

10.2018

# NATIONAL GEOGRAPHIC

LAST TRIBES OF  
THE AMAZON

*"Who's going to fight  
for the isolated ones,  
if not us?"*

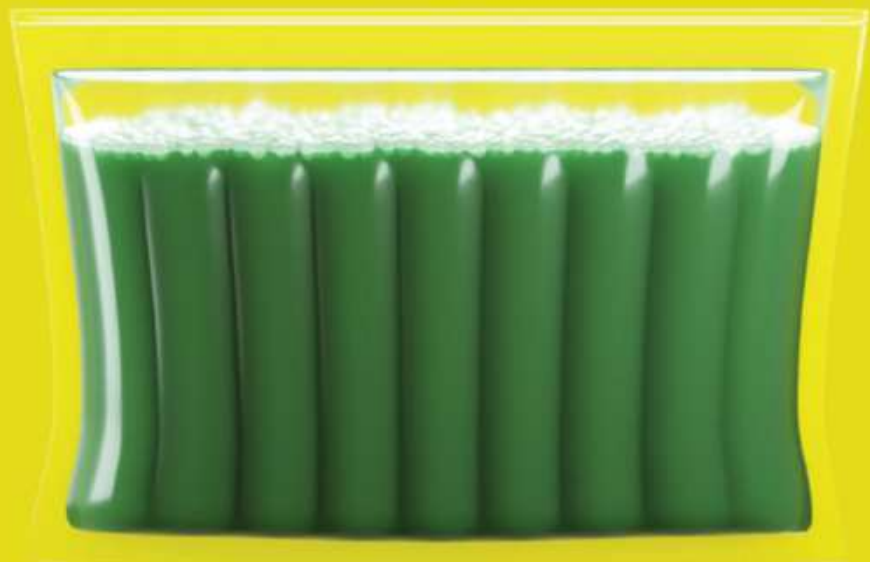
TAINAKY TENETEHAR  
GUAJAJARA TRIBESMAN  
AND FOREST GUARDIAN



- Soil
- Microbial Megacity
- Carbon-Sequestering Powerhouse
- All of the Above



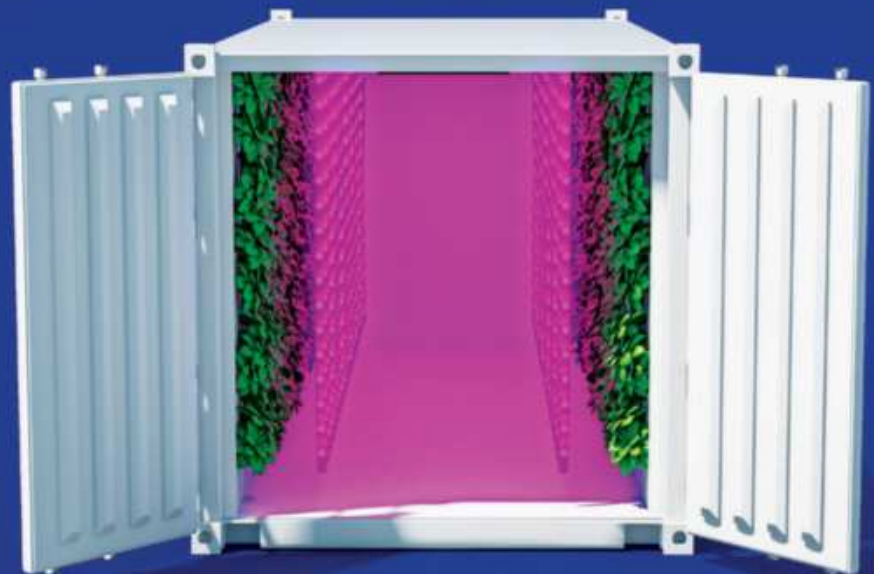
- Algae
- Biofuel
- Protein Supplement
- All of the Above



- Cricket
- Tortilla Chip Ingredient
- Protein Source
- All of the Above



- Shipping Container
- Urban Farm
- Entrepreneurial Spirit
- All of the Above



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# C O N T E N T S

## On the Cover

In Posto Awá, an Awá village in eastern Brazil, a baby black-bearded saki monkey hitchhikes a ride on the head of a five-year-old named Kaiou.

CHARLIE HAMILTON JAMES

## PROOF



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PHOTOGRAPHS BY CRAIG BURROWS

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EYE-POPPING LANDSCAPES

**THE ATACAMA DESERT**  
in Chile sees practically no rain; the high mountains that ring it help prevent moisture from reaching the sands.

**THE NILE RIVER,**  
the world's longest, runs for about 4,160 miles, depositing its freshwater into the Mediterranean Sea.



**MAMMOTH CAVE** in Kentucky is part of the world's longest cave system. Some 400 miles have been mapped.

NAT  
GEO  
BOOKS



## Explore New Worlds in Nat Geo Almanac 2019

Need a refresher on the world around you? The new *National Geographic Almanac* can help with that. The 2019 edition, coming this month, illuminates the worlds of science, nature, history, and geography in vivid detail. Dazzling photography, maps by distinguished cartographers, illustrated time lines, and quizzes in each section will help catch you up on the latest discoveries. Available where books are sold and at [shopng.com/books](http://shopng.com/books).

NAT GEO WILD

**Who's Taking Fido's Photo? Pupparazzi**  
Pet photographer Kaylee Greer is known for her fetching photos of canines in unusual settings—salt flats in Utah, a gondola in Venice—and at shelters to encourage adoptions. Greer and her fiancé, Sam Haddix, take viewers along on four-legged photo shoots in *Pupparazzi*, airing September 15, 22, and 29 at 10/9c on Nat Geo WILD.

