayana Flewellen, a co-founder of the Society of Black Archaeologists and instructor with DWP. "So we're really intentional about how we are documenting, being very cognizant of what is in the water around us to ensure that we're not disturbing the wreck or ocean creatures."

The sandy ocean floor covers and reveals as it fancies. What may be seen today may not be seen tomorrow. A proper expedition with historians and archaeologists can take years. But it is important to take as long as is needed to look.

"Our identities are informed by the past," says Calinda Lee, the head of programs and exhibitions for the National Center for Civil and Human Rights in Atlanta. "The past provides necessary context ... and [it] is something that we have to engage if we're going to be honest about what race means for us, has meant for us."

IT IS TIME FOR THE STORIES OF THOSE WHO DIED ABOARD SLAVE SHIPS TO RISE FROM THE DEPTHS, TO BE TOLD IN THEIR FULLNESS—WITH LOVE, HONOR, AND RESPECT.

I **LEARNED OF DWP** from a picture of Black women divers that I saw at the National Museum of African American History and Culture. Also in the photo was Ken Stewart, the visionary who got DWP off the ground almost 20 years ago. He had met the lone archaeologist at Biscayne National Park in the Florida Keys, Brenda Lanzendorf, who needed divers to help find the Spanish slave ship *Guerrero*, which had wrecked in 1827. As the southern regional representative for the National Association of Black Scuba Divers, Stewart had access to lots of divers. He rounded up a few. They learned how to map shipwrecks. Stewart declared that it was time for the group to dive with a purpose. Since then, DWP has helped document 18 shipwrecks and logged more than 18,000 hours in six countries.

Stewart steps with the quickness and the rhythm of an uptown New Yorker. He is meticulously groomed, his salt-and-pepper beard and mustache as neat as can be, with a beautiful voice that rises and falls with the cadence of a soulful love song. He is my herald, a songbird who called me forth and who continues to encourage me on this voyage.

I remember feeling my heart pound and leap as I gave him a resounding yes when he invited me to join them. A yes that started a rolling, powerful wave that eventually would wipe my life clean. I would resign from a communications director's job, give up my apartment in Washington, D.C., and siphon funds from my small bank account to travel and get the dives required to participate in DWP's training program.

I joined DWP partly because I wanted this adventure. Diving sites around the world. Pushing myself physically. But also because I've felt lost these past years. As if I don't belong. I am single, have no children, and among my close friends, I'm the only one who has had 10 different addresses—in eight cities, three countries, and on three continents—in the past 15 years. As a storyteller traveling the world reporting for magazines and news sites, I've felt like a global citizen but also like a leaf floating in the wind. Unrooted. Unmoored.

I prepared for a journey that I hoped could help me answer one core question: How can finding and telling the lost history of the slave trade help me,

Listen to the podcast *Into the Depths*. Use your phone's camera to scan the QR code.

‘BEING
CONNECTED WITH YOUR ANCESTORS
IS A VERY POWERFUL THING. IF YOU BREAK THAT CONNECTIVITY, IT’S LIKE YOU’RE WANDERING AROUND LOST.’

KAMAU SADIKI

DWP lead instructor Kamau Sadiki (at left) has participated in more than 20 diving missions. Sadiki helped identify the slave ships *São José Paquete d’Africa* in South Africa and *Clotilda* in Mobile, Alabama. Jewell Humphrey, an archaeology doctoral student on her first diving mission, represents a new generation searching for wrecked slave ships and documenting African American history. Preparing to become a professor, she wants to increase the presence of Black women academic leaders, who make up just 3 percent of faculty on college campuses.


NATIONAL ASSOCIATION OF BLACK SCUBA DIVERS
N.A.B.S.
CRESSI
SKIN
CRESSI
SKIN

I BEGIN TO SEE A WAY OF INTERPRETING ONE OF THE MOST **PAINFUL PARTS OF AMERICAN HISTORY** THROUGH A NEW LENS, WITH THE POSSIBILITY OF REPAIRING A DEEP WOUND.

as a Black American woman, figure out where I belong—and to whom I belong?

MOZAMBIQUE & SOUTH AFRICA: AFFIRMATION

MY JOURNEY BEGINS on Ilha de Moçambique (Mozambique Island), an island just under two miles long and less than a quarter of a mile wide, in the north of Mozambique. The island was the colonial capital of Portuguese East Africa from the 16th through the 19th centuries. Portuguese colonizers eventually turned it into a center of the slave trade; hundreds of thousands of Africans were trafficked from its port.

I have come at the invitation of DWP and the Slave Wrecks Project, hosted by the National Museum of African American History and Culture. The project includes the George Washington University, the Iziko Museums of South Africa, the U.S. National Park Service, and DWP, among others.

The island is colorful—reds, pinks, and blues painted on colonial-style buildings. On nondive days, I stroll through the cobblestone streets and the dirt paths. I eat good food such as *matapa de siri siri,* a stew of seaweed, cashews, and coconut milk that looks like creamed spinach. I note bright smiles on friendly faces that say, *"Tudo bem*—How's it going?" as I pass.

I also hear stories of the *São José Paquete d'Africa* shipwreck. The Portuguese ship traveled from Lisbon to Mozambique Island in 1794.

Traffickers loaded more than 500 people, many of the Makua ethnic group, into the ship's cargo hold. Headed for Brazil, the ship met its fate in the wee hours of the morning on December 27, on the rocks off Cape Town, South Africa. Two hundred twelve of the captive Africans on board were killed, the survivors sold into slavery.

The Slave Wrecks Project had been on a mission to find the *São José* and several other wrecks since 2008. The evidence eventually pointed to the area around Clifton, a suburb of Cape Town.

"We knew about the shipwreck, and Clifton, because it was identified by treasure hunters in the eighties as a Dutch ship," says Jaco Boshoff of the Iziko Museums, the lead archaeologist of the wreck and a co-founder of the Slave Wrecks Project. But he thought "maybe the identification was wrong, let's go have a look."

DWP provided divers to assist in the search. While Ken Stewart is my herald, Kamau Sadiki has been my guide, my sensei. He has served as my instructor and dive buddy. A shining light of clarity and purpose, he has been on more than 20 missions. He shares what it has meant for him to travel to Cape Town in 2013, to dive into those turbulent waters, and to find and touch artifacts from the *São José*.

"It was like you can hear the screams and the hollering and the pain, and the agony of being on a vessel in shackles, the sinking and breaking up in the sea," he says. "You know, in scuba diving we wear a mask, and sometimes they get foggy. But mine got wet from tears."

Trauma. Exactly what I feared to face. But then the story shifts and takes a surprising, and a soul-affirming, turn.

After positively identifying the *São José* and determining that some of the people held captive in its cargo hold were Makua, the team, which included Bunch and Sadiki, went back to the Makua-descendant community in the coastal village of Mossuril across from Mozambique Island to deliver the news.

Following a ceremony of singing, dancing, and speeches, Chief Evano Nhogache, the highest ranking Makua there, presented Bunch with soil from the island in a special cowrie-shell vessel with explicit instructions.

"He said that his ancestors have asked that when I go back to South Africa ... if I could

sprinkle the soil over the side of the wreck, so for the first time since 1794, [his] people can sleep in their own land," Bunch says.

"I lost it," Bunch adds, shaking his head as he recalls the scene. "I'm crying… I'm just thinking about the contradictions, the beauty that surrounds me, the fact that I'm a historian, but this is about how living people feel and think."

The team returned to South Africa to carry out Chief Nhogache's request. It was a rainy, stormy, dreary day on June 2, 2015. About 30 people turned out. Sadiki and two other divers walked into the water, and each distributed the soil from the cowrie-shell vessel.

"We stood for a moment. And I think there's one point where we just stood and embraced. And just let the waves hit us and wash us," Sadiki says. "I couldn't speak at all. And tears started flowing down all three of our eyes."

After traveling to Cape Town to see the wreck site for myself, I sit on the Sea Point Promenade, a two-mile stretch of palm trees, paved paths, and joggers that connects neighborhoods along the coast. It is adjacent to the location where the *São José* sank. I listen to the violence of the crashing waves on a bright sunny day, imagining what it would have been like more than two centuries ago as the ship struck those rocks and sank in the darkness. My heart aches for what those in the *São José*'s cargo hold must have felt that night of the wreck. The trauma still seems to exist as an actual energy radiating out from the sea. And I feel it.

But this time, I feel something else. Healing. Finality. Resolution that comes from knowing what happened.

And I am transported to a place of hope and possibility. I begin to see a way of interpreting one of the most painful parts of American history through a new lens, with a loving perspective, and with the possibility of repairing a deep wound—of closure. And that feels revelatory.

COSTA RICA: A QUEST FOR IDENTITY

I HEAD TO COSTA RICA, to the small towns of Puerto Viejo de Talamanca and Cahuita, about 10 miles apart in Limón Province on the Caribbean coast.

I meet with cousins Kevin Rodríguez Brown and Pete Stephens Rodríguez, then 19 and 18, respectively, and their aunt Sonia Rodríguez Brown.

The young men started scuba diving with the nonprofit diving group Centro Comunitario de Buceo Embajadores y Embajadoras del Mar (Ambassadors of the Sea Community Diving Center) when they were only 14 years old. The center has galvanized and trained local teens and young adults as scuba divers and citizen scientists since 2014.

"People call us recreational divers. And we are—*re*-creational," says journalist María Suárez, a co-founder of Ambassadors of the Sea. "We are re-creating diving. We are re-creating the history of Costa Rica. We are re-creating the way that the kids relate to the ocean."

Ambassadors of the Sea leads a community effort to help identify and document two possible wrecks of slave ships in their harbor, and it collaborates often with DWP.

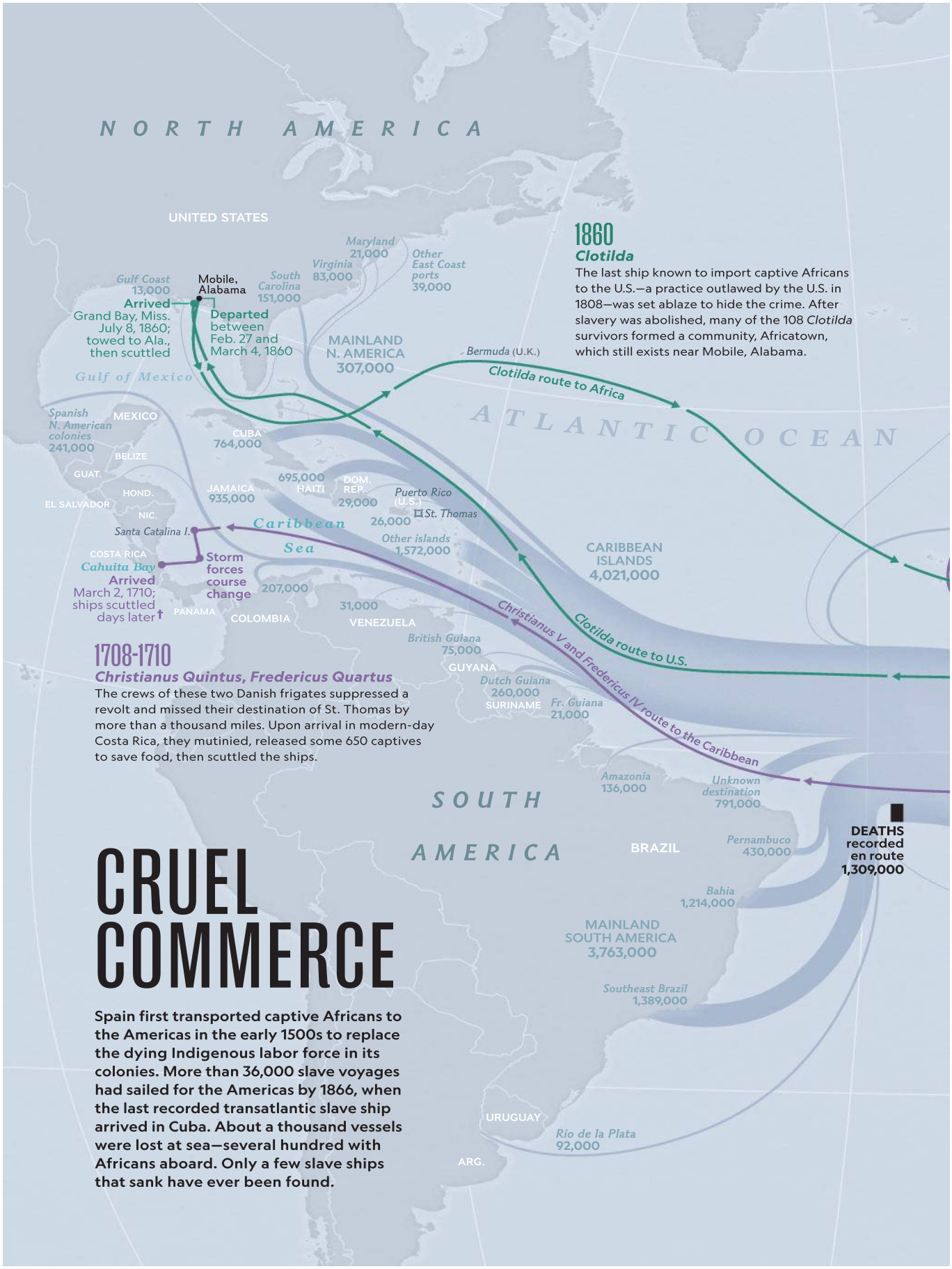
The Browns are one of the oldest families in Puerto Viejo, 200-plus relatives who look out for one another fiercely—and have a variety of skin hues, even within the same family unit. Stories of late, whispered in beds at night and over coffee in the morn, hypothesize that maybe the first Brown ancestor in these parts came in the cargo hold of one of the slave ships in the harbor.

Historians and archaeologists have gathered evidence that strongly suggests the bricks, cannons, anchors, bottles, and pipes at a site in the waters of Cahuita National Park belong to two Danish slave ships, the *Fredericus Quartus* and the *Christianus Quintus*.

"That site is just amazing," says Danish archaeologist Andreas Bloch, who has been helping Ambassadors of the Sea document the ships. "You have an archaeological site exactly where you've got tourists snorkeling and enjoying the wildlife. You have this amazing story that's just lying there as an open-air museum for everybody to see."

The two ships set sail from Denmark in 1708, heading to St. Thomas in the Danish West Indies filled with 806 captives from West Africa. But the ships, which were traveling in a convoy partly because of concerns the captives might rebel as they had once before, were blown off course by bad weather and navigational errors. In March 1710 they landed in the harbor at Cahuita. The crews on both ships mutinied. The sailors divided the ships' gold among themselves, then burned the *Fredericus* and scuttled the *Christianus* after some 650 Africans still alive reached shore.

About 100 of the Africans soon were



CRUEL COMMERCE

Spain first transported captive Africans to the Americas in the early 1500s to replace the dying Indigenous labor force in its colonies. More than 36,000 slave voyages had sailed for the Americas by 1866, when the last recorded transatlantic slave ship arrived in Cuba. About a thousand vessels were lost at sea—several hundred with Africans aboard. Only a few slave ships that sank have ever been found.

1860

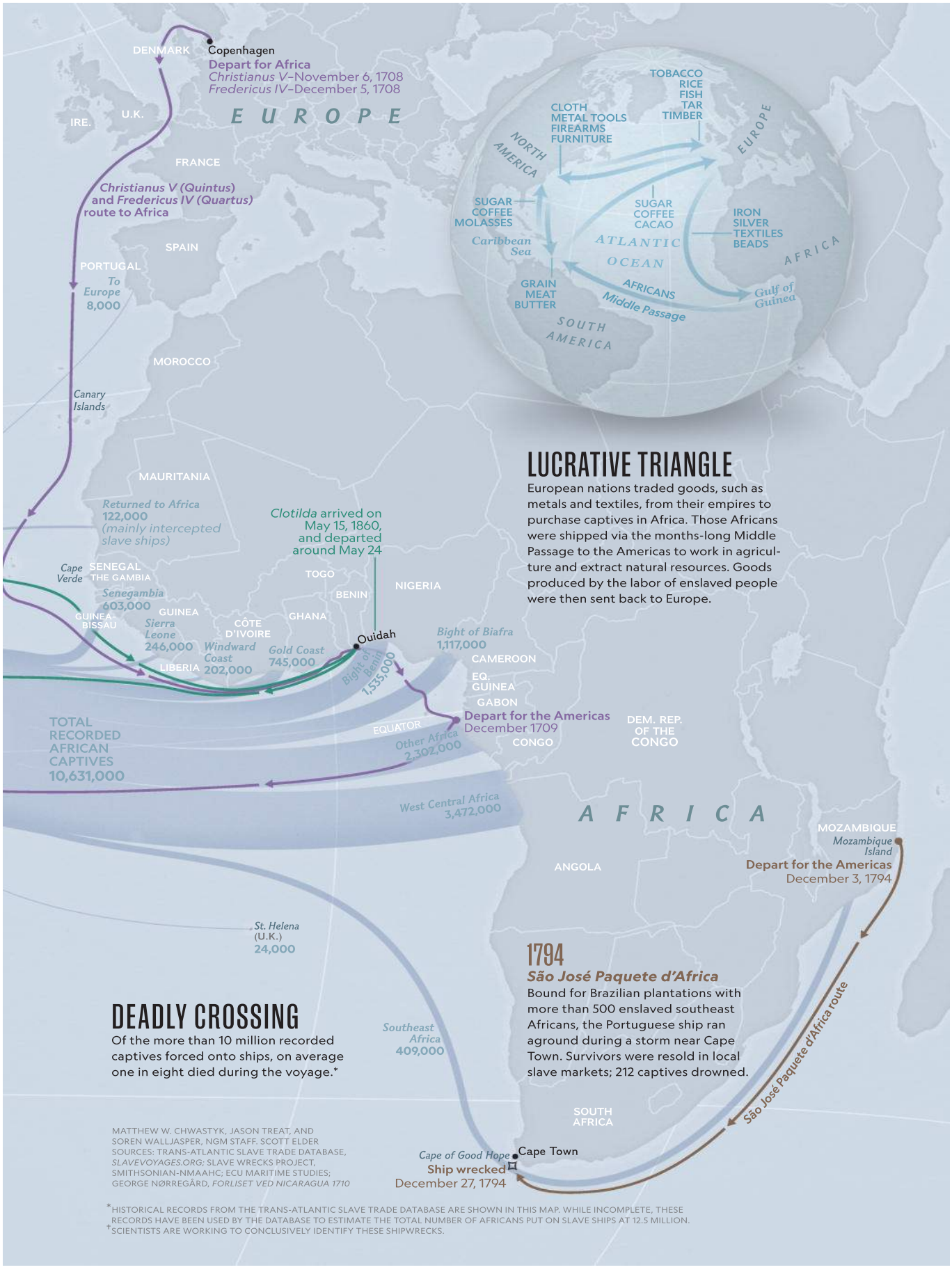
Clotilda

The last ship known to import captive Africans to the U.S.—a practice outlawed by the U.S. in 1808—was set ablaze to hide the crime. After slavery was abolished, many of the 108 *Clotilda* survivors formed a community, Africatown, which still exists near Mobile, Alabama.

1708-1710

Christianus Quintus, Fredericus Quartus

The crews of these two Danish frigates suppressed a revolt and missed their destination of St. Thomas by more than a thousand miles. Upon arrival in modern-day Costa Rica, they mutinied, released some 650 captives to save food, then scuttled the ships.



LUCRATIVE TRIANGLE

European nations traded goods, such as metals and textiles, from their empires to purchase captives in Africa. Those Africans were shipped via the months-long Middle Passage to the Americas to work in agriculture and extract natural resources. Goods produced by the labor of enslaved people were then sent back to Europe.

DEADLY CROSSING

Of the more than 10 million recorded captives forced onto ships, on average one in eight died during the voyage.*

1794

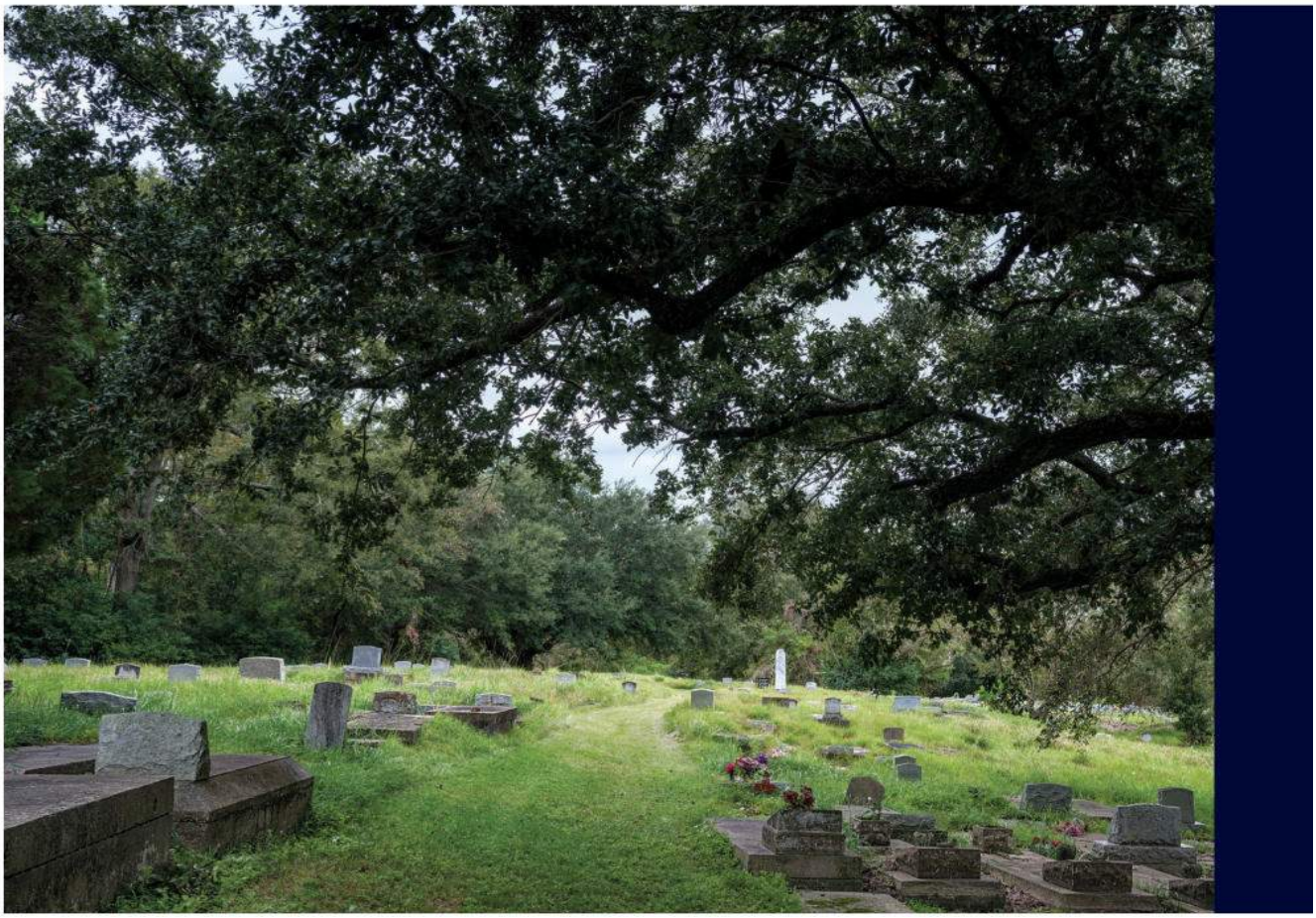
São José Paquete d'Africa

Bound for Brazilian plantations with more than 500 enslaved southeast Africans, the Portuguese ship ran aground during a storm near Cape Town. Survivors were resold in local slave markets; 212 captives drowned.

MATTHEW W. CHWASTYK, JASON TREAT, AND SOREN WALLJASPER, NGM STAFF. SCOTT ELDER
SOURCES: TRANS-ATLANTIC SLAVE TRADE DATABASE, *SLAVEVOYAGES.ORG*; SLAVE WRECKS PROJECT, SMITHSONIAN-NMAAHC; ECU MARITIME STUDIES; GEORGE NØRREGÅRD, *FORLISET VED NICARAGUA 1710*

*HISTORICAL RECORDS FROM THE TRANS-ATLANTIC SLAVE TRADE DATABASE ARE SHOWN IN THIS MAP. WHILE INCOMPLETE, THESE RECORDS HAVE BEEN USED BY THE DATABASE TO ESTIMATE THE TOTAL NUMBER OF AFRICANS PUT ON SLAVE SHIPS AT 12.5 MILLION.
†SCIENTISTS ARE WORKING TO CONCLUSIVELY IDENTIFY THESE SHIPWRECKS.

Along this arm of the Mobile River in Alabama are the remains of the *Clotilda,* the last known American ship to bring captive Africans to the U.S., in 1860. The captain tried to burn the ship because importing enslaved people had been illegal in the U.S. since 1808. Discovered in 2019, two-thirds of the structure survived, making it the most intact slave ship found to date. Some of the Africans trafficked on the *Clotilda* were buried at Old Plateau Cemetery (right) in Africatown, a community founded by the ship's survivors after slavery had been abolished.

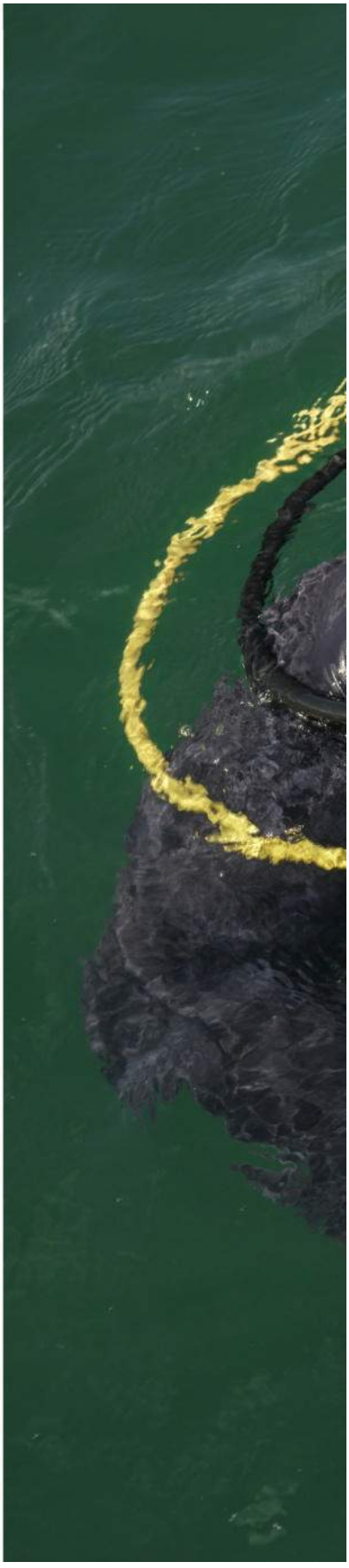


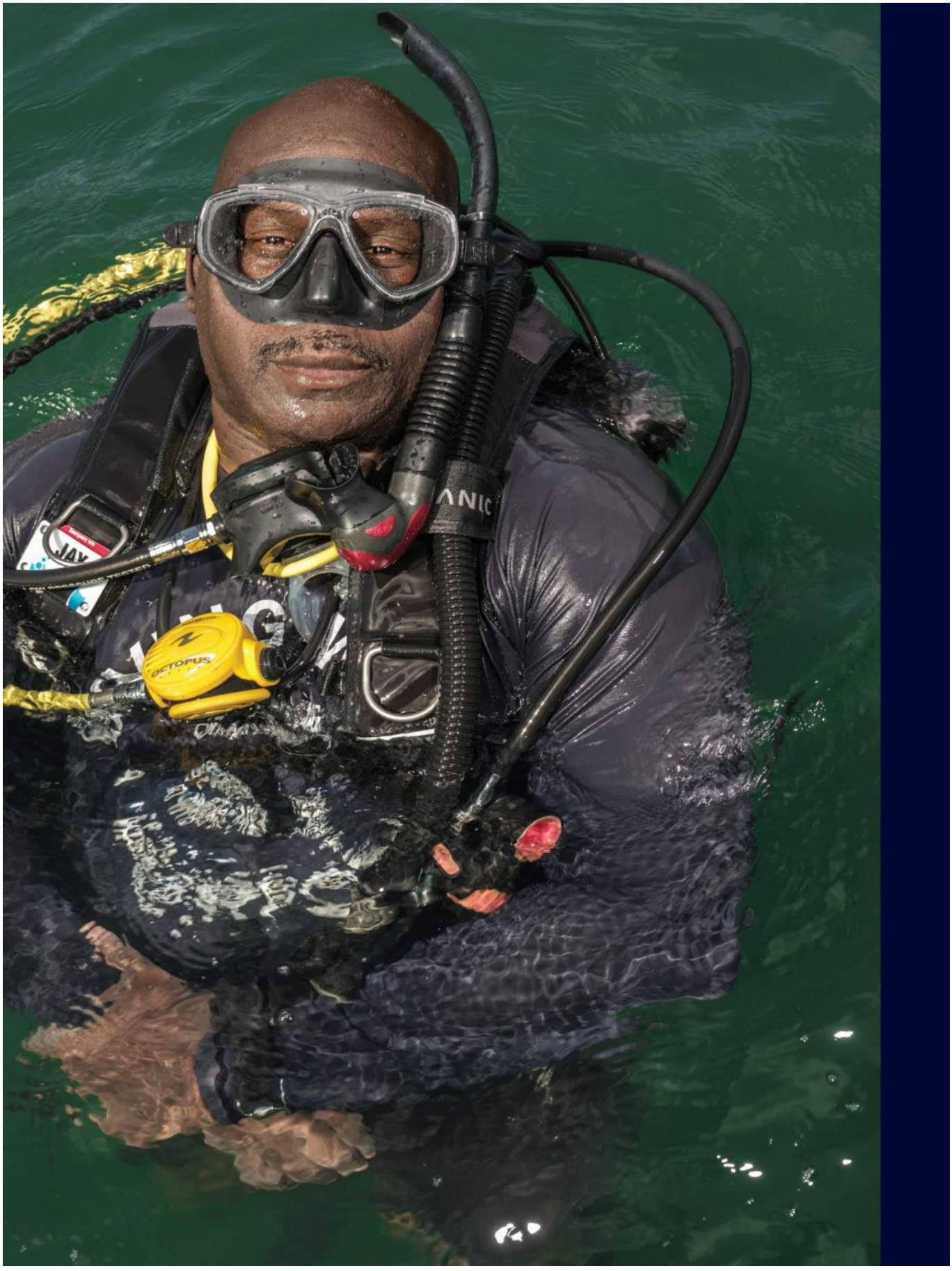
‘THE STORY OF SLAVERY IS A STORY OF EMPOWERMENT. IT’S ALSO A STORY OF RESILIENCE, **A STORY OF TRIUMPH.’**

JAY HAIGLER

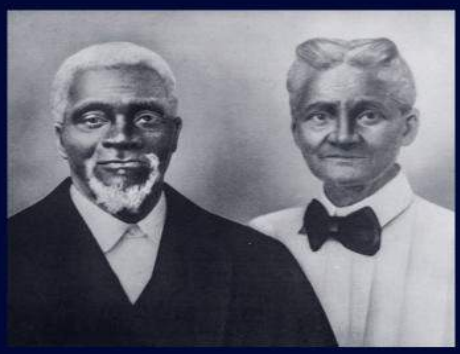
Albert José Jones (top) has been on more than 7,000 dives and is considered the godfather of Black scuba diving in the U.S. He founded the country’s oldest Black diving club, Underwater Adventure Seekers in Washington, D.C., in 1959, and co-founded the National Association of Black Scuba Divers, in 1991. DWP’s Haigler (right) has trained divers and searched for slave shipwrecks for 15 years. He says being underwater is a “life-changing, spiritual experience.”

PHOTO (TOP): COURTESY ALBERT JOSÉ JONES




OCTOPUS

ON A DIVE, I SEE IT: **THE OUTLINE OF AN ANCHOR ON THE OCEAN FLOOR.** I HOVER ABOVE AND FEEL THIS INTENSE, DESPERATE LONGING TO KNOW MY OWN FAMILY'S STORY.



Author Tara Roberts's great-great-grandparents Jack and Mary Roberts raised their family in Edenton, North Carolina.

recaptured and enslaved. But some disappeared into the hills, into oral history and myth. Some likely mixed into the local BriBri Indigenous community and left a line of descendants who still inhabit the area today.

Kevin Rodríguez Brown says they know the Brown family is part BriBri and part "Afro," the term Costa Ricans use to describe people of African descent. But before diving at the wreck site, he always thought the Afro part was 100 percent Jamaican, since he knew Jamaicans came as immigrants to Costa Rica in the late 1800s to build the railroad.

Sonia says the questions she and other members of the community began to ask deepened as the young divers started finding artifacts in the water. She wondered, "Why this is not in history? Why our family never taught us that? Why the community never say anything?

"So I make myself a question," Sonia continues in her soft and lyrical voice. "Who I am? And I think that is the most beautiful question that any people can do to [themselves]: Who I am?"

WHO I AM? Who am I? This kind of questioning sounds familiar.

Nearly 1,500 miles north of Costa Rica, along the Gulf of Mexico, are Mobile, Alabama, and Africatown, another Afro-descended community.

In Africatown many know for certain that their direct ancestors came over in 1860 on the *Clotilda,* the last known ship to bring captive Africans to U.S. shores. But those descendants are also fighting to get the story of the *Clotilda* and Africatown more widely told. They ask: Why is our history not in history books?

In 1808 the transatlantic slave trade had been abolished by the U.S. But an Alabama plantation owner and shipbuilder, Timothy Meaher, made a bet with a group of northern businessmen that he could bypass the law. He sponsored an expedition to West Africa and transported 110 captive people to the U.S. on the *Clotilda* (two died en route). The captain burned the ship on its return to hide the evidence, and Meaher dispersed most of the captives to the expedition's financial backers. He kept 32 people for himself.

Five years later, in 1865, the Civil War ended, and the captives were emancipated. The men worked in lumber and gunpowder mills and at the rail yards; the women grew vegetables and sold produce door-to-door. Some of these men and women, who had arrived on Alabama's shores naked and in shackles, managed to save money and eventually bought 57 acres on which to build their own version of home.

More than 150 years later, Africatown still exists, having experienced a heyday in the 1960s with more than 12,000 residents and barbershops, grocery stores, churches, a cemetery, and plenty of descendants who still have letters, pictures, documents, and stories, passed down through the generations.

"They had the brilliance and the intellect, and the passion and the wherewithal, to do all of those things. I look back and I even try to reflect over, What did I do in 10 years?" laughs Jeremy Ellis, whose ancestors on the ship were named

Pollee and Rose Allen. "If that doesn't get you excited, understanding that the DNA resides in you, I don't know what will."

In 2019 a team of archaeologists announced the discovery of the remains of the *Clotilda* in a remote arm of the Mobile River. The wreckage had settled deep into the mud, which helped preserve much of it. It's the most intact slave ship ever found.

People in the community kept saying "we need to find the ship," says Sadiki, who was part of the search team. "They knew how important it was to find a tangible artifact that got them where they are to help tell their story."

Most African Americans cannot trace their roots back to a slave ship. They hit what genealogists call the "1870 brick wall." Before 1870, the U.S. census did not track living enslaved people with names and identifying details.

On one of my last days in Costa Rica, María Suárez, Kevin Rodríguez Brown, and some of the other young people take me out on a boat to see the wreck site for myself.

Mask and gear on, I descend. The water is murky blue and green. It feels warm against my skin. Schools of fish swim by. I descend deeper, feeling at home underwater.

Then I see it. The outline of an anchor. It is partially buried, encrusted in coral and surrounded by grasses on the ocean floor.

I hover and imagine the Yoruba, Fon, Asante people maybe, young, scared, and suddenly freed on these shores. And I feel this intense, desperate, crushing longing to know my own family's story.

HIRE GENEALOGIST Renate Yarborough Sanders, who specializes in African ancestry research, and ask whether she can help me trace my family back to a slave ship.

"I don't ever like to say it's never gonna happen," she says. "But," she shakes her head, "it's not realistic."

Yarborough Sanders says she will try to find out what she can about my earliest known ancestor, my great-great-grandfather Jack Roberts, who was born enslaved in 1837.

My mom has a picture of Grandpa Jack and his wife, Mary. They are handsome. He has white cropped hair and a neatly trimmed white goatee, and she has on a bow tie.

Jack has these soft brown eyes. They are kind eyes. I think I might have liked to gather at his knee and hear his stories.

While I wait for a call, I decide to drive from my home in Atlanta to my family's hometown, Edenton, in Chowan County, North Carolina.

My mom and her 13 brothers and sisters grew up in a big house with columns and a porch, out in the country. The house is still there and still in the family, but it is in a state. There is a big hole in a side wall—a hole I can actually walk through if I bend my leg and stoop down. The windows are broken. There is mold on the walls. Plaster and debris are everywhere.

When I used to visit as a kid, my impression of the place was miles of cornfields and lazy quiet, only the droning of bees and singing of crickets to break up the monotony of the day. The oppressive weight of the silent country rested upon my shoulders back then, and it depressed me to come back here.

I get out of my car and stand on the property, looking around and watching the landscaper, Joseph Beasley, tend the yard, poking at weeds. I ask him about the fields.

"These little plants—those are soybeans," he says. "See that dark green stuff way back yonder? That's corn. Right across the edge here."

I don't know why this just dawns on me now. But my grandfather, who had only a fourth-grade education, managed to buy this house, a former plantation of an enslaver, and about a hundred acres of land in the 1930s.

It makes me realize I've probably missed even more about my family's legacy.

I book a room at a bed-and-breakfast on North Broad Street in downtown Edenton, which is considered one of the loveliest small towns in the South largely because of this area. The town sits right on the Albemarle Sound. Colonial mansions that likely housed enslaved people, or profited from the business of plantations, rise majestically above lines of trees on carefully tended lawns. In all my years coming to my grandparents' house, this is probably the second or third time that I have ever set foot downtown.

I expect ignorance, subtle racism, an intentional erasure of the complexity of the past. But I am surprised.

Friendly people wave at me as I cross streets. Shop owners and waitresses chat me up. The twang of the Deep South rings pleasantly in my ears. As I walk around town, I meet a Black birder walking his dog, who tells me about a local church's reconciliation group, a forum for both

‘THERE IS SOMETHING ABOUT THESE SHIPS, HOW THEY **MOVED TRADITIONS,** HOW THEY **MOVED CULTURE.’**

AYANA FLEWELLEN

Archaeologists Justin Dunnavant (at left), a National Geographic Explorer, and Ayana Flewellen are co-founders of the Society of Black Archaeologists and instructors with DWP.

Photographed while on a mission to evaluate an 18th-century wrecked merchant ship in St. John, they also run the excavations at a former Danish sugar plantation on nearby St. Croix.


Nexie
BARE
3/2mm
SCUBAPRO

the victims and benefactors of an unjust society to tell their stories, that meets every Thursday.

Historical markers to African American rebellion and accomplishment line sidewalks, not far from a big Confederate monument.

The contradiction.

The most notable marker honors Harriet Jacobs, a local woman who escaped slavery via the Maritime Underground Railroad. Jacobs went on to write one of the few known slave narratives, *Incidents in the Life of a Slave Girl,* in 1861 and became a revered abolitionist.

Edenton historical interpreter Charles Boyette tells me that the Maritime Underground Railroad was a "hidden network of connections and safe houses that allowed enslaved persons to seek their freedom along the waterways."

He says that Edenton was part of a network for thousands who escaped to the north with the help of sailors, dockworkers, fishermen, both free and enslaved, and others who made their living off the water and waterfront. I'd never heard of the Maritime Underground Railroad. I wonder whether my 12- and 13-year-old nieces Shi and Wu Murphy, who live only about 30 minutes away in the next town over, know about it. They don't.

Yarborough Sanders, the genealogist, calls on Zoom. She has results.

First, it turns out Jack bought even more land than my grandfather. At least 174 acres in total. Maybe it's in the family, because I managed to buy three homes by the time I was 31.

Second, he was a delegate to the 1865 Freedmen's Convention in Raleigh, a statewide assembly that took place after the end of the Civil War to consider aspirations and goals for the formerly enslaved.

That resonates. He tried to be part of the solution, despite the odds against him.

Finally, there was evidence that Jack fought in the Civil War, in the United States Colored Troops—Second Regiment, Company B.

Yarborough Sanders smiles at me. "If that's your ancestor, it is a huge, big deal."

She also tells me with laughter that he may have owned a speakeasy.

I feel a stirring of pride. I am not a descendant of sad people, of victims, of faceless people. Jack has become real to me—not perfect, just real.

As has Edenton.

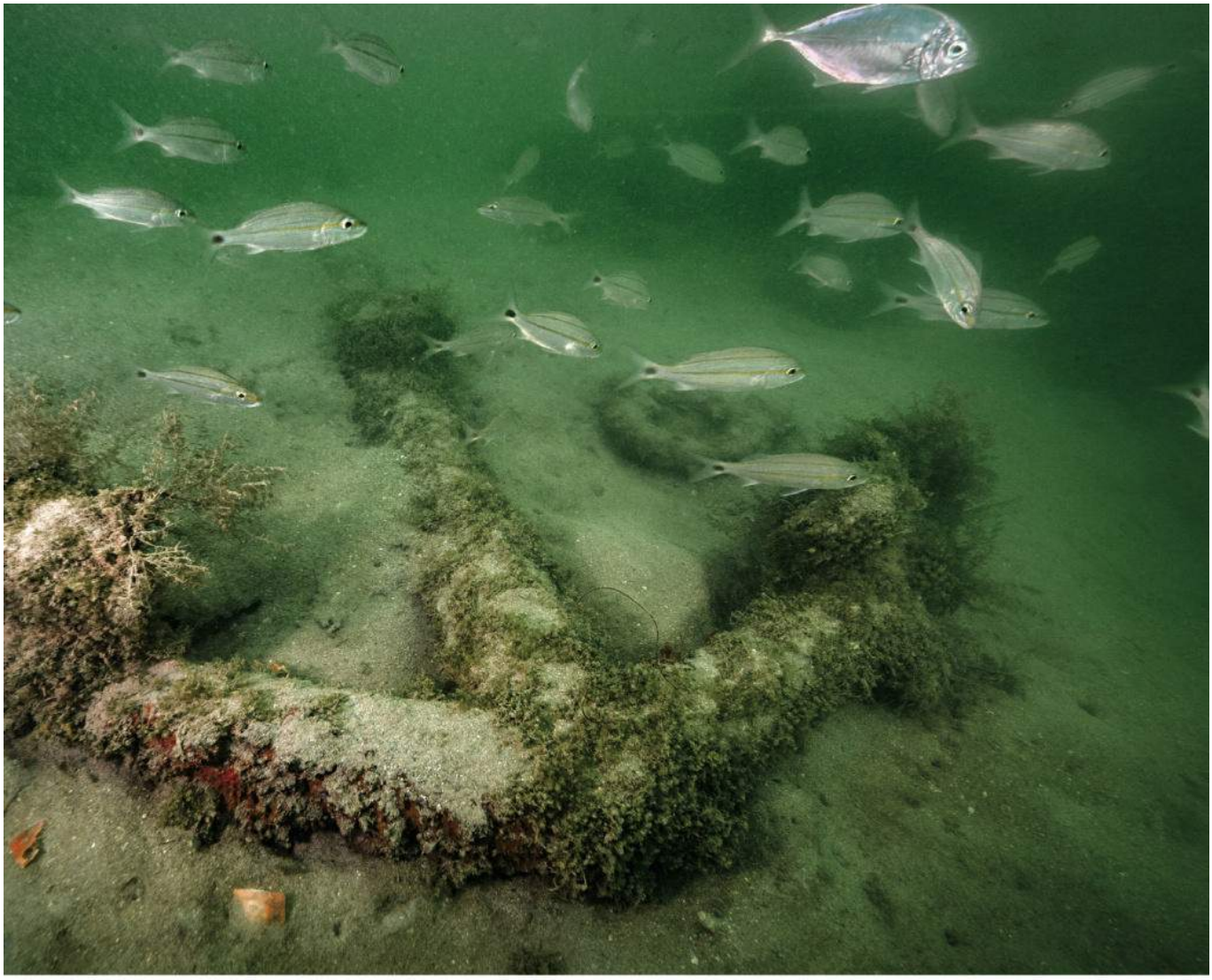
Turns out, I am in Edenton on June 19, 2021, "Juneteenth," the day the federal government just made an official holiday to celebrate the freedom of those who were enslaved. Oh, how the universe works.