TELEVISION

**Surviving Life Below Zero**

Six Alaska residents fight to get through the winter in one of America's most hostile environments, where resources are limited and they're threatened by carnivorous predators. *Life Below Zero* kicks off a new season with a 90-minute premiere episode on September 25 at 9/8c, on National Geographic.

BOOKS

**The Flavor of Italy in Food and Photos**

Let the experts at National Geographic and America's Test Kitchen bring Italian scenery, culture, and cuisine to your kitchen with *Tasting Italy*. Some 350 maps and photographs complement the 100 kitchen-tested recipes in this new guide, available where books are sold and at [shopng.com/books](http://shopng.com/books).

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CHARLIE  
HAMILTON  
JAMES

# Isolated and at Risk: Peoples of the Amazon

BY SUSAN GOLDBERG

One of the most challenging aspects of storytelling at *National Geographic* is introducing our readers to people and cultures they've never seen before. It's a beautiful part of our 130-year history but also an ethical minefield: What's our responsibility in telling the stories of those who, at least outwardly, seem so different from us? How do we cover cultures sensitively, without "exoticizing" or romanticizing what's natural for them?



Photographer Charlie Hamilton James is a National Geographic Society fellow.

'IF YOU STRIP AWAY YOUR  
PRECONCEPTIONS, IT'S A FAR  
MORE HONEST WAY OF  
CONVEYING WHAT PEOPLE ARE  
ACTUALLY LIKE.'

This month's cover story, on grave threats to the indigenous people who live in the Brazilian and Peruvian Amazon, brings this subject into high relief. Our photographer, Charlie Hamilton James, spent a month with indigenous groups such as the Awá and Guajajara people; overall, he has spent a year and a half in the Amazon. We talked about the challenges and responsibilities of taking photos in this setting.

**Goldberg:** Some of the people you took pictures of in the Brazilian and Peruvian Amazon have little contact outside of their own communities. How do you approach people in situations like this?

*Hamilton James:* You can go in with two mind-sets: You can go in to show how different people are, or you can go in to show how similar we all are. If you go in to show how different we are, what you tend to show is exaggerated bits of the culture, and you can see that in the imagery—it exoticizes people, it romanticizes them. My interest is in photographing some fellow human beings, and I'm really interested in how similar we all are. I just want to show people living as people live, in the most honest way I can.

**Do you think you can capture the truth of what's happening in these people's lives? You didn't grow up among them. And not to put too fine a point on it, but you're a**





**European Turtle-dove** (*Streptopelia turtur*)

**Size:** Body length, 27 - 29 cm (10.6 - 11.4 inches); wing length, 17.5 - 18.2 cm (6.9 - 7.2 inches)

**Weight:** 99 - 170 g (3.5 - 6 oz) **Habitat:** Agricultural landscapes and oak forests **Surviving number:** Unknown



*Photographed by Dietmar Nill*

# WILDLIFE AS CANON SEES IT

Mammal, no. Milk, yes. The European turtle-dove is one of the very few birds that produce "crop milk" to nourish their young. Subsisting entirely on grains, the turtle-dove feasts on farm fields as well as seeds growing in the wild. It winters in the southern parts of its range and summers in the north, taking different routes between each on its annual migrations. But

with fewer birds completing the trip each year due to hunting, disease and rapidly declining habitat, they could use some more of the milk of human kindness.

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



EOS System

**Canon**



**six-foot-four white guy, and these are smaller people living in the forest. It's pretty hard for you to fade into the woodwork, as it were.**

That's true, but actually, if you spend enough time, you do fade into the woodwork. At the same time, you're also getting to know people. You can't communicate with language, but what's really weird is we can laugh about the same things, even if we can't talk.

**So you feel like you're trying to be around people and just capture their humanity, the same way you would people in New York?**

Absolutely. The other day I was photographing cowboys branding cows, and I approached that situation in no different way than I approach tribal people in the Amazon. To me it's exactly the same. I haven't come with any preconceptions, and I think that's helped me. We've gone for hundreds of years into these remote places, and we've confirmed and reconfirmed these ideas of what these people should be. And most of them are wrong. If you strip away your preconceptions, and just go and hang out with the people and take pictures, I think it's a far more honest way of conveying what people are actually like.

**One of the pictures I really liked shows the villagers with their turtles**

**(pages 44-45), bathing them in the river, and I thought that was the most charming photograph. I can't speak for the turtles, as I hear some of them become dinner—but the people are laughing and obviously enjoying themselves. They let you into that scene.**

There was no barrier at all. That was a couple of days in; everyone was just relaxed with me, we're all having fun, so I'm just wandering around in my underpants in the river, taking these pictures. They're all laughing at me. It was the most photogenic and beautiful experience I've ever had. One of the reasons I like it is because everyone's laughing. Nowadays, we tend to show the miserable side of indigenous life in the Amazon: The trees are being cut down, everything's bad, and we show these people with sad faces. The world is threatening—but they still have fun, and I was really keen to show that.

**We try to make sure we're telling stories that are relevant and urgent. This feels like one of those stories.**

Isolated people living in the Amazon are being threatened by a number of serious issues. It's a very important story because it's happening more and more, and the number of isolated people and tribes is shrinking. What do you do? How do you mitigate a disaster unfolding? Everyone's doing the best they can, including us covering it.

Hamilton James describes this photo shot by an aide traveling with him: "I'm surrounded by several families of Awá people while they cook a breakfast of caiman, paca, and porcupine, which the men hunted in the forest the night before." The caiman and paca were killed with bow and arrow, he said, and "the porcupine was stolen off a jaguar that they found eating it."