DWP was invited by the U.S. Virgin Islands' state historic preservation office to map the remains of Coral Bay Shipwreck No. 1, a merchant ship from the 1700s that might have carried human cargo. This admiralty anchor, the manner of the ship's construction, and an intact bottle helped narrow the ship's date.
JENNIFER HAYES

And Edenton celebrates all out, with a soulful band, vendors, and food stalls right at the river. People of different races are communing. That evening, there is a vigil at the Confederate monument to get rid of the negative energy of plantation culture and bring in positive vibrations.

Curious eyes follow me as I walk around with all my recording equipment. People ask who I am and who my people are. And now I can say I am of Jack Roberts's clan—Jack begot John H., who begot John A., who begot Lula, who begot me. And there is recognition, laughter, stories from the past of my mom, my aunt Myrtle, my uncle George, my uncle Sonny.

Carol Anthony, a stranger passing by, upon



hearing my name, tells me that she is married to my uncle Teeny's stepson.

How did I not know this place? Many African cultures believe that the ancestors never die, never lose their connection with the living. That their energy is still there, supporting us, pushing us, loving us. What if, I think, all African Americans could look back and claim their past? See their ancestors fully? Know their whole story? Would that change everything?

I'm not a scientist or a historian. I am a storyteller. And I can now see that the stories we find as we discover ourselves don't just belong to us as individuals. They also belong to the communities of which we are a part. And if those groups are brave, they can use those stories to expand the possibility of who we might all become together.

This history—our history—has sad notes. Like any good love story, it has pain and hurt. But this history, Black history, American history, also has lifting notes—crescendos—full orchestras that tug at the heart and make it soar.

I thought this search for slave ships might be hard. I thought I would need hands holding mine, rubbing my back, consoling my tears and my heartache. Instead I found strength. And power. And adventure. And camaraderie. I found laughter. Love. Life. Kinship. I found something strong and necessary to root and ground me.

All from a picture in a museum.

Welcome home. □

Tara Roberts's maritime archaeology storytelling includes our six-part podcast. **Wayne Lawrence'**s photography, last featured in *National Geographic*'s Race Card Project in June 2021, illuminates the complexities of the human experience.

SAVING

BY **DENISE HRUBY**

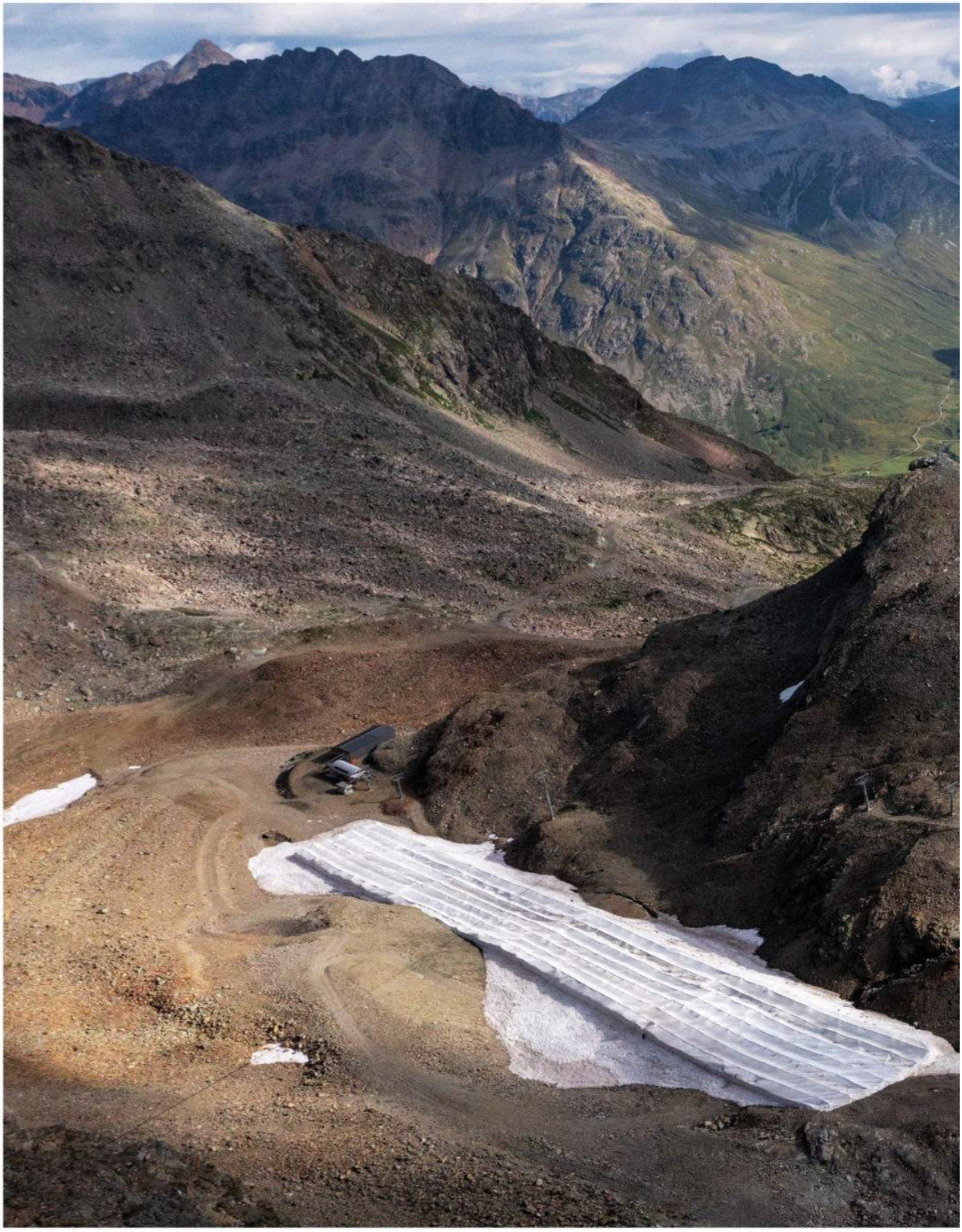
PHOTOGRAPHS BY **CIRIL JAZBEC**

IN THE ALPS, THE ECONOMY AND CULTURE REVOLVE AROUND SNOWY WINTERS. NOW THERE'S A SCRAMBLE TO PRESERVE SNOW AND ICE THREATENED BY WARMING.

WINTER

At Davos, Switzerland, in late October, a skier navigates a cross-country trail made of artificial snow produced the previous winter. It was stored over the summer in a 20-foot mound under a 16-inch layer of sawdust, then spread on the trail for the new season.

As the climate has warmed since the 19th century—and especially in the past few decades—the Alps have lost two-thirds of the ice from their roughly 4,000 glaciers. On the Pers Glacier in eastern Switzerland, geophysicist Christine Seupel, engineer Dieter Müller, and glaciologist Andri Moll measure the ice thickness with ground-penetrating radar.



Precious snow is covered with fabric to protect it from melting over the summer at Diavolezza, a Swiss resort. Natural snow has become so unreliable in the Alps that the ski industry now depends on making it artificially and storing it in depots.

SURROUNDED BY RUGGED PEAKS SO HIGH THEY TEAR CLOUDS APART,

the tractor-size groomer backs over a 40-foot-tall mound of compacted snow, unrolling a bolt of white fabric. On top of the mound, six workers are stitching fabric panels together with a handheld, heavy-duty sewing machine. It's June at Kitzsteinhorn in Austria, one of the highest and coldest ski areas in the Alps, and meltwater is gushing into ravines on the flanks of the mountain. But up on the glacier, the slope maintenance crew is preparing for the next season.

Even at 10,000 feet, counting on natural snow has become too risky. So the team led by technical manager Günther Brennsteiner is taking out insurance. They've spent a month plowing the last of this season's snow into eight multistory mounds, of which the largest are bigger than football fields. They're now spending another month covering the mounds with fabric to insulate them over the summer. When the new season begins, if it's too warm for fresh snow to fall—or even for artificial snow to be made—dump trucks and groomers will spread old snow on the slopes.

Figuring out how to stockpile snow at this scale hasn't been easy, says one of the workers, Hannes Posch. Before the crew started stitching the panels together, wind gusts sometimes ripped them apart, uncovering the mounds. Other times, the fabric froze solid into the snow.

"Everything that could go wrong, has," Posch says, as he zip-ties a sandbag to the fabric. Once, at the nearby resort of Kitzbühel, lightning set a

The National Geographic Society, committed to illuminating and protecting the wonder of our world, has funded Explorer Ciril Jazbec's work on climate change since 2019.

ILLUSTRATION BY JOE MCKENDRY

Researchers explore an ice cave in the Pers Glacier. Such caves form naturally, but the recent expansion of this one is a sign of how rapidly glaciers are retreating. Some have all but vanished, leaving locals with a deep sense of loss. By 2100, if climate-warming greenhouse gas emissions aren't cut dramatically, the Alps could be nearly ice free.

fabric-covered snow depot like this ablaze, and 30 firefighters battled the flames for hours. Snow is that precious these days.

"With the warming climate, everything has changed," Brennsteiner says. He started working here 31 years ago, during what now seem like the glory years of Alpine skiing.

Alpine winters are dying. Since the 19th century, average temperatures in these mountains have risen by two degrees Celsius, or 3.6 Fahrenheit—about twice the global average. Snow is arriving later in the season and melting sooner. The Alps as a whole have lost about a month of snow cover, according to scientists who analyzed data from more than 2,000 weather stations.

To many of the 14 million people who live in one of the world's most densely populated mountain ranges, the implications are terrifying. The economy here depends on snow to lure 120 million tourists a year—far more than visit the United States. Besides working at Kitzsteinhorn, Brennsteiner serves as mayor of Niedernsill, a village of 2,800 at the foot of the mountain. There's hardly a family in the village that doesn't depend on winter, he says. Without snow, it might shrink to a thousand people.

"We wouldn't have children in kindergarten," Brennsteiner says, describing a downward spiral. "This is the foundation of our lives here."

To save themselves, the people of the Alps are going to dramatic lengths. An estimated 100,000 snowmaking machines now power the Alpine ski industry, enough to blanket an area

Swiss glaciologist (and amateur violinist) Felix Keller, who grew up near the Morteratsch Glacier, has a plan to stop its retreat. “People say this is completely nuts,” he admits. “Maybe they’re right.”

Keller's plan is to recycle glacial meltwater into snow. Here his team tests a prototype of one of the "snow cables" that, hanging over the glacier, would shower it with 30 feet of snow annually.

the size of New York City within hours. Beyond snow depots like Kitzsteinhorn's, desperate locals are swaddling the ice on a few of the Alps' roughly 4,000 glaciers, to try to delay the rapid melt caused by global warming. In one visionary scheme, Swiss scientists hope to save a glacier by spraying a swath of it with human-made snow.

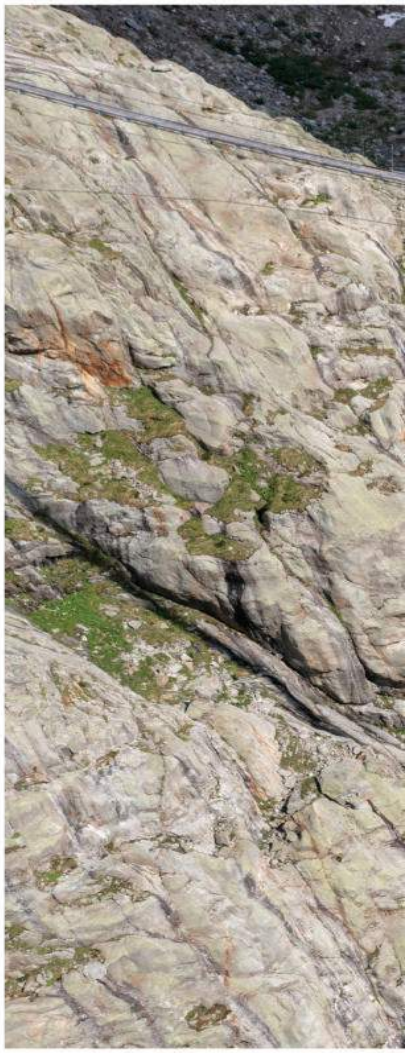
Some of these methods are ingenious and tantalizing; others are environmentally and economically questionable. All are driven by a profound apprehension: Without winter, what would our lives here be?

LIKE BRENNSTEINER and photographer Ciril Jazbec, I was lucky enough to grow up in the Alps at a time when snow was abundant. I remember the excitement of leaving my tiny footprints in the season's first snowfall; I remember the color of my dad's cheeks as he shoveled the house free, again and again. My parents clapped my first skis on my feet before I was three.

That period turns out to have been a historical blip. It was only in the second half of the 20th century that cold, snowy winters became a boon for the Alps. Before then they were a harsh burden, attributed in folklore to wicked demons. My generation is among the last to have heard oral histories of the struggle to survive here, back when the economy was based on farming. Snow used to cover tiny plots of land for months. Avalanches thundered down the mountainsides, burying villages. One of my grandma's nine siblings, Walter, died in one. He was 24.

When food was scarce—and it generally was—children from the poorest pockets of the Alps were forced to trek to lowland markets, where they sold themselves into seasonal bondage as farmworkers, typically from March to October. "A barely concealed slave market," the Cincinnati *Times-Star* wrote in 1908, describing one such market in Friedrichshafen, in southern Germany. It reported as many as 400 boys and girls up for barter, some as young as six, "as if they were a lot of calves or chickens." The practice lasted well into the 20th century.

After World War II, an economic boom created a thriving middle class across Europe—but not, at first, in the high Alps. The steep mountainsides made it impossible for farms to expand or to deploy the modern machinery that allowed others to prosper, says Johann Wolf, who was born in the remote village of Ischgl, Austria, in 1929, during the coldest winter on record.

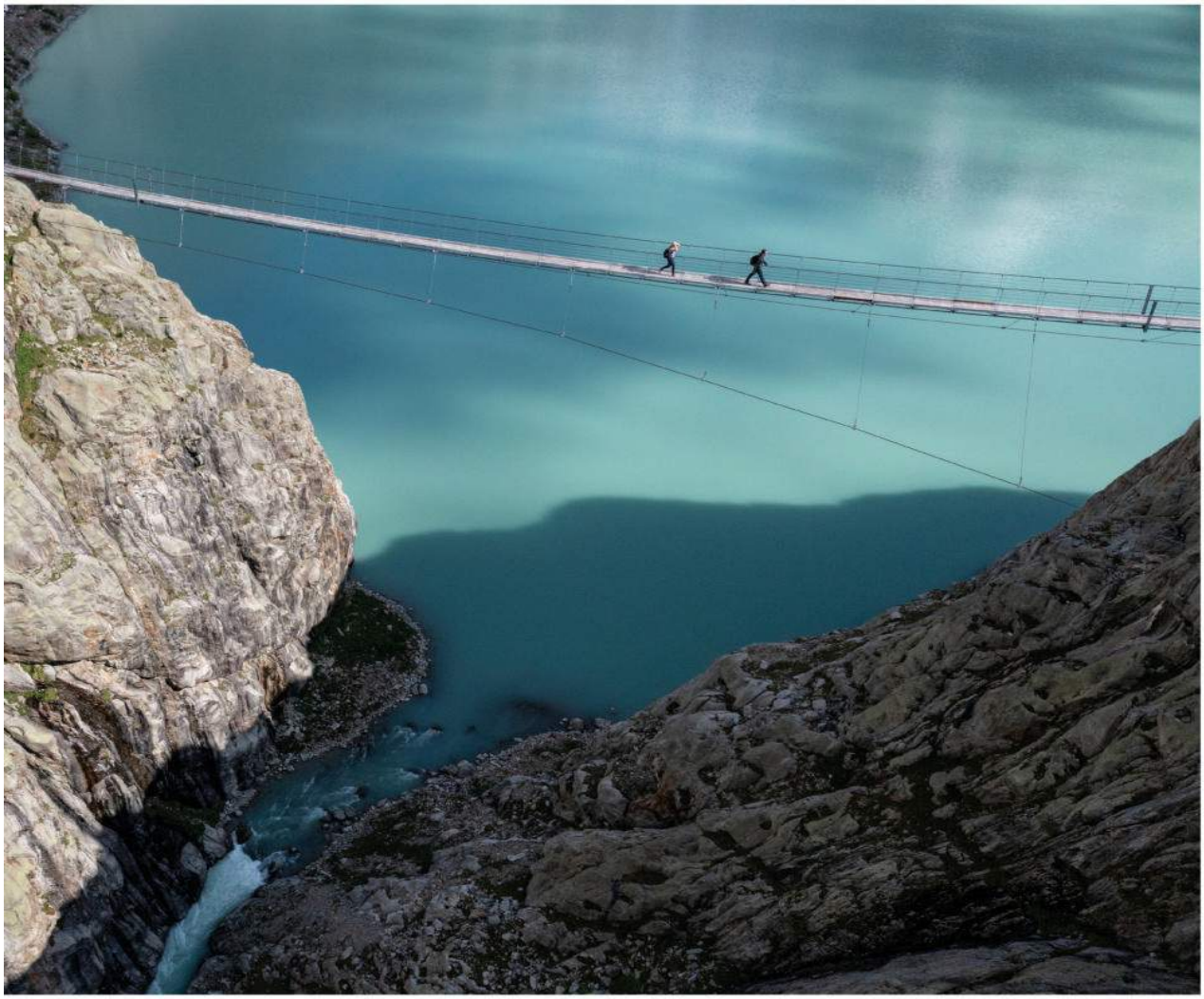


Where tourists now walk on a suspension bridge, several hundred feet above a meltwater torrent, they used to walk across ice on the snout of Switzerland's Trift Glacier. The lake didn't exist before this century; the bridge was first built in 2004. A power company plans to put a dam here.

"The scales turned against mountain farming," he says. Some of his siblings left the secluded valley, but he stayed.

Winter tourism, Wolf and other villagers reckoned, was the only thing that could save them. In desperation, they sold livestock and put up their land against loans to invest in a cable car. Ischgl stood to lose everything, but the gamble paid off. In 1963, the cable car began pulling tourists up the mountains, and locals out of poverty. Around the Alps, a similar transition was under way.

Today, a four-star hotel stands on the 400-year-old farm where Wolf was born. It's surrounded in Ischgl by luxury chalets with Jacuzzis, fine restaurants, and a vibrant nightlife



scene that has hosted concerts by Rihanna, Pink, and Lenny Kravitz. Next December, Ischgl is set to open thermal baths and an ice-skating rink.

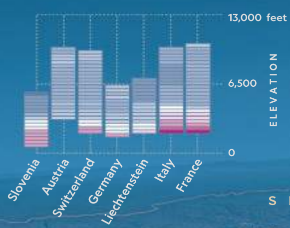
Many locals still see themselves as down-to-earth farmers who love their valley. Wolf's son Hannes and 26-year-old grandson, Christoph, introduce me to their cattle—Hermann, Kathi, Gitta, and Lilly—as the four munch fragrant hay on some of the Alps' most expensive real estate. The family would never think of getting rid of them. "It's heritage and duty," Wolf says.

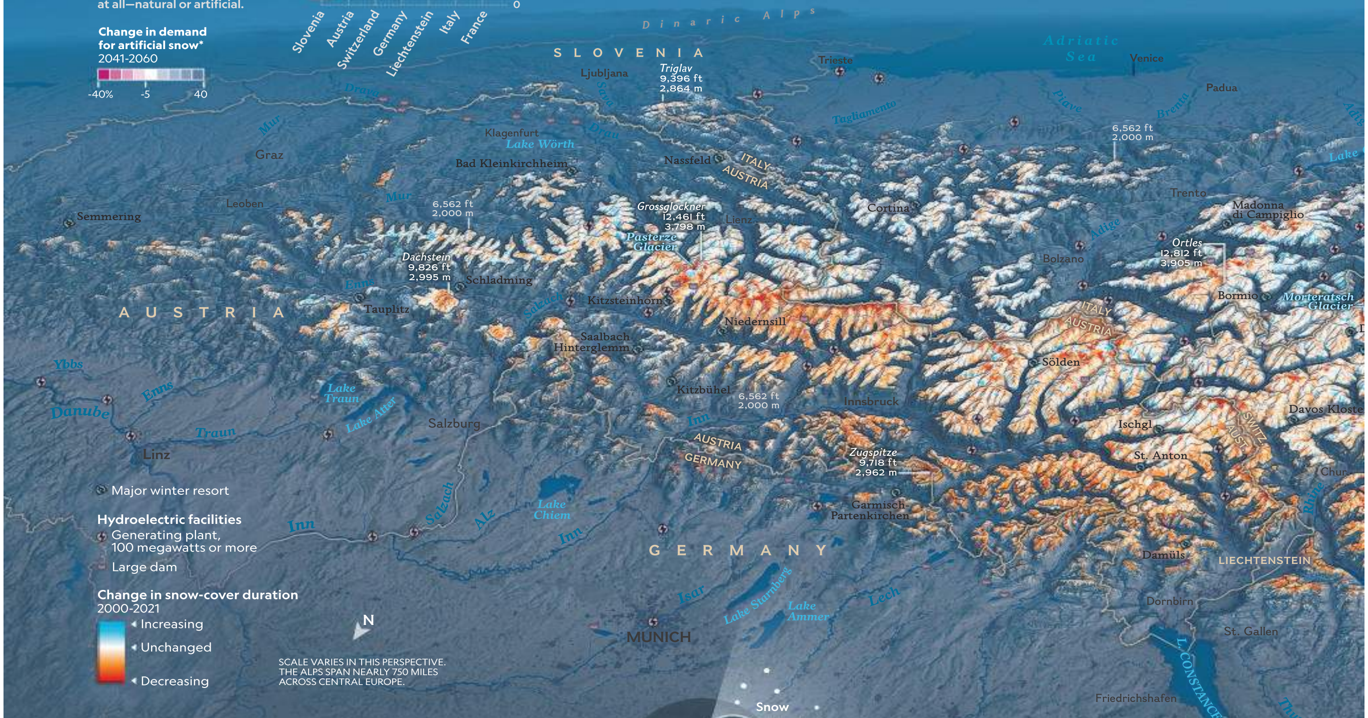
Yet Alpine farming is no longer enough to make a living. "Without winter, these valleys would be completely abandoned and empty," says Hannes Wolf. In 2020, Ischgl got a horrifying foretaste of such a world, when it became an early hot spot in the COVID-19 pandemic. Fleeing tourists helped spread the virus in Europe.

The pandemic shut down ski tourism across the Alps. Millions of hotel beds stayed cold. But climate change poses a more profound threat.

ONE OR TWO DEGREES of warming may not sound like much, but it can determine whether precipitation falls as snow—or rain. Turn up the temperature just a notch, and snowflakes might never form. That's why the Alps are in deep trouble, says Yves Lejeune, the scientist in charge of the Col de Porte meteorological observatory, at 4,350 feet in the western French Alps.

Desperation at the top
Under a worst-case climate change scenario, it could be ski areas at the highest elevations that have the greatest demand for snow production. Lower areas may be too warm for any snow at all—natural or artificial.





PRESERVING THE SNOW

Public and private groups are working to lessen the impact of shrinking snowfall. But current methods to create and preserve snow can cost millions of dollars, consume water and energy resources, and work only on a small scale.

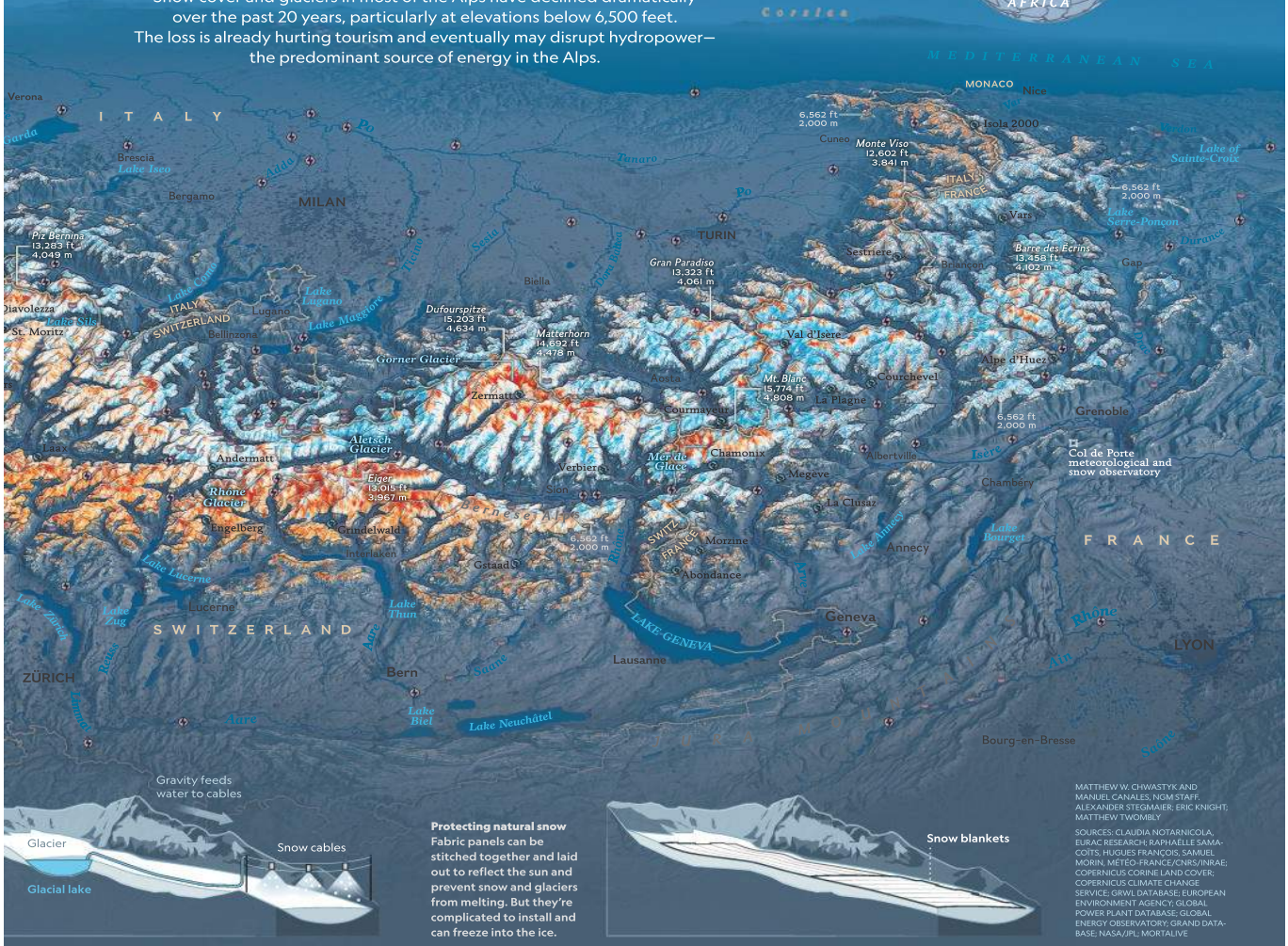
Machine-made snow
Typical electric-powered snow machines, invented in the 1950s, spray water. A fan diffuses the water into tinier droplets that can make snow—if the air is cold and dry enough.

Getting off the grid
Swiss engineers are innovating a system of cables that uses water from melting glaciers to make snow. Water pressure would be created by gravity and could work without electricity in remote areas.

*COMPARED WITH 1986-2005

ALPINE MELT

Snow cover and glaciers in most of the Alps have declined dramatically over the past 20 years, particularly at elevations below 6,500 feet. The loss is already hurting tourism and eventually may disrupt hydropower—the predominant source of energy in the Alps.



Protecting natural snow
Fabric panels can be stitched together and laid out to reflect the sun and prevent snow and glaciers from melting. But they're complicated to install and can freeze into the ice.

MATTHEW W. CHWASTYK AND MANUEL CANALES, NGM STAFF. ALEXANDER STEGMAIER; ERIC KNIGHT; MATTHEW TWOMBLY

SOURCES: CLAUDIA NOTARNICOLA, EURAC RESEARCH; RAPHAËLLE SAMACOITS, HUGUES FRANÇOIS, SAMUEL MORIN, MÉTÉO-FRANCE/CNRS/INRAE; COPERNICUS CORINE LAND COVER; COPERNICUS CLIMATE CHANGE SERVICE; GRWL DATABASE; EUROPEAN ENVIRONMENT AGENCY; GLOBAL POWER PLANT DATABASE; GLOBAL ENERGY OBSERVATORY; GRAND DATABASE; NASA/JPL; MORTALIVE

WARMING GLOBE, WANING WINTER

BY **MATTHEW W. CHWASTYK, MANUEL CANALES,**

AND **ALEXANDER STEGMAIER**

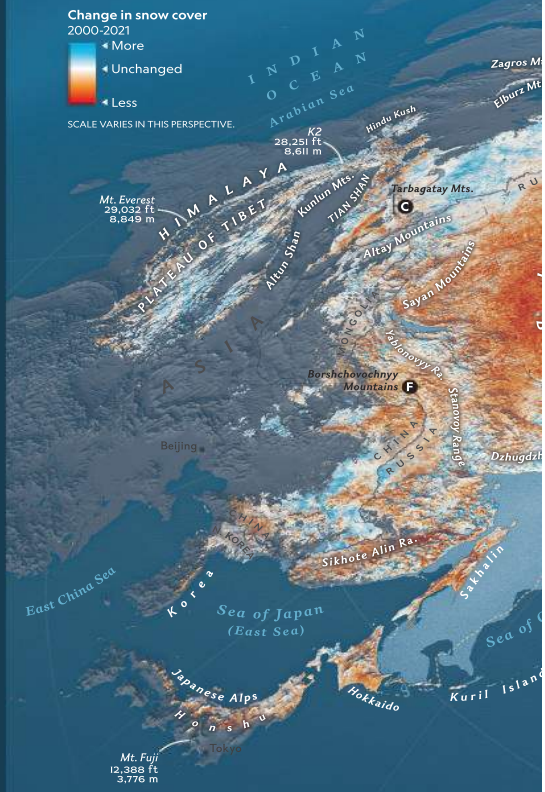
SNOWFALL IS DECREASING IN MOUNTAIN RANGES AROUND THE WORLD, DRASTICALLY IN SOME REGIONS. VITAL TO ECOSYSTEMS AND ECONOMIES, SNOW AND ICE LEVELS AFFECT TOURISM, HYDROPOWER PRODUCTION, AND WATER SUPPLIES IN MANY PARTS OF THE WORLD. SCIENTISTS ARE TRACKING THE CHANGES, AND INNOVATORS ARE SEARCHING FOR SOLUTIONS.

Snowfall varies by region and is influenced by factors such as latitude, elevation, humidity, and proximity to oceans or lakes. Rising air temperatures boost humidity levels, and winter precipitation increasingly falls as rain instead of snow. Low-elevation and coastal areas are especially at risk of reduced snowfall.

ERIC KNIGHT; MATTHEW TWOMBLY. SOURCES: CLAUDIA NOTARNICOLA, EURAC RESEARCH; NASA/JPL; NOAA; NATIONAL SNOW AND ICE DATA CENTER

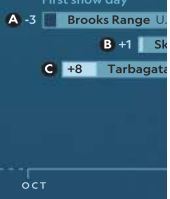
TRACKING A CHANGIN

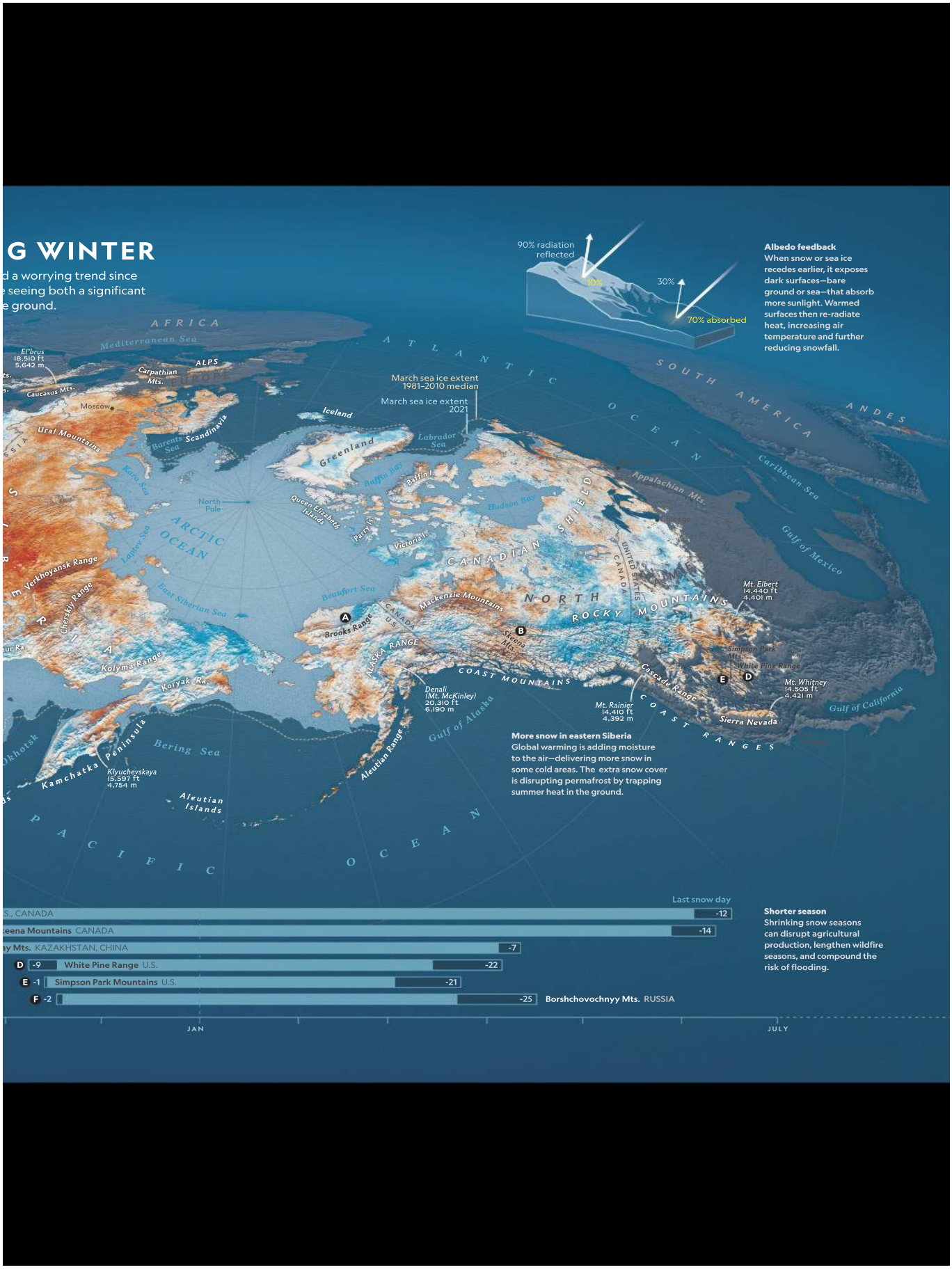
Snow-cover data from satellites are helping scientists recor
2000. Nearly 80 percent of the world's mountain ranges are
decline in snow-covered area and fewer days of snow on th



COUNTING THE SNOW DAYS

In many mountain ranges the first snow is arriving later in the year and the last snow earlier. The ranges at right have shown some of the largest changes in the last snow day over the past 21 years.




G WINTER
d a worrying trend since
e seeing both a significant
e ground.
90% radiation reflected
10%
30%
70% absorbed
Albedo feedback
When snow or sea ice recedes earlier, it exposes dark surfaces—bare ground or sea—that absorb more sunlight. Warmed surfaces then re-radiate heat, increasing air temperature and further reducing snowfall.
March sea ice extent 1981–2010 median
March sea ice extent 2021
AFRICA
Mediterranean Sea
El'brus 18,510 ft 5,642 m
Caucasus Mts.
Carpathian Mts.
ALPS
EUROPE
Moscow
Ural Mountains
Barents Sea
Scandinavia
Iceland
Greenland
Labrador Sea
Baffin Bay
Baffin I.
Kara Sea
North Pole
Queen Elizabeth Islands
Parry Is.
Victoria I.
Hudson Bay
ARCTIC OCEAN
Laptev Sea
Verkhoyansk Range
Cherskiy Range
East Siberian Sea
Beaufort Sea
Mackenzie Mountains
CANADIAN SHIELD
NORTH AMERICA
ROCKY MOUNTAINS
Brooks Range
ALASKA RANGE
Kolyma Range
Koryak Ra.
Denali (Mt. McKinley) 20,310 ft 6,190 m
COAST MOUNTAINS
Cascade Range
Mt. Rainier 14,410 ft 4,392 m
Mt. Elbert 14,440 ft 4,401 m
Simpson Park Mts.
White Pine Range
Mt. Whitney 14,505 ft 4,421 m
Sierra Nevada
COAST RANGES
Gulf of California
Gulf of Mexico
Caribbean Sea
Appalachian Mts.
ATLANTIC OCEAN
SOUTH AMERICA
ANDES
Gulf of Alaska
Bering Sea
Kamchatka Peninsula
Klyuchevskaya 15,597 ft 4,754 m
Aleutian Islands
Aleutian Range
PACIFIC OCEAN
More snow in eastern Siberia
Global warming is adding moisture to the air—delivering more snow in some cold areas. The extra snow cover is disrupting permafrost by trapping summer heat in the ground.
Last snow day
S., CANADA -12
eena Mountains CANADA -14
y Mts. KAZAKHSTAN, CHINA -7
D -9 White Pine Range U.S. -22
E -1 Simpson Park Mountains U.S. -21
F -2 -25 Borshchovochnyy Mts. RUSSIA
JAN
JULY
Shorter season
Shrinking snow seasons can disrupt agricultural production, lengthen wildfire seasons, and compound the risk of flooding.

Sun-blocking plastic fabric drapes the tip of the Rhône Glacier in Switzerland. A cave dug each summer in the shifting ice has attracted tourists since 1870. For now, the year-round, 12-acre cover preserves enough ice to house the cave.

ONE OR TWO DEGREES OF WARMING CAN MEAN THAT SNOWFLAKES NEVER FORM. THAT'S WHY THE ALPS ARE IN DEEP TROUBLE.

On his way to work, Lejeune passes Le Sappey-en-Chartreuse, a small village with a church at its center and ski runs up the mountainsides. At age five, he learned to ski here. But the village lies low, at about 3,300 feet. "Now, it's finished," Lejeune says bluntly. "Maybe they'll have one or two good years, but not more."

Such areas already were plagued by a series of snow-scarce winters in the 1980s and '90s. Machines that make snow became the Alps' first line of defense. In lower-lying regions, millions in investments seemed justified to guarantee a steady tourism season. Winters with light snow were assumed to be outliers then.

Lejeune's data prove that they weren't. He points to a graph comparing the snow depth at Col de Porte in the past 30-year period with the previous one. The line plunges downward, showing an average snow-cover decrease of 15 inches. "That's a lot," Lejeune says. "That's really a lot."

The warming now has reached higher elevations. "If someone had told me back then that we'd ever need snow machines, I'd have said, 'You're crazy,'" says Peter Leo, Kitzsteinhorn's head of snow management. Today "we couldn't live without these machines."

Neither can most of the Alps' 1,100 ski lift operators. Much of the snow in ski areas is now human made. On Kitzsteinhorn alone, 104 grass-colored "snow cannons" are strategically positioned around the slopes. Each weighs and costs as much as a small car.

When Leo turns one on, it becomes hard to hear him. On the machine's outer ring, nozzles infuse water droplets with air, and a massive fan—"strong enough to suck you in," he yells—blows them into the sky. As they descend, water droplets from the inner rings clump around the initial crystals, forming snowflakes.

STANDING ON A GLACIER like Kitzsteinhorn, it's hard to grasp how tiny snowflakes could have formed such an immense mass of ice. It happened over centuries, each fresh layer of snow pressing on the ones beneath, until the snow solidified into ice and began to flow downhill under its own weight. Snow accumulates in winter, and snow and ice melt in summer, mostly at lower altitudes. When winter gain exceeds summer loss, the glacier's snout advances down into the valley; when summer triumphs, the glacier retreats. Since the late 19th century, glaciers in the Alps have retreated almost continuously.

Swiss glaciologist Felix Keller has an idea for reversing that trend. Keller grew up in a village next to St. Moritz, the birthplace of winter tourism in the Alps. When I met him there last year, he took me to the nearby Hotel Morteratsch, where he showed me a black-and-white photograph of the last crown prince of Germany, Wilhelm, taken in 1919. The prince and his entourage stood beaming on the Morteratsch Glacier, which at the time was right outside the hotel. Thick ice covered the entire valley.

Keller and I went to the same spot. In the century since Wilhelm's visit, larches and pines have taken over; in late summer, locals forage there for mushrooms and cranberries. The Morteratsch Glacier has retreated out of sight, more than a mile up the valley.

Alpine glaciers overall have lost two-thirds of their volume since 1850, and the loss is accelerating. "If we don't act, all will be gone," says Matthias Huss, a glaciologist at ETH Zurich. By "act," Huss means drastically cut the carbon emissions that cause global warming.

Keller has an additional action in mind. The idea came to him on a balmy summer day in 2015, while he was fishing in a lake fed by meltwater from the Morteratsch. Glacial silt clouded the water, and the trout weren't biting. That's when it occurred to Keller: Couldn't some of that meltwater be kept high in the mountains and turned back into ice?

"I figured that within 10 minutes, I'd find out

why that can't work," he says. "But I didn't."

His friend and fellow glaciologist Hans Oerlemans, who has studied the Morteratsch since 1994, added a crucial twist: The meltwater should be converted into fresh snow, which reflects 99 percent of sunlight and could shield the ice in summer. Oerlemans calculated that covering just 10 percent of the glacier, in the zone where most ice loss occurs, would allow it to begin advancing again after 10 years. He and Keller felt giddy at the simplicity of the idea.

A few high-altitude ski areas already are insulating patches of glaciers by spreading fabric on them. And at a few, such as Kitzsteinhorn or Diavolezza, near the Morteratsch, snowmaking machines have caused a localized thickening of the ice. But neither of those approaches could be scaled up enough to save an entire glacier. To save the Morteratsch, Keller and Oerlemans estimate, they'd need to cover about 200 acres of it with more than 30 feet of snow every year—more than two and a half million tons of the stuff. Making that much snow with typical snow machines would use way too much energy.

For "MortAlive," as he and Oerlemans call their project, Keller asked for help from researchers at Swiss universities, from a leading cable car company, and from Bächler Top Track AG, a snowmaking company. The team devised a scheme in which seven hoselike snow cables, each more than half a mile long, would be suspended between two moraines that flank the Morteratsch Glacier. Water from a meltwater lake at higher altitude—expected to form soon at a neighboring glacier—would flow downhill through the cables, spray out through nozzles patented by Bächler, and fall as snow on the Morteratsch. No electricity would be required.

In a parking lot near the glacier, I watched the first trial of a prototype. The team had suspended a single snow cable with six nozzles between two poles. At one point a pipe froze and had to be replaced—but the system worked. When the first snowflakes landed on his head, Keller had tears in his eyes.

Just getting to the point where a prototype could be tested required four million dollars from the Swiss government, a bank, and three foundations. The full-scale system would cost $170 million to install, Keller says. To build it, he'd need to get a permit to dig a tunnel through a protected area. It would take about a decade until the first snow could be sprayed onto the Morteratsch. By then, the glacier will have retreated another few hundred yards.

Huss, for one, is convinced the snow cables will never be deployed—because, he says, there would be little gained from the great expense. Even under a moderately optimistic climate scenario, Huss says, his simulations show that the Morteratsch Glacier will all but vanish before the end of the century—with or without MortAlive.

Keller points out that such simulations are notoriously imprecise. But he knows the glacier is running out of time.