📍 ISLA HOLBOX



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PROOF



NATIONAL GEOGRAPHIC

VOL. 234 NO. 4

# FLOWERS IN A NEW LIGHT



**LOOKING  
AT THE  
EARTH  
FROM  
EVERY  
POSSIBLE  
ANGLE**

PHOTOGRAPHS  
BY **CRAIG P. BURROWS**

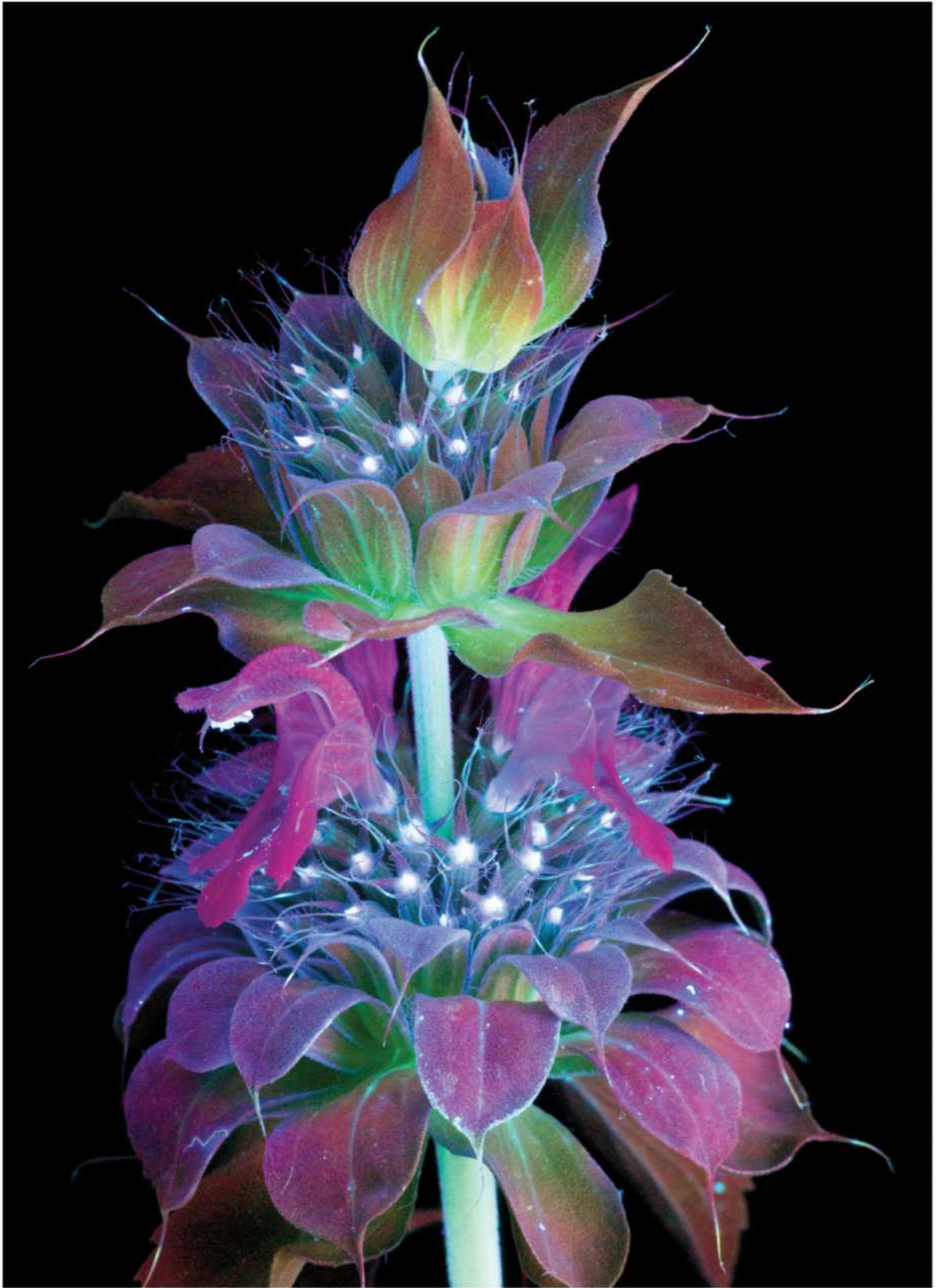
A technique that relies on ultraviolet light reveals the hidden, colorful—and even sparkly—attributes of common plants.