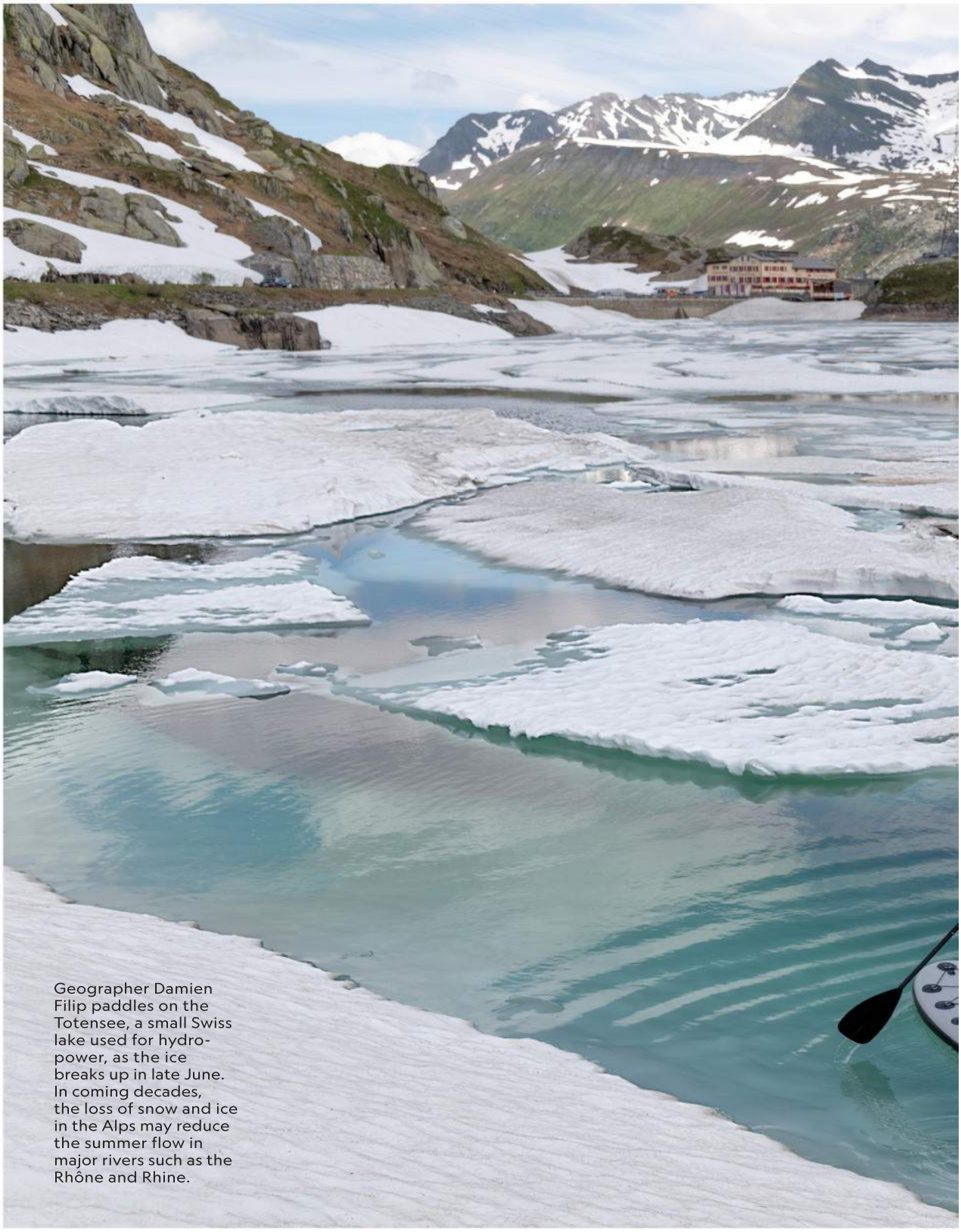
"If on my deathbed I can tell my children and grandchildren that I at least tried to do something clever," he says, "that will be better than saying I just talked about all the problems."

IN MOST OF THE ALPS, ice and snow seem doomed. That may spell trouble downstream. Europe's mightiest rivers—the Rhône, Rhine, Danube, and Po—all derive a substantial portion of their flow during dry summers from glacial meltwater. Seasonal shipping and irrigation could become a problem. The Alps, however, will continue to be Europe's "water towers"—clouds will continue to burst and empty on their flanks—and rich countries likely will find ways to safeguard their water supplies.

The loss of winter tourism may prove trickier. Entire communities are now grappling with their very existence being dependent on a phenomenon so fleeting it melts at the touch of your hand. Many are investing more heavily

ALPINE GLACIERS OVERALL HAVE LOST TWO-THIRDS OF THEIR VOLUME SINCE 1850, AND THE LOSS IS ACCELERATING.

The joy of hurtling down a snow-covered mountainside on skis is what draws millions of tourists to the Alps each winter—but a few visitors prefer to go up, not down, and to do it the hard way. An ice climber grapples with a frozen waterfall in the gorge at Pontresina, Switzerland.



Geographer Damien Filip paddles on the Totensee, a small Swiss lake used for hydro-power, as the ice breaks up in late June. In coming decades, the loss of snow and ice in the Alps may reduce the summer flow in major rivers such as the Rhône and Rhine.

in summer—in mountain biking or hiking trails, summer tobogganing or climbing spaces. Kitzsteinhorn is seeing an influx of summer tourists from scorched countries such as Saudi Arabia. But summer tourism has always existed in the Alps, and expanding it enough to make up for the loss of skiing will be hard.

The French village of Abondance, altitude 3,000 feet, is in the middle of this difficult transition. When its lifts shut down in 2007, it was described in one news story after another as the first ski village to fall victim to climate change. But its 1,400 residents weren't ready to bid *adieu* to skiing. In 2008 they voted in a new mayor, Paul Girard-Despraulex, who fulfilled his sole campaign promise and reopened the lifts.

Born into a family of farmers the year the cable car was built, Girard-Despraulex had seen his village prosper with skiing. Yet when an investor approached him with a plan to double down—to develop Abondance into a massive ski resort by connecting it with a neighboring one—the mayor was flabbergasted. The plan would have entailed blowing up part of a mountain and destroying an old fir forest. "That's something we did not want to do," Girard-Despraulex says.

Elsewhere in the Alps, too, plans for expanding winter tourism have met resistance. In Austria, 160,000 people signed a petition to stop plans to connect the Ötztal and Pitztal ski areas, again by blowing up part of a mountain. In Morzine, France, near Abondance, a new cable car project was halted after locals protested. An independent analysis had shown that it might not pay off in an increasingly snowless climate.

In Abondance, Girard-Despraulex is pushing diversification. Aside from its stunningly beautiful ski area, it now boasts ice-skating on a natural lake and sleigh rides in winter, as well as more mountain biking and hiking in summer. There's a museum dedicated to Abondance cheese—dairy farming remains important around the village. Recently, Girard-Despraulex had the roof reslated on an abandoned, 900-year-old abbey, so it could safely open to visitors.

"We have not yet exactly found the right approach, the right ideas, but we are thinking, testing, and experimenting," he says. In the abbey's courtyard, he points to a mural depicting the wedding at Cana, where Jesus is said to have turned water into wine. An upcoming restoration, the mayor says, will make the faded colors shine again.

Cold, snowy winters are a defining element of Alpine lifestyle, folklore, and traditions. Gian-Nicola Bass, who preserves some of these ways at the Upper Engadin Cultural Archives in Switzerland, believes that soaking in ice-covered Lake Sils helps toughen his immune system.

NO MIRACLE will save winter in the Alps. Making snow, stockpiling it, spraying it on glaciers—all that will, at best, buy time in a few places.

The beauty of the Alps, the envy of outsiders long before people here built their lives around snowy winters, will remain. But the waning of snow and ice represents an emotional loss, a loss of culture and identity, as well as an economic one. When Switzerland's Pizol Glacier shrank to such a tiny sheet of ice that it was taken off the glacier monitoring service, locals mourned its death with a funeral.

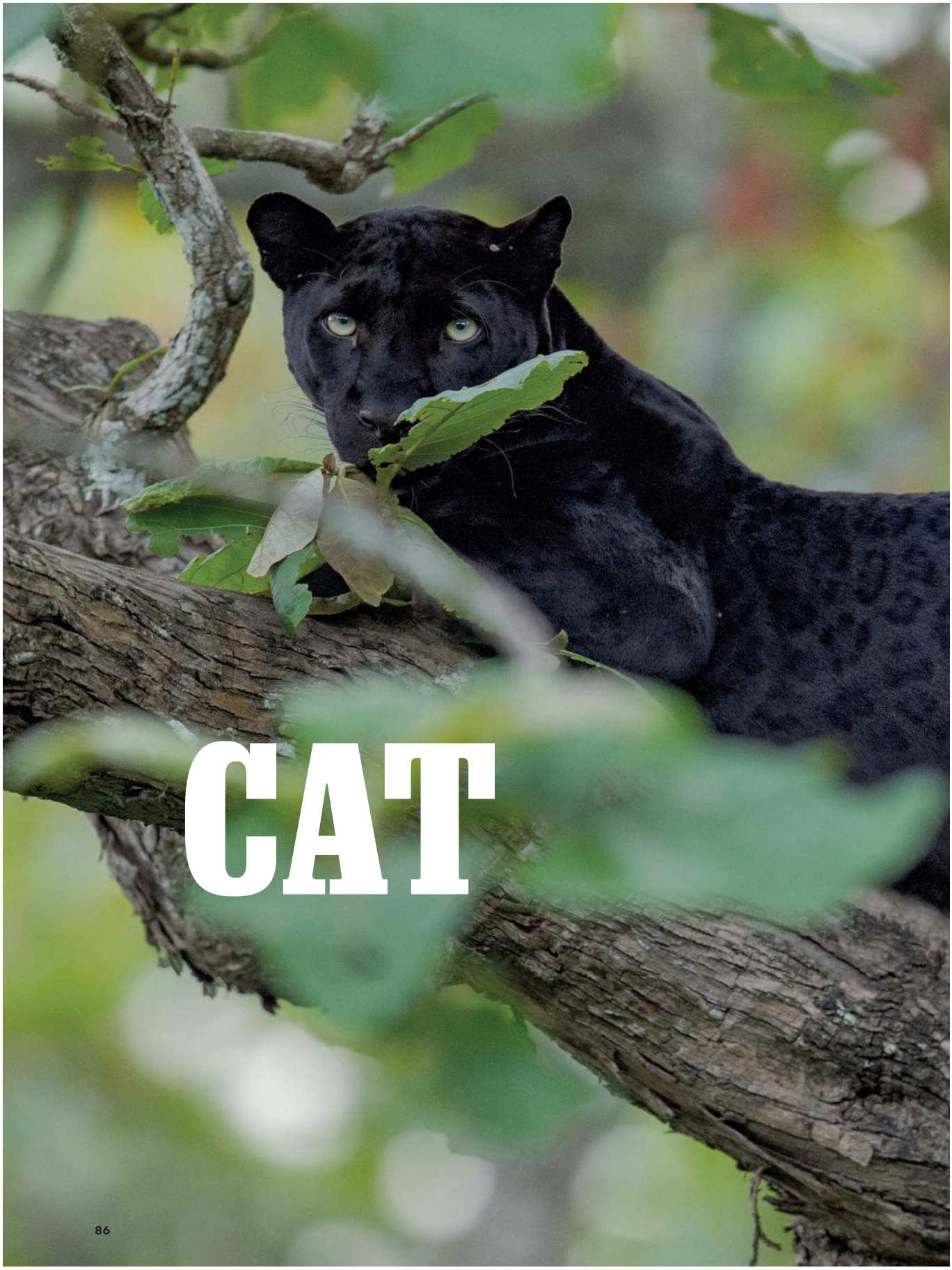
When I was little, skiing was a pastime enjoyed by the vast majority of people in the Alps, no matter their status or income. Like me,

my childhood friend Dominik and his partner, Julia, were pushed onto the slopes at a very early age. Less than three decades on, their son, Johann, who just turned four and is my godson, is fascinated by snow. But he knows it largely from songs and books.

On a sunny Sunday last February, we drive up Unterberg mountain near Vienna, in the easternmost Alps, in search of the real stuff. Just underneath the 4,400-foot peak, we find a little winter. "It sparkles!" Johann yells, tossing himself in the snow and gingerly licking it from his mitten. He wants to build a snowman, but the snow is less than an inch deep.

His mother, Julia, 33, learned to ski here. "We never even wondered if Unterberg would have enough snow to open," she says, as we trudge past the idle T-bar lifts. When those lifts were about to close for good in 2014, locals crowdfunded almost $83,000 to keep them going. But at this altitude it's too warm to invest in snowmaking. So Unterberg relies solely on natural snow, promoting itself as a ski area where "the snow still falls from the sky." Last winter, that made for 10 days of skiing. The winter before, zero. □

After reporting for years in Asia, Austrian writer **Denise Hruby** has returned home to focus on environmental challenges in Europe. **Ciril Jazbec,** a Slovenian, photographed India's ice stupas—small, artificial glaciers—for the July 2020 issue.



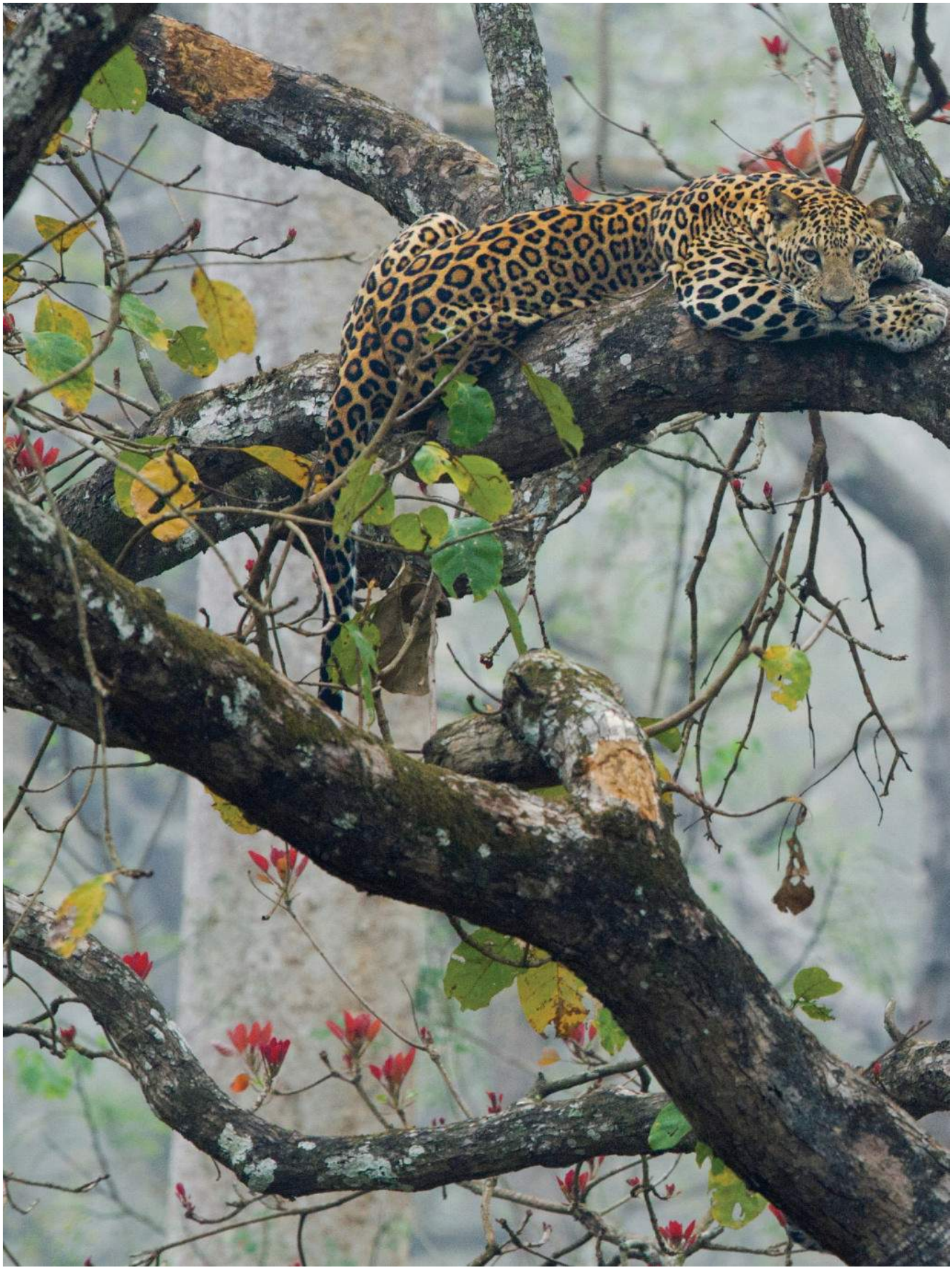
CAT

BIG HAVEN

In Nagarahole Tiger Reserve, tigers and leopards are thriving as India's conservation efforts begin to pay off.

BY
YUDHIJIT BHATTACHARJEE

PHOTOGRAPHS BY
SHAAZ JUNG



Leopards court in a flowering coral tree on a misty winter morning at Nagarahole Tiger Reserve. The two are likely to mate several times while they are together, which can be for up to a week.

PREVIOUS PHOTO

A black panther rests on a branch of a teak tree. Black panthers are leopards with a genetic mutation that causes the dark pigmentation of their coats. The rosette patterns are still visible against their fur.

When the waters of the Kabini River recede during the summer months, the surrounding area transforms into a grassland where spotted deer and other animals come to graze. The landscape offers an abundance of prey for big cats.

DRAPED IN MIST, THE LUSH, FORESTED LANDSCAPE OF NAGARAHOLE TIGER RESERVE IN INDIA'S SOUTHWESTERN KARNATAKA STATE LOOKS ENCHANTED.

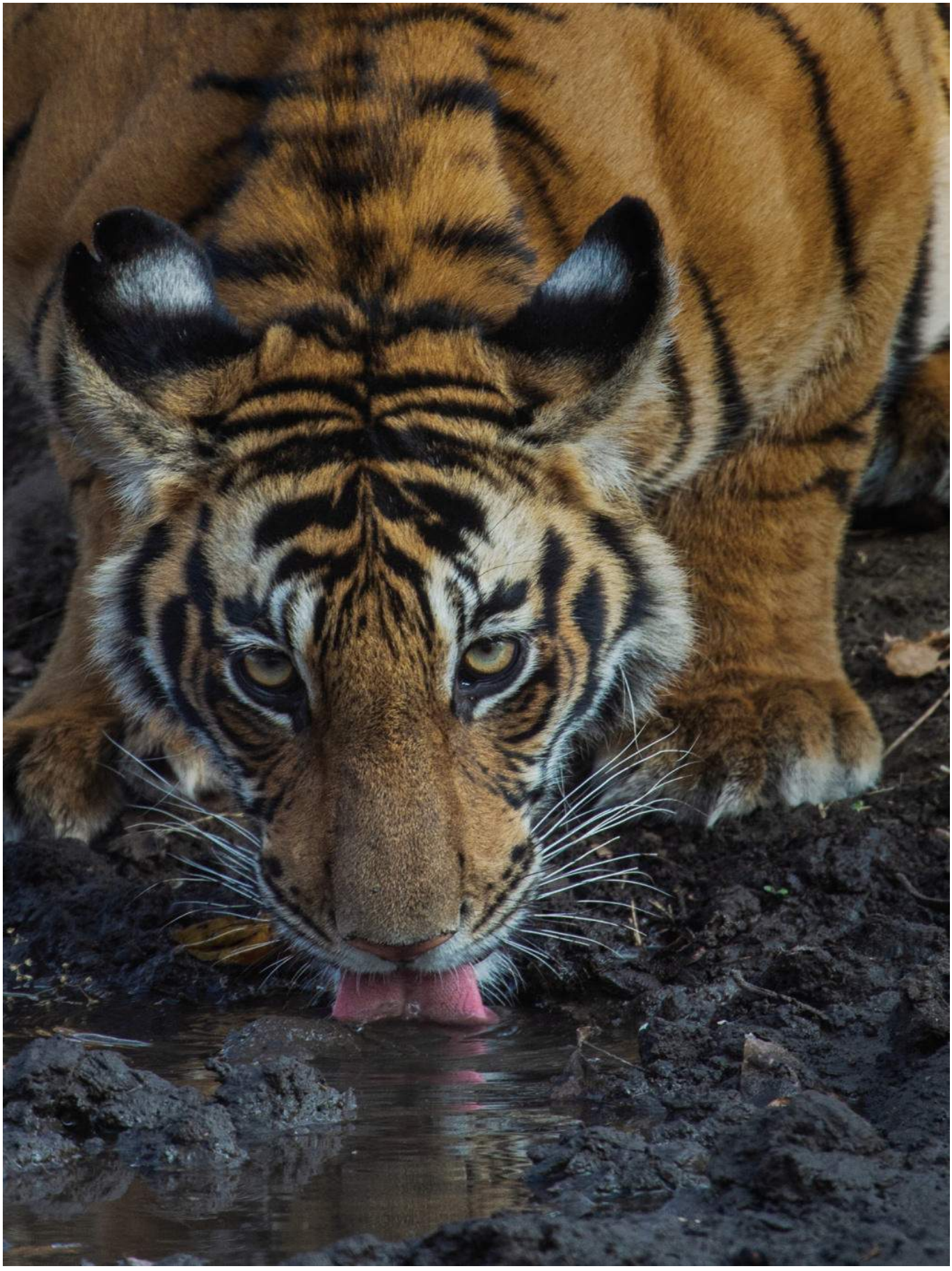
An elephant lumbers through the foliage, feeding on shrubs and leaves, its gigantic ears flapping as if to the beat of a metronome. Up ahead along the dirt road, bison-like gaur graze in a meadow, not so much as glancing in our direction.

Guided by photographer Shaaz Jung, who has lived in a lodge in the forest for the past 12 years, we drive on, stopping by a herd of spotted deer. An iridescent blue kingfisher flits between the trees. As sunlight cuts through the haze, the tranquility is broken by the bark of a deer ringing out in the distance. It's an alarm, warning that a predator lurks nearby.

Calls like this are heard here with increasing frequency. Nagarahole abounds with Bengal tigers and Indian leopards. Tourists flock to the reserve to catch a glimpse of these big cats, including an especially bold black panther—a leopard with a mutation that causes dark pigmentation. That cat, often sighted, has become something of a star.

"Usually when you go on a safari, it's like, Did you see a tiger?" says Krithi Karanth, a scientist at the Centre for Wildlife Studies in Bengaluru (formerly Bangalore). "Now it's like, Oh, you saw a tiger. Great, but did you see the black panther?"

A tiger drinks from one of Nagarahole's water holes. Across the reserve, park authorities have installed solar-powered bore wells, which are activated when the water level drops, helping keep these essential water sources full throughout the year.



NAGARAHOLE IS THE PERFECT PLACE FOR TIGERS AND LEOPARDS TO COEXIST: TIGERS PROWLING IN THE UNDERGROWTH, LEOPARDS LOUNGING IN TREES.

Less than a 10th of the 327-square-mile park is open to visitors. At the southern end of this tourism zone lies the Kabini River, fringed with brush and tall grasses. Beyond are meadows and streams and dense woods. It's the perfect milieu for tigers and leopards to coexist: tigers prowling in the undergrowth; leopards lounging in trees, safe from tigers.

The likelihood of seeing these big cats has gone up significantly during the past decade in Nagarahole and many other wildlife reserves across India, thanks to the success of conservation efforts. The latest count of tigers at Nagarahole was 135, more than twice the number from a decade ago. The country now has almost 3,000 tigers in the wild, according to the latest official census, completed in 2018. That's 33 percent higher than in 2014. The number of leopards has increased 62 percent since 2014, to nearly 13,000.

One sign of this growing population is more sightings of big cats beyond the edges of reserves, which also has increased the potential for conflict with humans. "I have tigers living around my house in central India," says conservationist Belinda Wright, founder of the Wildlife Protection Society of India, who lives on the edge of Kanha Tiger Reserve in the state of Madhya Pradesh.

The rising numbers are particularly encouraging to conservationists because tiger and leopard counts are now more credible. Until 2006, India's tiger census, conducted every four years, was more of a guesstimate based on a survey of paw prints—a lengthy and tedious exercise carried out by teams covering tens of thousands of square miles. The bulk of the counting is now done using images from camera traps that enable the identification of individual tigers and leopards by their unique patterns of stripes or spots.

Vijay Mohan Raj, chief conservator of forests in Karnataka, credits the success at Nagarahole and other reserves to more effective antipoaching personnel strategically stationed inside the reserves. These frontline workers, Raj says, now are better trained and better equipped because of increased government funding that followed India's commitment in 2010 to an international plan to double the number of tigers worldwide. "That's been the biggest deterrent for anybody looking to enter the forest to poach for meat or even to collect firewood," he says. "All such incursions stopped."

As a result, the density of prey species such as deer and wild boar has gone up, helping their predators—tigers and leopards—to thrive. At Nagarahole the big cats also appear to have benefited from 26 solar-powered bore wells installed next to ponds, keeping them full even in the dry months.

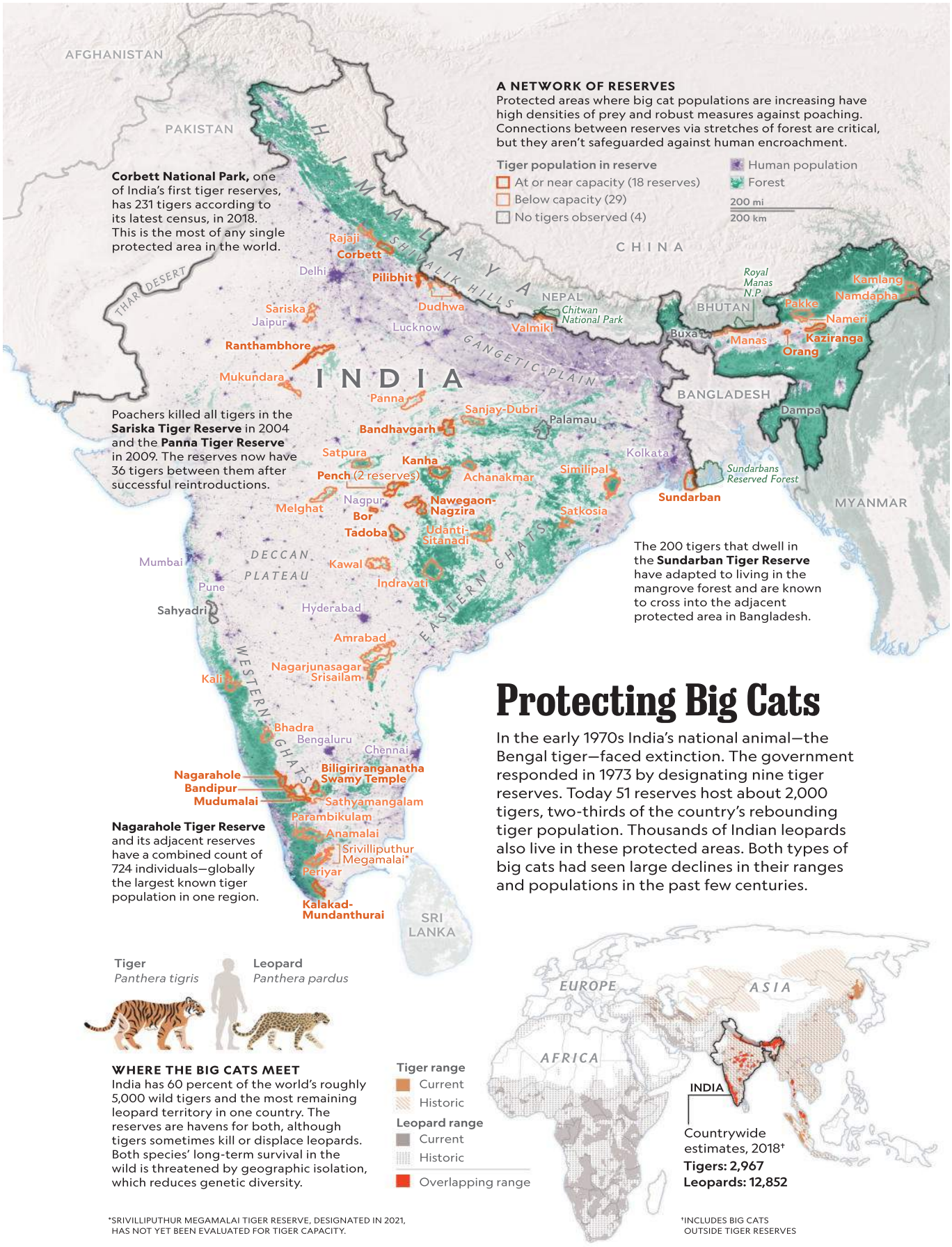
The future of big cats in Nagarahole and similar reserves hinges in part on minimizing conflict between the animals and neighboring communities. In one village I visited just outside the park boundary, I watched kids rolling rubber tires along a mud track as the sun was setting over the Kabini. A cart trundled by, pulled by a pair of oxen, their bells jangling.

As the competition for territory inside India's reserves intensifies, tigers and leopards are wandering into such villages more often, killing cattle and sometimes humans. In Karnataka alone, at least nine people were killed by tigers from 2019 to 2021.

Even though revenue from big cat tourism has been growing, Wright says, the money hasn't helped local residents. "So they don't feel they benefit from the presence of tigers," she adds. Wildlife authorities do compensate people who lose cattle to tigers and have moved some villages away from tiger terrain, but they still need to do more to give surrounding communities a stake in the success of the reserves, conservationists say, or the gains made over the past decade could disappear. □

Yudhijit Bhattacharjee is a contributing writer for *National Geographic*. **Shaaz Jung** has spent hundreds of hours documenting the lives of big cats after becoming fascinated with leopards.

RILEY D. CHAMPINE AND TAYLOR MAGGIACOMO, NGM STAFF. SOURCES: WILDLIFE INSTITUTE OF INDIA; NATIONAL TIGER CONSERVATION AUTHORITY; WWF; IUCN; WORLDPOP; FOREST LANDSCAPE INTEGRITY INDEX; WDPA; PANTHERA; © OPENSTREETMAP CONTRIBUTORS



A NETWORK OF RESERVES
Protected areas where big cat populations are increasing have high densities of prey and robust measures against poaching. Connections between reserves via stretches of forest are critical, but they aren't safeguarded against human encroachment.

Tiger population in reserve
- At or near capacity (18 reserves)
- Below capacity (29)
- No tigers observed (4)

Human population
Forest
200 mi
200 km

Corbett National Park, one of India's first tiger reserves, has 231 tigers according to its latest census, in 2018. This is the most of any single protected area in the world.

Poachers killed all tigers in the **Sariska Tiger Reserve** in 2004 and the **Panna Tiger Reserve** in 2009. The reserves now have 36 tigers between them after successful reintroductions.

The 200 tigers that dwell in the **Sundarban Tiger Reserve** have adapted to living in the mangrove forest and are known to cross into the adjacent protected area in Bangladesh.

Nagarahole Tiger Reserve and its adjacent reserves have a combined count of 724 individuals—globally the largest known tiger population in one region.

Protecting Big Cats

In the early 1970s India's national animal—the Bengal tiger—faced extinction. The government responded in 1973 by designating nine tiger reserves. Today 51 reserves host about 2,000 tigers, two-thirds of the country's rebounding tiger population. Thousands of Indian leopards also live in these protected areas. Both types of big cats had seen large declines in their ranges and populations in the past few centuries.

Tiger
Panthera tigris

Leopard
Panthera pardus

WHERE THE BIG CATS MEET
India has 60 percent of the world's roughly 5,000 wild tigers and the most remaining leopard territory in one country. The reserves are havens for both, although tigers sometimes kill or displace leopards. Both species' long-term survival in the wild is threatened by geographic isolation, which reduces genetic diversity.

Tiger range
- Current
- Historic

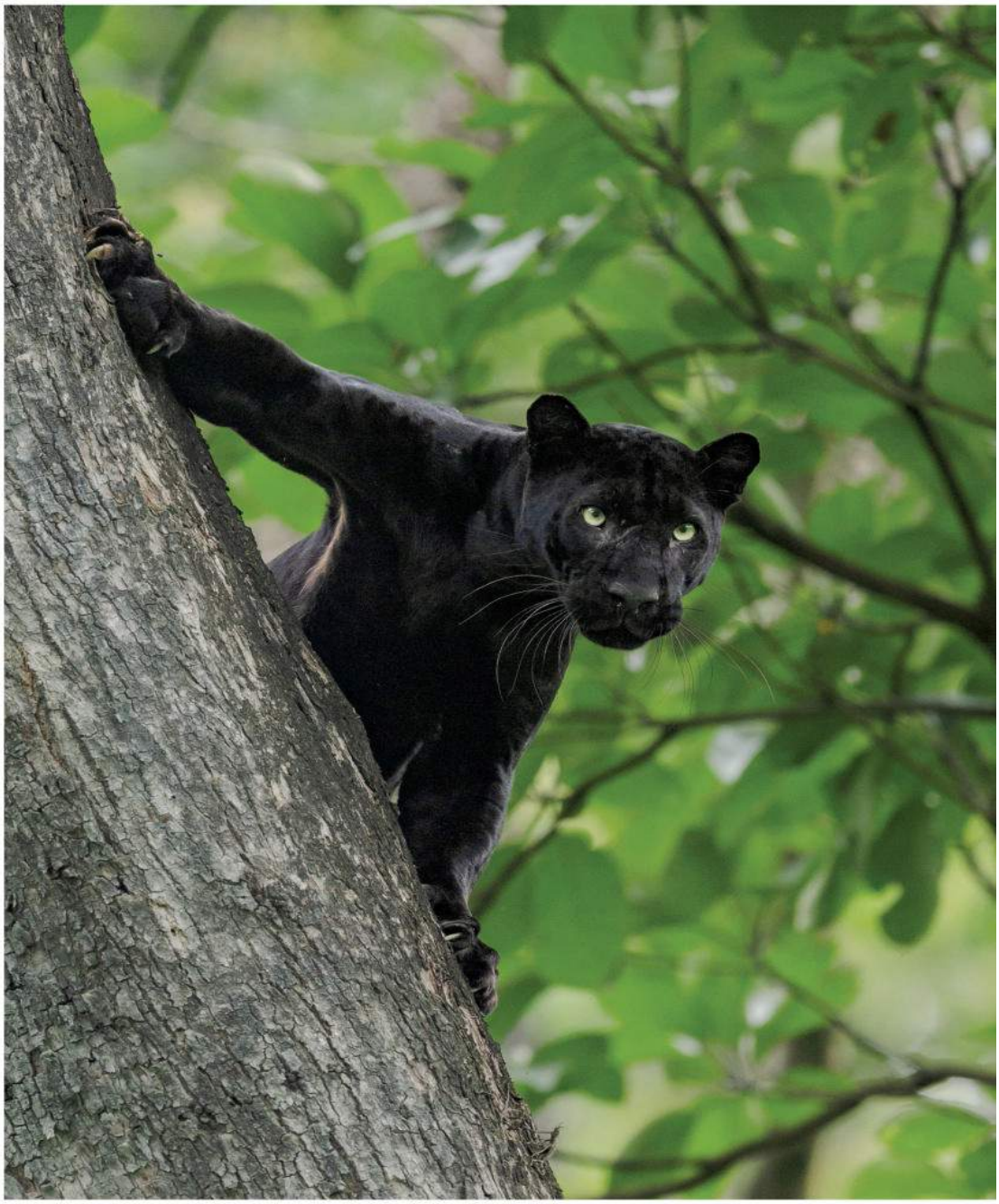
Leopard range
- Current
- Historic

Overlapping range

Countrywide estimates, 2018†
Tigers: 2,967
Leopards: 12,852

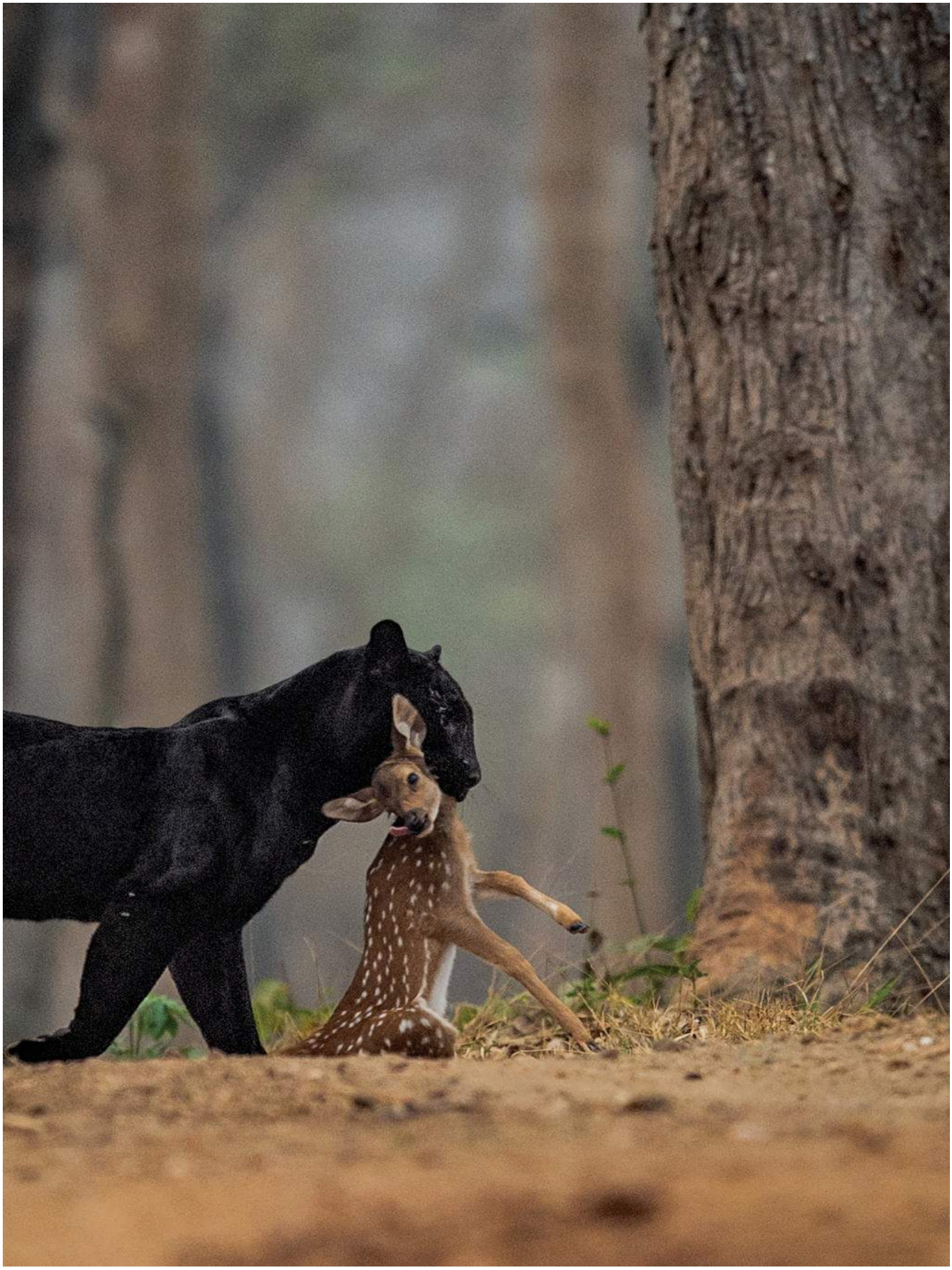
*SRIVILLIPUTHUR MEGAMALAI TIGER RESERVE, DESIGNATED IN 2021, HAS NOT YET BEEN EVALUATED FOR TIGER CAPACITY.

†INCLUDES BIG CATS OUTSIDE TIGER RESERVES



A leopard and a black panther keep a wary eye out for trouble. Being able to climb trees is a superpower that helps leopards avoid confrontations with tigers, which would prevail in a fight. Leopards tend to spend the daytime resting high off the ground on branches. They clamber down in the evenings to hunt. Leopards can haul kills into trees to keep them from scavengers.

A black panther heads toward a thicket with a just captured fawn. As Nagarahole has improved anti-poaching measures, herbivores such as spotted deer have become plentiful. With the rise in prey population, big cats have thrived.



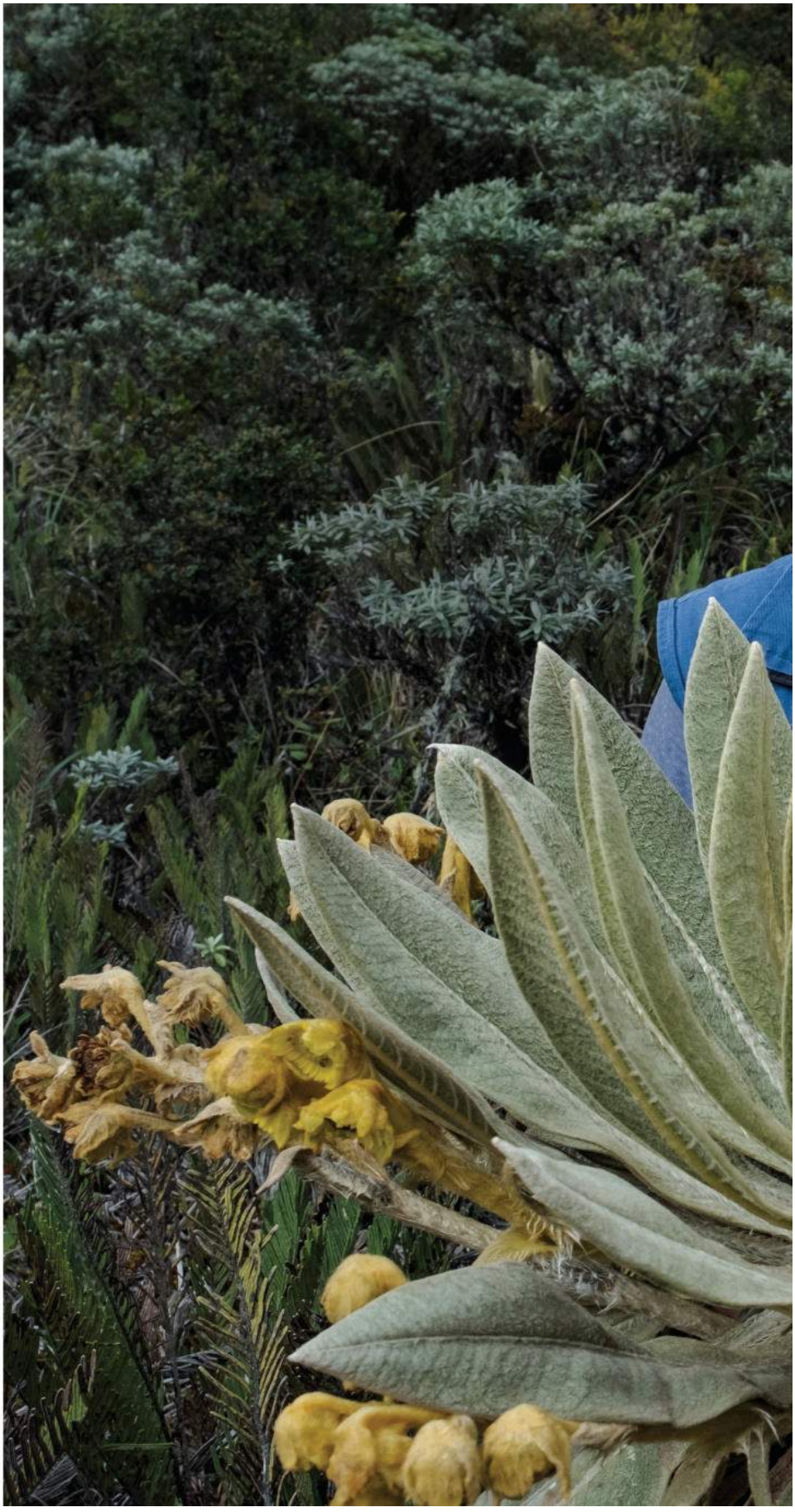
Since 2016, 1,280 community leaders in Colombia have been killed after resisting intrusions by developers and drug cartels.

Defending the Land, Paying With Their Lives

BY
JORDAN SALAMA

PHOTOGRAPHS BY
FLORENCE GOUPIL

Indigenous leaders, teachers, farmers, and others have been targeted after speaking up against damage to their lands and culture.