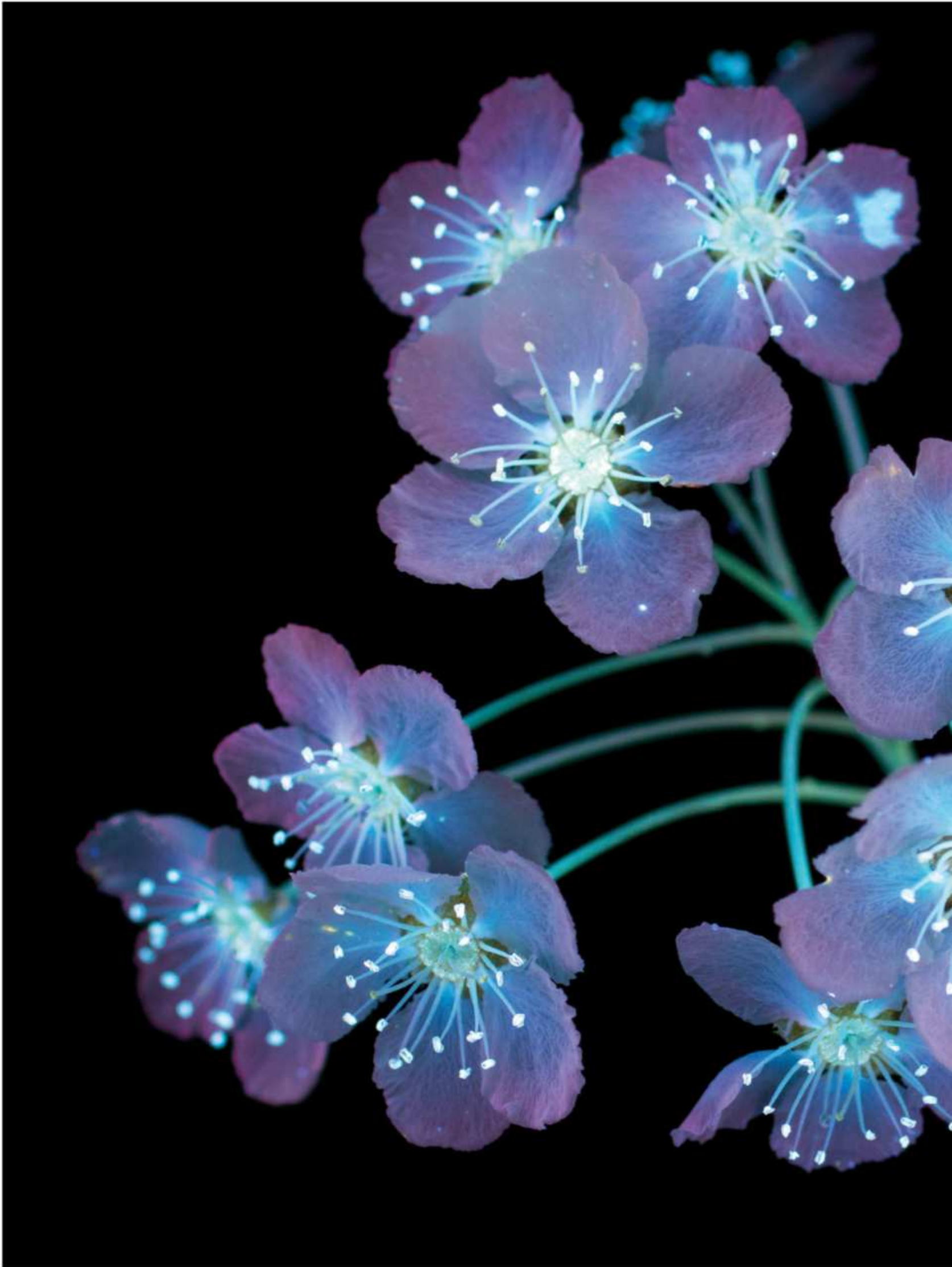
Plains coreopsis  
(*Coreopsis tinctoria*)  
is a common North  
American flower.  
Photographed under  
ultraviolet light, its pig-  
ments glitter and glow.



The common myrtle shrub (*Myrtus communis*) can often pass unnoticed. The anthers of its normally white flowers contain pigments that, under ultraviolet light, provide a brilliant flourish.



Some colorful flowers of *Monarda* sp., also known as bee balm or bergamot, attract pollinators with their vibrant hues. Under UV light the plant looks like an electrified rainbow.



The Callery pear tree (*Pyrus calleryana*) produces white flowers that look purple under UV light. The colors that humans normally see are created when wavelengths are reflected by certain materials (e.g., grass





absorbs all colors but green). Fluorescence is the emission of light of one wavelength from a substance that absorbs radiation of another wavelength. As a result, flowers reveal these colors only under UV light.

# THE BACKSTORY

A DARKROOM AND ULTRAVIOLET LIGHTS CAN MAKE ORDINARY FLOWERS GLOW WITH UNEARTHLY COLORS.

**STEP ONE** for photographer Craig Burrows is to select a flower. He does this carefully, foraging in parks and cracks in the pavement. Once he finds a worthy candidate—full in body and complex in texture—he brings it home. If he can't find a specimen he likes, he'll go to his garden and grow it himself.

Burrows lives near Los Angeles, a prime place for diverse plants. He has photographed flowers since 2014 with a technique known as ultraviolet-induced visible fluorescence (UVIVF) photography. The method allows a flower to reveal the spectacular colors it emits when exposed to UV light. Ordinary pigments come to life in strange new ways, showing colors you'd expect on another planet. Daisies and sunflowers often have the most striking fluorescence, their pigments glowing in vibrant colors. Many flowers reveal

something different from what's seen under conventional light.

The UVIVF process requires near-perfect darkness and that the plants remain almost perfectly still. Flowers can't run from the camera, but during a 20-second exposure they might shift, droop, or turn. Burrows holds his breath during each exposure, mindful that an errant exhalation or disturbance of dust can cause motion blur or introduce distracting particles. The result is a series of luminous botanical portraits spangled with glowing embellishments.

"It's not that I'm creating something special," says Burrows. "I'm finding something that's right in front of us and sharing it in a way that other people haven't seen yet." The most interesting things, he says, are often hidden in plain sight. —DANIEL STONE



The white flower of *Kalanchoe marmorata* (left) becomes pink in Burrows's studio.



# Despite Perils, Decide to Hope

OUR PLANET IS BESET BY CONFLICT, CLIMATE CHANGE, POLLUTION, DISEASE, AND OTHER HAZARDS. WHAT BETTER TIME TO BE HOPEFUL?