Fanor Mulcué, an Indigenous Nasa leader in southern Colombia, contemplates an *Espeletia* plant native to the Andean plateau. Key to the creation of freshwater reserves in the highlands, many species are endangered because of encroaching mining and agricultural activities.

PREVIOUS PHOTO

Ati Quigua performs a ritual to protect a river in the Sierra Nevada de Santa Marta mountains in northern Colombia's Cesar Department. An Indigenous Arhuaco environmentalist and politician, she has protested mining and large-scale development that threaten natural resources in the Sierra Nevada, a UNESCO biosphere reserve.

LUIS MANUEL SALAMANCA balanced on the tailgate of a rickety covered pickup truck, clinging onto the roof rack as it careened down the winding backroads of the Andes. It was dawn on May 22, 2018, and the Nudo de Almaguer—a fertile knot of dome-shaped mountains in southwestern Colombia known in English as the Colombian Massif—was beginning to stir.

As the fog lifted, a woman milking a bloated brown cow came into sight in a clearing. Red-and-white buses crammed with schoolchildren fought for passage with horse-drawn carts and cargo mules on narrow roads. More than 650 feet below, the Magdalena River rushed through a steep, emerald gorge fed by waterfalls tumbling down from every direction.

We were heading toward Quinchana—a village of some 90 families hidden in the misty, verdant hills of Huila Department, a region known for coffee growing and oil exploration and home to the headwaters of several major rivers. Quinchana is also the trailhead to a small community called La Gaitana and an archaeological site of pre-Columbian artifacts—imposing megalithic stone deities and tombs that date to the first through eighth centuries. They were rediscovered in 1942, helping put this region on the map.

Salamanca had dedicated his career to studying and preserving this history. The 64-year-old was one of Colombia's most renowned anthropologists. Soft-spoken and selective with his words, he had a gentle face, round with a ball-shaped nose, a countenance that exuded the comfort of a fuzzy sweater.

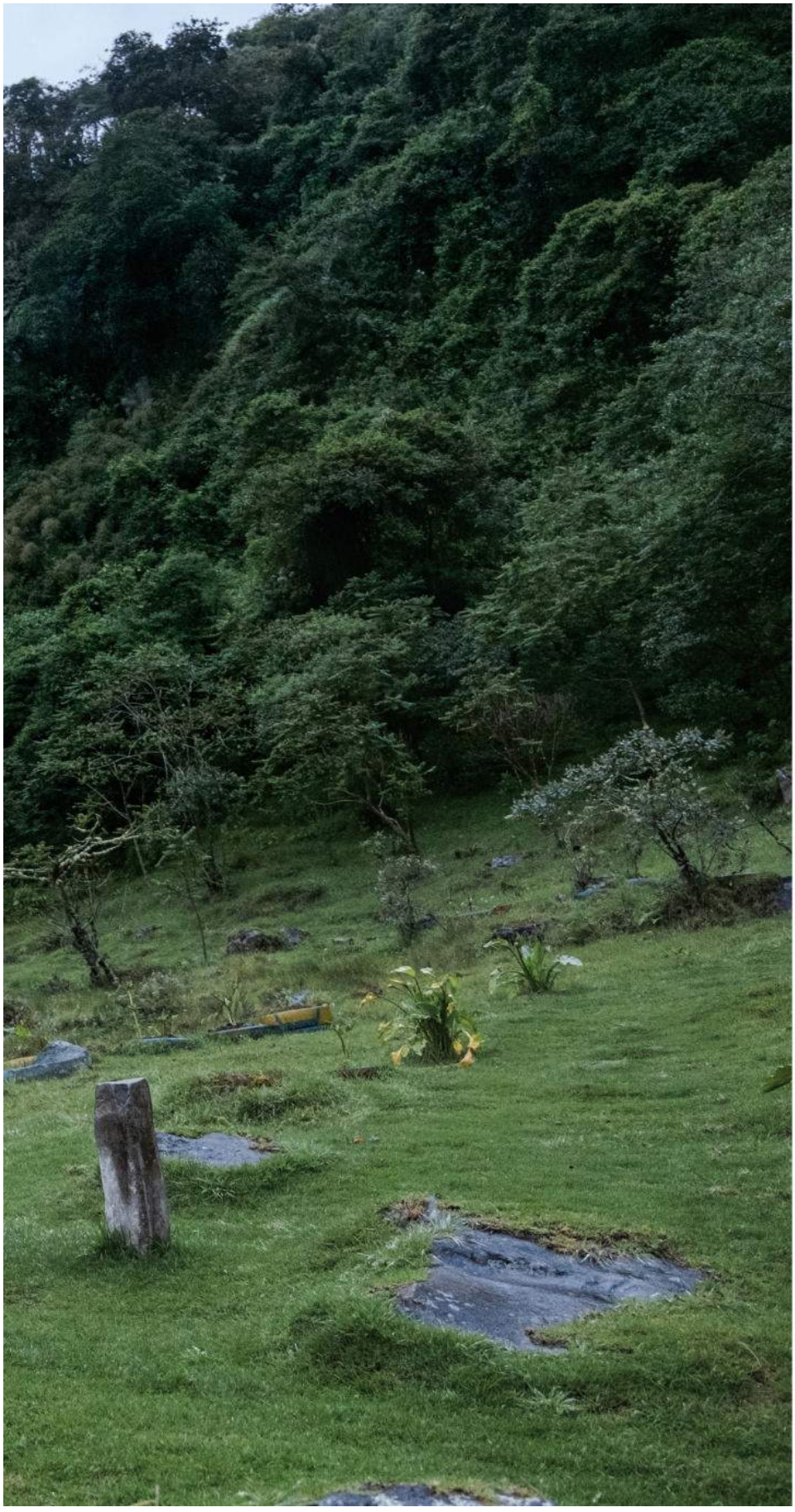
Alexandra Isabel Salamanca holds a photo of her father, Luis Manuel Salamanca, as a young man. A famed anthropologist and conservationist in southwestern Huila, he was murdered on May 11, 2019. "My father was shot on the other side of this window," said Alexandra Isabel. No arrests have been made.

I'd come to see Salamanca during a fraught moment of transition for Colombia, a country that had suffered half a century of violent armed conflict. I was following the course of the Magdalena River—the central, storied waterway that runs for nearly a thousand miles through the heart of the South American nation—and spending time with people working to support a fragile peace along its banks. Mid-2018 was a time of relative calm. It wouldn't last.

"Better to go before it rains," Salamanca told me, gazing at clouds in the crevasses of the valley as he gripped the cold metal bars of our truck at every bump in the pavement. The shared *camioneta* was overflowing with passengers by the time we whistled it down, and Salamanca and I were left to hang on to the outside. "Better to go before it rains," he repeated quietly to himself.

The most famous artifacts in the massif are the extraordinary megalithic statues at a UNESCO World Heritage park of well-manicured lawns and gravel trails in nearby San Agustín, the municipal capital. The park boasts large, upright stone slabs carved into humanlike renderings of lizards and monkeys that preside over spectacular views of the surrounding hills.

Strolling the orderly trails of San Agustín is like visiting a zoo of stones. La Gaitana, in contrast, Salamanca told me, would be like encountering pre-Columbian relics in the wild. The site is hidden away on a mountainside, the trail obscured by decades of overgrowth dating to when Quinchana



Colombia is one of the world's most biodiverse countries and is home to sacred relics that mark the enduring influence of pre-Columbian cultures.

A replica of a pre-Columbian statue guards a waterfall in Cauca, in southwestern Colombia. Ancient cultures believed the first- to eighth-century megaliths that dot this landscape protected rivers and all living beings.

was off-limits, a gateway to a drug-trafficking corridor controlled by guerrillas.

For more than half a century, the Marxist-inspired Revolutionary Armed Forces of Colombia, known as the FARC, were at war with the Colombian state. The conflict drew in other leftist militias, right-wing paramilitary groups, drug cartels, and the U.S. military, rendering huge swaths of jungle and other remote areas unsafe for visitors and locals alike. Almost 270,000 people died in the conflict, 81,000 disappeared, and 7.4 million were displaced from their homes.

A peace deal signed in 2016 was supposed to change everything. FARC soldiers agreed to lay down their weapons, and the government pledged to welcome them back into society. Crucially, the state promised to establish or improve public services in rural areas once controlled by guerrillas. There was hope that former conflict zones would reopen to visitors, creating more opportunities for the people who live there.

But the lure of commercial rewards from untapped resources has come at a high price. Gold miners, cattle ranchers, and narco traffickers have moved in, and locals who dare to defend their land and culture from development have become targets. According to the Institute for Development and Peace Studies, a Bogotá-based nonprofit known as INDEPAZ, 1,280 Colombian "social leaders"—many of them Indigenous and Afro-Colombian land defenders and environmentalists—have been murdered since the 2016 peace agreement. Armed groups vying for control of the resource-rich territory have been implicated, but less than 10 percent of investigations result in sentences.

The liberation of land once controlled by rebels has been a boon for science and tourism—but has led to an assault on natural resources.

"The way in which these killings of leaders are being carried out, the kinds of leaders being targeted, the places where it's happening, it's systematic," Leonardo González of INDEPAZ told me. Systematic and frequent: Colombia was the world's deadliest country for environmental activists in 2020 for the second year in a row, according to Global Witness, an environmental and human rights investigative organization based in London. Almost a year to the day after I met Salamanca, the anthropologist became one of those grim casualties. On the night of May 11, 2019, he was shot and left for dead in front of his door.

THE DAY I SPENT with Salamanca, our camioneta ride ended at Quinchana's town strip; from there our journey would be on foot. We clambered down in front of a modest family home that doubled as a general store. A colorful, quirky array of provisions was for sale in the living room: Teddy bears and coloring books shared shelves with rubbing alcohol, canned lentils, and feminine-hygiene products.

The morning was quiet, but my heart was racing. Not too long before, these FARC-controlled towns were no-go zones for the uninvited. Foreigners and Colombians, especially wealthy ones, were kidnapped for ransom. Loggers and developers avoided rebel-controlled jungles. Places like Quinchana—strategically located near mountain passes long frequented by salt, leather, and sugar traders in the preindustrial era—became drug- and weapon-smuggling corridors that financed the guerrillas.

"The guerrillas controlled everyone's movements. They decided who to allow in and who to keep out," Salamanca recalled.

The liberation of large tracts of Colombian territory from the FARC has been a boon for science and tourism. Colombia is the second most biodiverse country in the world, home to a kaleidoscope of ecosystems, landscapes, and species. It boasts huge expanses of coral reefs, grassland llanos, and buzzing rainforests. In the steaming-hot central valleys, rivers and wetlands are home to caimans, vulnerable manatees, and critically endangered freshwater turtles. On the Pacific

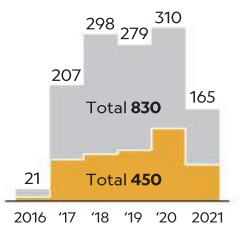
IN THE CROSSHAIRS

A 2016 peace accord with rebels was meant to end bloodshed and open opportunities in former conflict zones. But criminals and elites have exploited resources, hoarded profits, and threatened community leaders who challenged them. By mid-December, 1,280 activists had been killed.

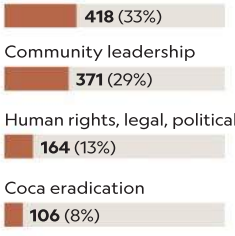
MOST AT RISK: INDIGENOUS PEOPLE

Killings of activists fell in 2021, partly due to better organization within civilian defense groups and disarray in cartels and militias. Indigenous activists and Afro-Colombian land defenders are disproportionately targeted.

Number of assassinations*



Victims, by social cause†



*FROM THE NOV. 24, 2016, PEACE DEAL THROUGH DEC. 19, 2021
†THE FOUR SOCIAL CAUSES WITH THE MOST VICTIMS ARE SHOWN. OF 1,280 FATALITIES, 323 WERE ACTIVISTS ON MORE THAN ONE ISSUE.

Seventy percent of victims were in rural farming areas and mountain regions. The killers are often linked to drug cartels trying to control coca cultivation and trafficking routes.

coast, thousands of humpback whales make annual migrations to Colombia's nutrient-rich waters, and slender waterfalls pour from volcanic outcrops onto black-sand beaches. Here, Afro-Colombian and Indigenous Emberá and Wounaan people know their way through labyrinths of mangroves and mountains, and are preserving traditions rooted in generations of ancestors.

Biologists have explored new corners of the country, discovering unknown species and protecting endangered ones. Annual international tourist arrivals rose by more than one million people from 2016 through 2019.

At the same time, the free-for-all passage of loggers, ranchers, and gold miners has fueled deforestation, and cultivation of coca—the key ingredient for cocaine—reached an all-time high in 2018, according to the UN Office on Drugs and Crime. Large development projects—such as Los Besotes dam in the Sierra Nevada de Santa Marta mountains and fracking explorations along the Magdalena River—threaten to flood land, contaminate water, and displace communities and species that depend on both.

Authorities have failed to rein in those who put profits over protection of resources. There's evidence of widespread corruption among regional authorities who've turned a blind eye to deforestation, mining, and wildlife trafficking that benefit elites. Politicians at the highest levels, including the ruling Centro Democrático party, have been linked to violent paramilitary groups that are implicated in many killings. The *paras*, as they're known, arose in the 1970s and '80s when wealthy landowners, drug traffickers, and corporate interests funded private armies to eliminate leftists.

The failure of the state to establish a strong presence in former conflict zones has allowed criminal groups to flourish, fighting over natural resources, smuggling corridors, and ports where they can move illicit goods.

Activists are fighting back—and paying with their lives.

Those targeted include Indigenous leaders, teachers, scientists, conservationists, farmers trying to replace coca with legal crops, feminists, and advocates for the 2016 peace accord. Juana Perea Plata was the 50-year-old owner of an ecolodge, who mobilized opposition to an industrial port near her home in Chocó Department on the Pacific coast. She was murdered in

CHRISTINE FELLENZ AND MONICA SERRANO, NGM STAFF; ERIKA NUNEZ. SOURCES: INDEPAZ; GREEN MARBLE

Nazaria Calambás Tunubalá's family mourn at her funeral in Cauca. In October 2021, the 34-year-old Indigenous Misak, a former mayor, was gunned down. Groups vying for drug routes and resources have targeted Indigenous and Afro-Colombian women in particular.

The mighty Magdalena River flows through the green hills of Huila, in the southwestern massif. Colombia is the second most biodiverse country on Earth, home to a kaleidoscope of ecosystems and species under threat from encroaching deforestation, mining, and energy projects.

October 2020 by the Clan del Golfo, a notorious drug cartel formed by paras. A year later, cartel member Néstor Leonel Lozano Muriel was sentenced to nearly 18 years for her murder. Forty-seven-year-old Carlos Fredy Londoño Bautista, a teacher and union leader who was preserving local traditions in Meta Department on the edge of the Amazon rainforest, was killed in front of his students in August 2021. In November 2019 Carlos Aldairo Arenas Salinas, 44, a bearded trekking guide passionate about Andean condors and their bleak highland *páramo* habitat, was murdered for opposing logging of a forest in Tolima Department. In January 2021 Francisco Vera, an 11-year-old environmentalist from Cundinamarca Department, known for campaigning on social media against fracking and mining, received death threats and was assigned a government bodyguard.

Activists say the government should do more than send bodyguards. They want investment in education and social programs to create alternatives in remote areas to drug trafficking and exploiting natural resources. They also want the government to ratify the Escazú Agreement, the first environmental treaty signed by 24 countries across Latin America and the Caribbean and the first binding agreement anywhere that commits signatories to protect environmental activists.

A July 2021 Colombian law did criminalize environmental offenses, including the promotion and financing of wildlife trafficking and deforestation. But enforcement depends on rooting out elite corruption.

In a November 2021 report on deforestation, researchers with the International Crisis Group cited senior Colombian law enforcement officials as saying that "politicians involved in activities such as cattle ranching have bribed officers or manipulated judicial investigations. Prominent figures have evaded punishment even in cases where authorities have identified them as financiers of illegal land clearing. Information about the government's work on specific cases has been leaked to armed groups, which then attempt to bribe or threaten the relevant officials."

A rare exception was in 2019 when a governor, two mayors, and a local landowner were collectively fined more than a million dollars for clearing an unauthorized 85-mile road through unspoiled Amazon rainforest in Guaviare Department. The scheme resulted in 57,000 acres of deforestation and displaced small farmers for cattle ranches and illegal palm oil plantations. Prominent senators' families also have been implicated in other land grabs and kickbacks for ranching schemes.

Francia Márquez Mina, a prominent Afro-Colombian activist from Cauca, survived an assassination attempt in 2019. The state "is allowing us to be murdered," she said. Since taking refuge in the capital, Bogotá, she has launched a long-shot bid for the presidency in the May election.

Some conservative politicians have sought to discredit activists as Marxists and have minimized the dangers they face, perhaps emboldening attackers. In the days before and after the November 2020 murders of two rural teachers unionists, ruling party senators accused the national teachers union of "indoctrinating" children. In a 2017 television interview, Luis Carlos Villegas, then defense minister, claimed the "immense majority" of killings since the peace accords were not to silence activists but were rather disputes over property, women, and illicit profits.

A **TWO-HOUR WALK** uphill from Quinchana, Salamanca and I found the La Gaitana archaeological site guarded by a pair of four-foot-high monkey statues with wide faces, round ears, and mouths bearing tall rows of teeth. The real-life monkeys—along with tapirs, spectacled bears, jaguars, and pumas—had been driven away long before to more remote mountain redoubts less disturbed by humans. Here, vestiges of their presence were immortalized in stone.

Salamanca led me to a clearing of grassy, knee-high mounds. "An ancient cemetery for children," he said quietly, pointing to gravestones of dark boulders overgrown with moss. Despite his age, Salamanca never seemed to stop moving; when he wasn't studying an archaeological site, he rode a slender silver bicycle in the hills. He was stepping out for an evening walk in San Agustín when he was killed.

In the territory of the Nasa people in Cauca, members of the Guardia Indígena (Indigenous Guard) perform a ritual to ask deities for protection. The unarmed defense network was formed to safeguard ancestral lands from militias, traffickers, and developers seeking to exploit resources.


FORMAR PROFESORES INDIGEN
FORTALECER

News of Salamanca's assassination made national headlines. *La Nación,* a leading newspaper, hailed him as "The Most Illustrious of the Agustinianos," praising his contributions to scientific and cultural understanding. "We were absolutely shocked," his daughter Dalila told me.

The exact motive behind Salamanca's murder is unknown. But he's remembered as an outspoken citizen unafraid to defend his beliefs, a trait that might have earned him enemies. He opposed construction of a nearby megadam, El Quimbo, that opened in 2015, displacing 450 families and flooding 20,000 acres of forest and farmland in Huila Department. He also opposed the Magdalena Master Plan, a proposed dam network championed by the governments of Colombia and China, Colombia's second biggest trading partner. If completed, the dams would flood some of the farthest reaches of the Magdalena River in the massif, raising fears of catastrophic environmental and archaeological losses.

In the days after Salamanca's death, hundreds took to the streets in San Agustín, candles in hand, demanding justice. A $2,700 reward was offered for tips, and San Agustín's mayor promised answers. Nearly three years later, no one has been charged. This too is routine in cases involving social leaders. Authorities sometimes capture individuals who pulled the trigger, but rarely those who order or incentivize killings.

As of December 2021, the Colombian attorney general's office reported having determined the

A member of the Guardia Indígena looks over the hills of Tierradentro, an archaeological park and UNESCO World Heritage site in Cauca. Beside him, a staff nailed atop a sacred rock marks Native authority over the land. Despite death threats, guardians feel a responsibility to protect the natural and cultural treasures of Colombia.

masterminds of only 111 of the 500-plus murders of human rights defenders documented by the Office of the UN High Commissioner for Human Rights since 2016, and had convicted only 15 of those who plotted the murders. The judicial system is virtually nonexistent in rural areas formerly controlled by the FARC.

Francia Márquez Mina is one of Colombia's most prominent activists; her work driving out illegal gold miners from Afro-Colombian communities in Cauca Department won her the prestigious Goldman Environmental Prize in 2018. She fled her hometown in 2014 after repeated death threats. On May 4, 2019, she survived an assassination attempt in Santander de Quilichao, when several men opened fire with guns and grenades, injuring three of her government bodyguards.

"Nothing is being done to actually end the killings," Márquez lamented. "We have a state that is allowing us to be murdered."

Still, many social leaders feel they have no choice but to continue their work despite the risks—even if it means using burner phones, changing daily routines, or moving every few weeks. "It's up to us" to save communities under threat from exploitation, said Márquez, a long-shot candidate in Colombia's May 2022 presidential election. "If we don't, there will be no change."

THE MAY 15, 2019, march to protest Salamanca's murder was a prelude to more.