BY ANNE LAMOTT

Y

**YOU WOULD ALMOST** have to be nuts to be filled with hope in a world so rife with hunger, hatred, climate change, pollution, and pestilence, let alone the self-destructive or severely annoying behavior of certain people, both famous and just down the hall, none of whom we will name by name.

Yet I have boundless hope, most of the time. Hope is a sometimes cranky optimism, trust, and confidence that those I love will be OK—that they will come through, whatever life holds in store. Hope is the belief that no matter how dire things look or how long rescue or healing takes, modern science in tandem with people’s goodness and caring will boggle our minds, in the best way.

Hope is (for me) not usually the religious-looking fingers of light slanting through the clouds, or the lurid sunrise. It’s more a sturdy garment, like an old chamois shirt: a reminder that I’ve been here before, in circumstances just as frightening, and I

BY SHOWING UP WITH  
HOPE TO HELP OTHERS, I'M  
GUARANTEED THAT HOPE  
IS PRESENT. THEN MY OWN  
HOPE INCREASES. BY CREATING  
HOPE FOR OTHERS, I END UP  
AWASH IN THE STUFF.

came through, and will again. All I have to do is stay grounded in the truth.

Oh, that's very nice, you may well respond. And what does that even mean, the truth?

I don't presume to say what capital-T Truth is. But I do know my truth, and it's this: Everyone I know, including me, has lived through devastating times at least twice, through seemingly unsurvivable loss. And yet we have come through because of the love of our closest people, the weird healing properties of time, random benevolence, and, of course, our dogs.

At regular intervals, life gets a little too real for my taste. The wider world seems full of bombers, polluters, threats of all kinds. My own small world suffers ruptures—a couple of deaths, a couple of breakups, a young adult who had me scared out of my wits for a couple of years—that leave me struggling to stay on my feet.

In these situations I usually have one of two responses: either that I am doomed or that I need to figure out whom to blame (and then correct their behavior). But neither of these is true. The truth is that—through the workings of love, science, community, time, and what I dare to call grace—some elemental shift will occur and we will find we are semi-OK again. And even semi-OK can be a miracle.

**“SOMETIMES I HAVE TO BELIEVE** that heaven is just a new pair of glasses.” That was said by a priest who helped establish Alcoholics Anonymous roughly 80 years ago—and when I remember to put on such glasses, I spy reasons for hope on every street. You can't walk a block without seeing recycling bins. Nations are pledging serious action on climate change. My young friend Olivia, who has cystic fibrosis, got into a clinical trial two years ago for a newfangled drug—and it's working, meaning she will live a great deal longer than we ever dared to hope.

I like these days in spite of our collective fears and grief. I love antibiotics. I'm crazy about electricity. I get to fly on jet airplanes! And in the face of increased climate-related catastrophes—after I pass through the conviction that we are doomed, that these are End Times—I remember what Mister Rogers's mother said: In times of disaster we look to the helpers.

Look to the volunteers and aid organizations clearing away the rubble, giving children vaccines; to planes and trains and ships bringing food to the starving. Look at Desmond Tutu and Malala

## Show Up With Hope, to Help

On any day, in any place, we can find opportunities to work for good and create hope.

**National Public Lands Day**, September 22, enlists help restoring parks and other sites. Last year, volunteers made \$18 million in improvements at 2,600 sites. [neefusa.org/npld](http://neefusa.org/npld)

**Food Rescue US** helps businesses that have too much food give to people who have too little, via food delivery volunteers. [foodrescue.us](http://foodrescue.us)

The **EarthEcho Water Challenge** equips people to protect local water sources by doing basic monitoring. [worldwatermonitoringday.org](http://worldwatermonitoringday.org)

**Be The Match** helps patients with blood cancers like leukemia find a marrow donor and receive a transplant; find dates for its Walk+Run fund-raisers at [bethematch.org](http://bethematch.org).





Yousafzai, Bill Gates and the student activists of Parkland, Florida; anyone committed to public health, teachers, and all those aging-hippie folk singer types who galvanized the early work of decontaminating the Hudson River.

You could say that river cleanup was child's play compared with the melting of the ice caps—and I would thank you for sharing and get back to doing what is possible. Those who say it can't be done should get out of the way of those who are doing it.

We take the action—soup kitchens, creek restoration, mentoring—and then the insight follows: that by showing up with hope to help others, I'm guaranteed that hope is present. Then my own hope increases. By creating hope for others, I end up awash in the stuff.

We create goodness in the world, and that gives us hope. We plant bulbs in the cold, stony dirt of winter and our aging arthritic fingers get nicked, but we just do it, and a couple of months later life blooms—as daffodils, paperwhites, tulips.

Hope is sometimes a decision that we won't bog down in analysis paralysis. We show up in waders or with checkbooks. We send money to India, and the Sierra Club, the Union of Concerned Scientists, and to Uncle Ed's GoFundMe account for his surgery.

**YOU WANT HOPE?** In India you see families waking up on hard, dusty streets and the poorest moms combing their kids' hair for school. School is hope. Closer to home you see a teenager recover from a massive brain bleed and head off to a college for kids with special needs—not only alive but carrying a backpack full of books and supplies, and lunch. (Lunch gives me hope.)

You saw someone, maybe yourself or your child, get and stay sober. You read that the number of mountain gorillas in central Africa has risen consistently over the past few years. One had barely dared to hope, and yet? If this keeps up, we'll be up to our necks in mountain gorillas.

We might hope that this or that will happen, and be disappointed—but when we instead have hope in the resilience and power of the human spirit, in innovation, laughter, and nature, we won't be.

I wish I had a magic wand and could make people in power believe in climate science, but I don't. I do, however, have good shoes in which to march for science and sanity. (Sanity: Is that so much to hope

I WISH I HAD A MAGIC WAND AND COULD MAKE PEOPLE IN POWER BELIEVE IN CLIMATE SCIENCE, BUT I DON'T. I DO, HOWEVER, HAVE GOOD SHOES IN WHICH TO MARCH FOR SCIENCE AND SANITY.

for? Never!) I see people rising up to their highest, most generous potential in every direction in which I remember to look, when I remember to look up and around and not at my aching feet.

My friend Olivia hates having cystic fibrosis, and every moment of life is a little harder than it is for people without the disease. But most of the time she's the happiest person I'm going to see on any given day. She is either in gratitude or in the recording studio, where she is recording her second album of songs she wrote and plays on guitar. The engineer hits the mute button when she needs to cough, which is fairly frequently. She got a terrifying diagnosis 23 years ago, but with her community's support, she and her parents kept hoping that she would somehow be OK or at least OK-ish—and then voilà, the successful clinical trial of a miracle drug.

Children pour out of school labs equipped with the science and passion to help restore estuaries and watersheds. Church groups pitch in to build water wells to nourish developing-world villages. As John Lennon said, "Everything will be OK in the end. If it's not OK, it's not the end." This has always been true before; we can decide to hope that it will be again.

Sometimes hope is a radical act, sometimes a quietly merciful response, sometimes a second wind, or just an increased awareness of goodness and beauty. Maybe you didn't get what you prayed for, but what you got instead was waking to the momentousness of life, the power of loving hearts. You hope to wake up in time to see the dawn, the first light, a Technicolor sunrise, but the early morning instead is cloudy with mist. Still, as you linger, the ridge stands majestically black against a milky sky. And if you pay attention, you'll see the setting of the moon that illumined us all as we slept. And you see a new day dawn.

## Hope, Noted

Anne Lamott is the author of nine *New York Times* best sellers, including *Some Assembly Required*, *Bird by Bird*, and *Help, Thanks, Wow*. Her new book—*Almost Everything: Notes on Hope*—comes out this month. She lives in California with her partner, Neal, and dog, Lady Bird.



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# MORE BRAINS MAKE RESEARCH POSSIBLE

PHOTOGRAPH BY REBECCA HALE

**BRAINS ARE** in short supply. Neuroscientists need brain tissue of all types to study the diseases that affect more than 15 percent of people in the world. Enter Tish Hevel. In 2015, after Hevel's father died from Lewy body dementia, her family wanted to offer his brain for research—but knew that it would take much more than an organ donor card. The experience inspired Hevel to create the Brain Donor Project “to raise awareness of the critical need” and make enrolling easier for would-be donors. Nearly two years in, more than 2,000 people have signed up. —LORI CUTHBERT



This donated brain of a 101-year-old man is larger than a typical brain of someone his age. He's said to have been astute until the day he died.

## MEDICINE

### Busting Myths About Donating Your Brain

The organization that Tish Hevel created—online at [braindonorproject.org](http://braindonorproject.org)—aims to simplify “the process of donating postmortem human brains for research,” she says, and dispel misconceptions about it. Here's what you need to know.

#### 1. ORGAN DONOR

If your driver's license says you're an organ donor, then congrats: You've done a noble thing. But not all your organs are included. Your heart, corneas, and pancreas might go to a lucky person, but your brain will stay with you unless you've made separate arrangements to donate it.

#### 2. HEALTHY BRAINS

What state your brain will be in when it's donated may be a crapshoot, but the truth is, it matters only if certain conditions or infectious diseases are present. Science needs brains of all types, since a critical part of the research process is comparing diseased and healthy organs.

#### 3. OPEN CASKET

You may fear that brain removal will cause discomfiting changes in appearance. It won't; the brain is removed through an incision in the back of the head, and “it's not disfiguring,” says Hevel.

#### 4. THE COSTS

In the United States, if you donate your brain to one of six National Institutes of Health brain banks, there's no cost to the family for retrieving the brain after death, for the donation, or for storage.

#### 5. THE TIMING

Time is of the essence if you've donated your brain to science. Pathologists need to collect the brain within 24 hours of death, and they prefer to harvest the tissue as soon as possible. So be sure to tell your family about the choice you've made and how your wishes should be carried out.

#### 6. SIGNING UP

The donation process isn't complicated, and is outlined at [braindonorproject.org](http://braindonorproject.org). You'll fill out several forms to return via email or snail mail—and that's all it takes to arrange your contribution of what Hevel calls “the most precious resource.”



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SXSW 2018  
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AUDIENCE AWARD  
2018

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CRISTINA COSTANTINI & DARREN FOSTER

# SCIENCE FAIR

WHAT'S THE BIG IDEA?