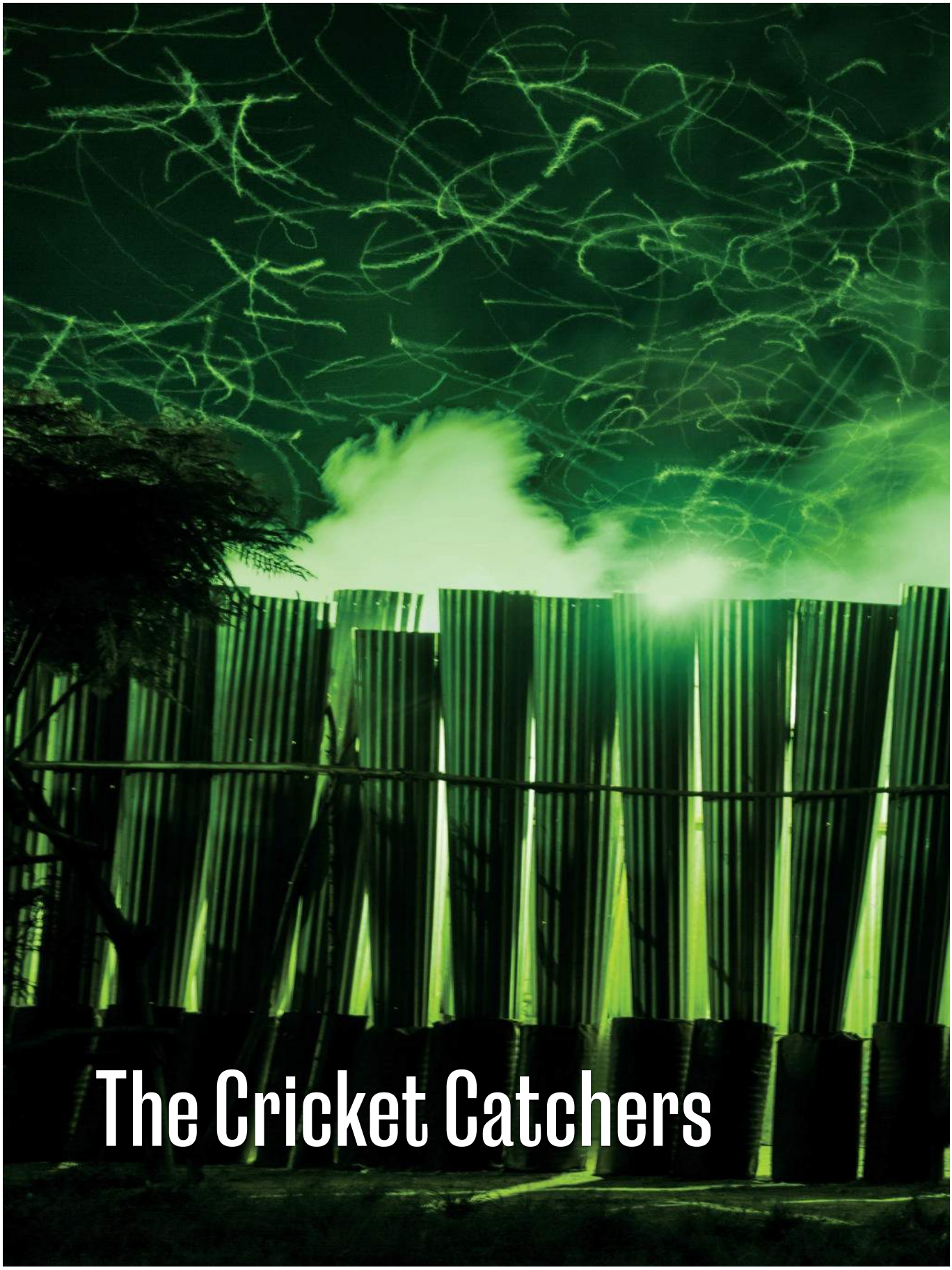
That November, Colombia was rocked by nationwide demonstrations of discontent. In the first half of 2021, the country again erupted in rallies against tax hikes, rising poverty levels, and slow implementation of the peace deal. When riot police cracked down on protesters in cities including Cali, Pereira, and Ibagué, dozens were killed and hundreds were injured.

The plight of social leaders is a central grievance for protesters nationwide. Yet the carnage continues: In 2021, 165 murders of social leaders were registered by INDEPAZ as of mid-December. Meanwhile, Colombia's countryside—home to immense reserves of biodiversity and vital carbon sinks found almost nowhere else on Earth—suffers at the hands of developers and criminals.

Looking down on the green hills of the massif in 2018, Salamanca and I watched a thin layer of clouds blanket the river valley, creating the illusion of smoke rising from the land. Improving livelihoods in former conflict zones while safeguarding communities and natural resources is a long-term undertaking, Salamanca told me.

"It's like buying an abandoned farm," he said. "You have to put a lot of money and a lot of work into it, and then wait a while, hoping someday for the results to show." □

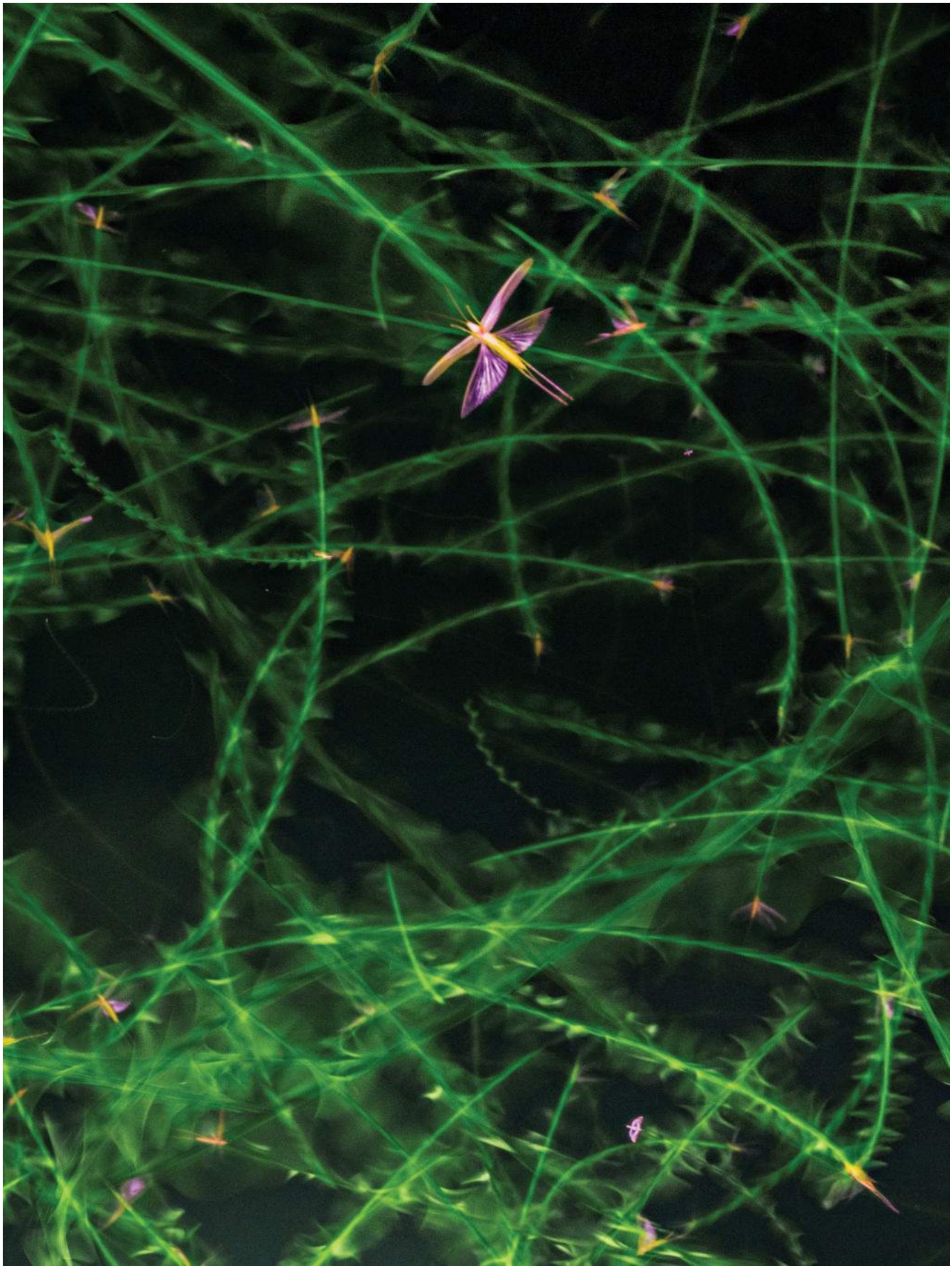
Jordan Salama's first book, *Every Day the River Changes: Four Weeks Down the Magdalena,* chronicles his journey down Colombia's greatest waterway. **Florence Goupil,** a French-Peruvian photographer, focuses on the environment and on Indigenous communities in Latin America.


The Cricket Catchers

TRAPPERS OF THE HOPPING INSECTS BRING A KEY SOURCE OF PROTEIN TO UGANDAN MARKETS. BUT OVERHARVESTING AND CLIMATE CHANGE COULD THREATEN THIS FOOD OF THE FUTURE.

BY **HALIMA ATHUMANI**

PHOTOGRAPHS BY **JASPER DOEST**



A slow shutter speed captures flight patterns of cone-headed bush crickets, commonly called grasshoppers or *nsenene* in Uganda. As their numbers drop, the development of captive-breeding techniques could improve food security, create new sources of income for farmers, and protect wild populations.

PREVIOUS PHOTO

A young man listens to the whir of insects' wings and the clang of their bodies colliding with the corrugated metal sheets that form the walls of a giant trap. Lured by ultrabright lights and sedated by smoke, swarming bush crickets slide into the drums. They are a much loved snack, but growing demand and habitat loss are driving down their numbers.

Trappers unload sacks of live bush crickets from car roofs at Katwe Market in Kampala. Vendors clamor to outbid one another, with the winner sometimes reselling smaller portions to other vendors to maximize profits. Scarcity and the growing market for the salty, fried treats have made the nsenene business increasingly competitive.

It's a cold night, and strong winds are blowing atop a hill in southwest Uganda.

The wind rattles the four-by-eight-foot metal sheets that form the slanted walls of the giant insect trap. A diesel generator roars a few yards away, powering a 400-watt bulb at its center. The light is blinding to human eyes, but it's a magnet for *Ruspolia differens*. In Uganda they're commonly referred to as "grasshoppers" or *nsenene* (en-SAY-nay-nay), but they're actually cone-headed bush crickets.

At the bottom of the metal sheets, dozens of drums stand empty. Soon, hopes Kiggundu Islam, chairman of the local bush cricket trappers association, they'll be filled with millions of the nearly three-inch-long insects.

The "visitors," as they're called locally, come together to mate and feed in huge swarms after

Muntadhar Nasif holds bush crickets he caught while helping a friend with his trap. He used to catch them as a child, but today Nasif makes a stable income as a tour guide. He says it's too risky to get in the nsenene trade, as swarms are smaller and less reliable than they once were.

NGM MAPS

each rainy season in the autumn and spring, when hundreds of people across the country set aside their day jobs to come out and catch them. Salted and fried, the crickets are a delicacy in Uganda, sold for two dollars a bag at open-air markets, taxi parks, and roadsides. ("You see how you enjoy having a movie with popcorn? Me, it's a movie with nsenene," says one fan.)

It's November 2020, and it should be the middle of the autumn harvest in Harugongo. Legend has it the insects come from the moon, and tonight it's full. Yet "we've got nothing," Islam says. "Where are they?"

Protein dense and full of iron, zinc, and other essential minerals, bush crickets, and edible insects in general, have been lauded by the UN Food and Agriculture Organization as a "food source of the future," key for establishing food security, alleviating hunger, and preventing undernutrition. That's important in countries such as Uganda, where nearly a third of children are stunted, and half of children under five and a third of women are anemic.

But what once was a small-scale and personal harvest in Uganda has become an increasingly commercialized undertaking, with giant hilltop and rooftop traps taking tons of the insects at a time to meet the growing demand. Meanwhile, decreasing catches suggest bush crickets are being overharvested, leading to pressure to make the collection more sustainable.

Uganda's growing electrical grid has made large-scale traps more common. Insect collectors, who lash lights to the ends of wooden poles, can amplify bulbs to 1,200 watts—some 20 times stronger than a standard household bulb. The light attracts more crickets, but it also puts harvesters at risk of UV burns and eye damage.

When Islam began collecting them in 2017, it was only for himself and his family. They collected the crickets that were attracted to their home by a security light.

But the growing market promised a nice income, and Islam soon set up two commercial traps. "The nsenene came in big numbers," says Islam, a slim man with a deep voice. "We had a lot of customers who came for them.

"On a good [night] you can get as many as 400 bags," each weighing up to 110 pounds, "which we then transport to Kampala and sell," he says. But three days on the Harugongo hilltop have yielded nothing so far.

"The demand for this insect has escalated," says Philip Nyeko, an entomologist in the Department of Forestry, Biodiversity, and Tourism at Makerere University in Kampala. "The supply, being seasonal, cannot now keep up."

Nyeko leads a team of researchers developing a method for farmers to captive-breed the bush crickets. The goal is to take the pressure off wild populations, allow for a year-round supply of nsenene, and provide another source of income for farmers, whose crops are increasingly at risk from severe droughts and pests.

But until recently, not much was known about the biology, ecology, or life cycle of these insects. The scientists had to start from scratch.

"If you bring them from the wild, under what conditions do you keep them? Where do you keep them?" Nyeko says he wondered. What temperature do they prefer? What foods do they thrive on? Where will they lay their eggs?

Namuna Mzee picks nsenene off a stalk of corn. Unlike the crickets' locust cousins—responsible for outbreaks across East Africa that devastate crops and livelihoods—these hoppers are not usually as destructive in Uganda, where they create jobs for collectors and vendors. Climate change has intensified locust outbreaks, but it poses a threat to the bush cricket, whose life cycle is closely tied to predictable rainy seasons.

ON A SUNNY MORNING at Katwe, a market in Kampala, small wooden stalls line a muddy dirt road that leads to an open playing field. Next to the stalls are men and women seemingly sitting idle under large umbrellas.

Then a man appears on foot, carrying a plastic sack. It's half-filled with bush crickets. The vendors snap awake and crowd around him. They're pulling the bag from all sides, hollering over each other. How much? Are you bringing more? When?

The man is a bush cricket wholesaler, but he has little for them today. The half sack is bought by a middle-age man with a nearby stall. Everyone else slumps away disappointed, hoping to be able to afford the next sack—whenever it comes.

The problem is not just overharvesting, says Hajji Quraish Katongole, head of the Old Masaka Basenene Association Limited, the national trappers organization, which sets safety rules for collection and registers collectors. "God has blessed Uganda with fertile soil and favorable environment," he says, but logging to clear land for sugarcane and oil palms has destroyed much bush cricket habitat. And climate change is making the rainy seasons unpredictable, affecting the crickets' swarming patterns.

"If we just depend on the wild, it may not be sustainable" for the species' future, says Geoffrey Malinga, a senior lecturer at Gulu University, which has partnered with Makerere University and the University of Copenhagen for the captive-breeding project's upcoming field trials. Cone-headed bush crickets can't be allowed to disappear—they're a crucial protein source for

some Ugandans, "especially for children who are poor and are not able to afford sources of proteins like meat," Malinga says.

By 2019, after eight years of experiments, Nyeko and his collaborators cracked the code of keeping and breeding bush crickets. Wire-mesh and Plexiglas cages, a variety of grains to eat, and damp sand did the trick. Next: field tests. The pandemic delayed plans to roll out a pilot project with farmers in 2020, but now it's set to start in early 2022. The researchers have selected 99 villages in the central Ugandan district of Mityana to participate, with the goal that it'll catch on from there.

"The farmers we shall train shall then train other farmers," Malinga says.

They also plan to test out a porridge-nsenene mix for schoolchildren.

On the hill in Harugongo, Islam is back. A mask, pants, and long sleeves protect him from the trap's bright light—and the painful Nairobi flies. It's a few days into the 2021 fall season, and he's caught about three sacks' worth—two fewer than this time the previous year. Like others, he took out loans to stay in business and worries how he'll repay them. "You struggle for plan B now," he says. "You will have to go and hunt somewhere else [for] money, not in grasshoppers." □

Halima Athumani is a Uganda-based journalist. This is her first story for the magazine. **Jasper Doest** focuses on stories that explore the relationship between the natural world and humankind.

An aerial view of traps shows how harvesters work together to increase brightness and warmth to attract more bush crickets. Decades ago, people used bedsheets to collect the insects for themselves and their families, but a boom in nsenene popularity turned collecting into a business, leading to the spread of these large traps.

INSTAGRAM

THOMAS P. PESCHAK

FROM OUR PHOTOGRAPHERS

WHO

A National Geographic Explorer who focuses on wildlife and conservation

WHERE

Cousine Island, Seychelles

WHAT

Nikon D3 with a 16mm fish-eye lens (both in waterproof housing) and two underwater strobe lights

While in the Seychelles to photograph a book about biodiversity, Peschak took his camera everywhere. One day as he was walking to the sea, where he planned to take underwater images of the islands' vibrant reefs, a common white tern began to hover near his face. Peschak, in full scuba gear with fins clenched in his teeth, raised his camera and clicked the shutter. This image is one reason he tells aspiring photographers that the best camera and lens combination is often the one you're holding in your hands.

National Geographic is the most popular brand on Instagram, with more than 270 million followers. This page showcases images from our accounts: **@natgeo, @natgeotravel, @natgeointhefield, @natgeoadventure, @natgeoyourshot.**

Subscriptions For subscriptions or changes of address, contact Customer Service at *ngmservice.com* or call 1-800-647-5463. Outside the U.S. or Canada call +1-515-237-3674.

NATIONAL GEOGRAPHIC (ISSN 0027-9358) PUBLISHED MONTHLY BY NATIONAL GEOGRAPHIC PARTNERS, LLC, 1145 17TH ST. NW, WASHINGTON, DC 20036. $39 PER YEAR FOR U.S. DELIVERY, $50.00 TO CANADA, $69.00 TO INTERNATIONAL ADDRESSES. SINGLE ISSUE: $8.00 U.S. DELIVERY, $10.00 CANADA, $15.00 INTERNATIONAL. (ALL PRICES IN U.S. FUNDS; INCLUDES SHIPPING AND HANDLING.) PERIODICALS POSTAGE PAID AT WASHINGTON, DC, AND ADDITIONAL MAILING OFFICES. POSTMASTER: SEND ADDRESS CHANGES TO NATIONAL GEOGRAPHIC, PO BOX 37545, BOONE, IA 50037. IN CANADA, AGREEMENT NUMBER 1000010298, RETURN UNDELIVERABLE ADDRESSES TO NATIONAL GEOGRAPHIC, PO BOX 819 STN MAIN, MARKHAM, ONTARIO L3P 9Z9. UNITED KINGDOM NEWSSTAND PRICE £6.99. REPR. EN FRANCE: EMD FRANCE SA, BP 1029, 59011 LILLE CEDEX; TEL. 320.300.302; CPPAP 0725U89037; DIRECTEUR PUBLICATION: D. TASSINARI. DIR. RESP. ITALY: RAPP IMD SRL, VIA G. DA VELATE 11, 20162 MILANO; AUT. TRIB. MI 258 26/5/84 POSTE ITALIANE SPA; SPED. ABB. POST. DL 353/2003 (CONV L.27/02/2004 N.46) ART 1 C. 1 DCB MILANO STAMPA. QUAD, MARTINSBURG, WV 25401. SUBSCRIBERS: IF THE POSTAL SERVICE ALERTS US THAT YOUR MAGAZINE IS UNDELIVERABLE, WE HAVE NO FURTHER OBLIGATION UNLESS WE RECEIVE A CORRECTED ADDRESS WITHIN TWO YEARS.

SAIL EUROPE'S LEGENDARY WATERWAYS

WITH NATIONAL GEOGRAPHIC

See Europe from an exhilarating perspective, cruising its fabled rivers in the company of a National Geographic Expert and a National Geographic photographer. Explore some of Europe's most enchanting Christmas markets at the height of the holiday season, discover Holland and Belgium when the tulips are in bloom, or delve into history and culture along the Danube or the Rhine. When you're ready to travel again, join us on one of our new river cruises, operated on the world-class ships of AmaWaterways, and embark on an enriching and unforgettable voyage.

NATIONAL GEOGRAPHIC

EXPEDITIONS

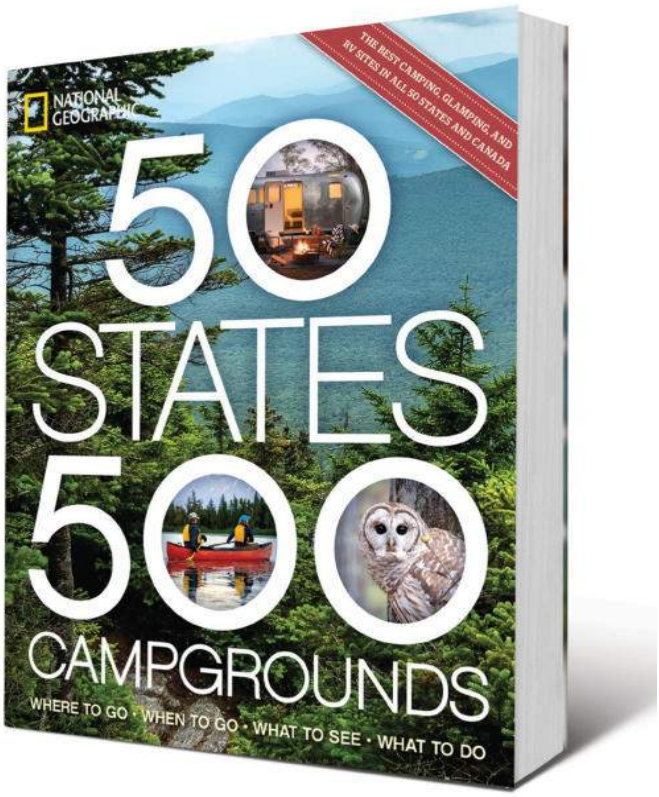
To learn more about all our trips and to request a **FREE** catalog

NATGEOEXPEDITIONS.COM | 1-888-351-3274

Above: Salzburg, Austria


PURINA
CARES HERE.
AND HERE.
TAILORED NUTRITION FOR EVERY PET.
A PET FOR EVERY HOME.
You care about your pet's needs, and every pet's future. So do we.
Nutrition is at the heart of what we do, but it's not all we do.
See our commitment to tailored pet nutrition and increasing
pet adoptions at PURINA.COM/CARES.
PURINA Your Pet, Our Passion.
PURINA TRADEMARKS ARE OWNED BY SOCIÉTÉ DES PRODUITS NESTLÉ S.A.

PLAN YOUR NEXT CAMPING ADVENTURE



Whether you're looking to pitch a tent, find the ultimate RV resort, or glamp among the stars, this comprehensive guide offers the best campgrounds in all 50 states and Canada. Inside you'll find:

- **CAMPSITES** throughout the country
- **TOP-NOTCH DESTINATIONS** for all adventurers
- **NEED-TO-KNOW** camping information including fees, permit requirements, campground amenities, and more
- **EXPERT RECOMMENDATIONS** for excursions—including biking, hiking, fishing, and kayaking
- **And so MUCH MORE!**

Filled with more than 200 stunning photographs, this guide is a treasure-trove of information to plan your next camping adventure!

AVAILABLE WHEREVER BOOKS ARE SOLD

NatGeoBooks @NatGeoBooks

NATIONAL GEOGRAPHIC