OFFICIAL SELECTION  
FLYOVER FILM FESTIVAL  
2018

BEST DOCUMENTARY FEATURE  
41ST PORTLAND INTERNATIONAL  
FILM FESTIVAL 2018

OFFICIAL SELECTION  
THE MARTHA'S VINEYARD  
FILM FESTIVAL 2018

OFFICIAL SELECTION  
SAN FRANCISCO JEWISH  
FILM FESTIVAL

FILM ISLAM STUDENT CHOICE  
AWARD FOR BEST FEATURE  
CLEVELAND INTERNATIONAL  
FILM FESTIVAL

AUDIENCE AWARD  
TUMBLEWEED FILM FESTIVAL  
FOR CHILDREN & YOUTH 2018

OFFICIAL SELECTION  
MOUNTAINFILM  
2018

OFFICIAL SELECTION  
EDINBURGH INTERNATIONAL  
FILM FESTIVAL 2018

OFFICIAL SELECTION  
ASPEN IDEAS FESTIVAL  
2018

WINNER BEST EDITING  
LOS ANGELES ASIAN  
PACIFIC FILM FESTIVAL 2018

WRITTEN BY CRISTINA COSTANTINI, DARREN FOSTER, PRODUCED BY JEFFREY PLUNKETT, DARREN FOSTER, CRISTINA COSTANTINI  
DIRECTED BY CRISTINA COSTANTINI, DARREN FOSTER, JEFFREY PLUNKETT, PRODUCED BY PETER ALTON, PRODUCED BY TOM MARONEY, ALEJANDRO VALDES-ROCHIN  
EDITED BY JENNIFER WOOD, PRODUCED BY JEFF MORROW, EXECUTIVE PRODUCERS ISAAC LEE, DANIEL EILEMBERG, GEORGE LANSBURY, KEITH SUMMA

PG

IN THEATERS THIS FALL

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NATIONAL  
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FILMS

DISPATCHES  
FROM THE FRONT LINES  
OF SCIENCE  
AND INNOVATION

**Grow Your Words**

There's no erasing mistakes with Sprout, a Danish brand of pencil. Instead of the rubber nub that's typically on the end of such writing utensils, this one has a biodegradable capsule that holds a collection of seeds. After it's worn to a stub, the pencil can be planted and watered until it blooms into a handful of daisies, a sprig of basil, or one of eight other plants. —NS



ANIMALS

## PRANCE DISCOVERY

THE DANCE MOVES OF AN UNUSUAL-LOOKING BIRD CAME AS A SURPRISE TO SCIENTISTS.

A **FALLEN TREE** in a forest may seem unremarkable—but to some birds of paradise, it's the ideal stage for a mating dance. Edwin Scholes, who runs Cornell's Birds-of-Paradise Project, and Tim Laman, a biologist and National Geographic photographer, were doing research in the Arfak Mountains of western New Guinea when they found a downed log and set up a camera in hopes of catching a courtship display. The bird that appeared was different from others of its species, says Scholes: Its feathers fanned into a unique crescent shape, and it had distinctive moves, "like a Latin dance where all the motion is below the hips." What he and Laman observed confirmed a previous discovery of genetic variation. Last year they announced a new species: the Vogelkop superb bird of paradise. Such sightings may benefit the region, says Scholes, by encouraging ecotourism that provides a "new economic incentive to keep the forest intact." —NINA STROCHLIC

GENETICS

## High-Tech Chocolate

Scientists at the Innovative Genomics Institute (IGI) have teamed up with candy-maker Mars to use the Crispr gene-editing technology to protect one of the world's favorite treats. The goal: give the cacao plant an immune system that can resist a virus ravaging West Africa's crops. That could avert losses on two levels, says IGI's Susan Jenkins: "The self-centered side is 'Oh my gosh, no more chocolate'"—and for cacao-growing regions "the socio-economic impact is huge as well." —NS



FROM THE DIRECTORS OF *MERU*



"ALEX HONNOLD'S  
FREE SOLO CLIMB  
SHOULD BE CELEBRATED  
AS ONE OF THE GREAT  
ATHLETIC FEATS  
OF ANY KIND, EVER"

- *The New York Times*

"ANOTHER PASSAGE CAN  
BE WRITTEN IN THE ANNALS  
OF HUMAN ACHIEVEMENT"

- *THE NEW YORKER*

LIVE BEYOND FEAR

# FREE SOLO

A FILM BY ELIZABETH CHAI VASARHELYI & JIMMY CHIN

NATIONAL GEOGRAPHIC DOCUMENTARY FILMS presents LITTLE MONSTER FILMS' TONYANT LETA, co-produced by PARKES-MACDONALD / BANG NATION production  
ALEX HONNOLD'S "THE SOLO," "JAMES HESTER," "YOUNG ESCOBARDO" and "JIMMY CHIN CLIMB POPPA" and "AMY SCHAEFER" with TRACY MATHNEY  
and WALTER PEREZ (AUBREY MACDONALD) THE PRODUCTION: MATT BEHNER with SARAH MCGAN. ©2013 ELIZABETH CHAI VASARHELYI, JIMMY CHIN, EVAN HARRIS, SHANNON DILL  
ELIZABETH CHAI VASARHELYI and JIMMY CHIN

IN THEATERS THIS FALL

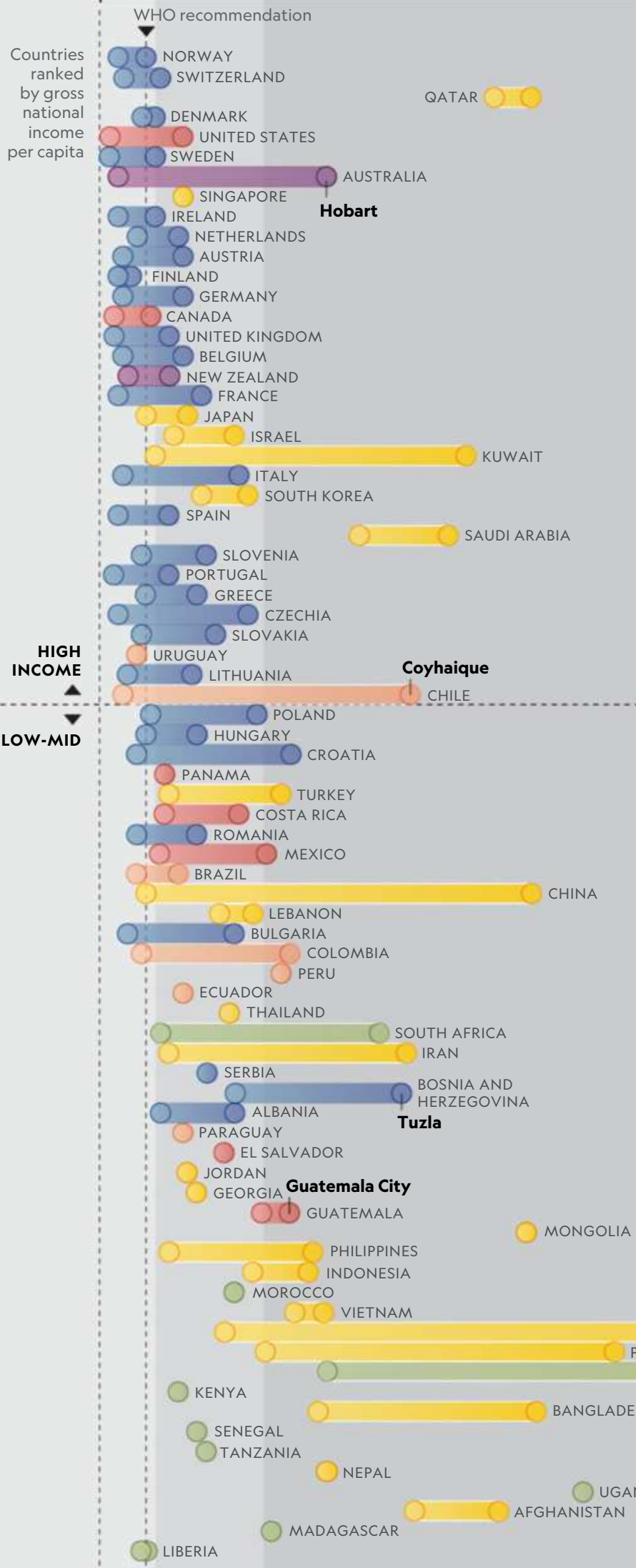
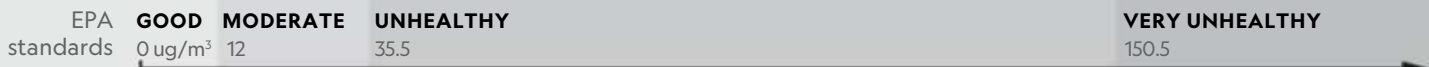
[FreeSoloFilm.com](http://FreeSoloFilm.com)



NATIONAL  
GEOGRAPHIC

DOCUMENTARY  
FILMS

AIR QUALITY\*



# WHERE CLEAN AIR IS SCARCE

BY MONICA SERRANO AND SEAN MCNAUGHTON

**AIR POLLUTION KILLS** seven million people a year. Two of the chief contributors are lax vehicle emissions standards and traditional cooking methods, according to the findings of a recent World Health Organization analysis of air quality data from more than 4,300 cities in 108 countries.

More than 90 percent of the deaths occur in low- and moderate-income countries where families are more likely to cook with charcoal and kerosene. These materials release pollutants into the air that can cause heart disease, lung cancer, and other health issues.

Urban population growth compounds the problem: Air quality in many of the world's megacities is five times worse than what WHO recommends. But the organization sees signs of hope in some nations, such as India and Mexico, that are initiating clean energy efforts and stricter vehicle standards.

COUNTRIES WITH MORE THAN TWO MILLION INHABITANTS; DATA AVAILABLE ONLY FOR SOME CITIES AND COUNTRIES. \*MEAN ANNUAL CONCENTRATION ( $\mu\text{g}/\text{m}^3$ ) OF FINE SUSPENDED PARTICLES LESS THAN 2.5 MICRONS ( $\text{PM}_{2.5}$ ) IN DIAMETER. EPA  $\text{PM}_{2.5}$  STANDARDS FOR THE AIR QUALITY INDEX ARE SHOWN FOR COMPARISON. NGM STAFF. SOURCES: WORLD HEALTH ORGANIZATION; WORLD BANK



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GENIUS

# RUTH METZEL

BY LORI CUTHBERT PHOTOGRAPH BY REBECCA HALE



**Her mission: preserve an endangered ecosystem in rural Panama. The key: community outreach.**

Ruth Metzels may have figured out a way to save a critically endangered ecosystem: build relationships with the people who live there. For a decade the ecologist has studied tropical dry forests in Panama's rural Los Santos Province. There, intensive cattle farming reflects the threat to the forests countrywide. Many farmers, proud of their traditions yet aware that land-use techniques need to change, are eager to do something about it.

Metzels co-founded Azuero Earth Project as a way to guide those who lean most heavily on the forest ecosystem toward living more harmoniously with it. "The key," she says, "is to reach people where they're at." Azuero works with cattle ranchers to identify exactly which trees—native and fruit—to plant on their land and where. The new growth helps form a corridor that replenishes the forest and restores habitat for wildlife, especially the critically endangered Azuero spider monkey. With over 5,000 trees planted since 2017, Metzels has high hopes for this approach.

To support Azuero's mission, Metzels was awarded a National Geographic Society grant to teach Panamanian artisans how to responsibly source the grasses, seeds, and other native materials they use to make crafts. The end goal, says Metzels, is preventing this endangered ecosystem from being degraded any further—and growing it.

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# EXPLORE

IN THIS SECTION  
 Taxidermist Tools  
 How to See Pixels  
 Photographing Whales



ILLUMINATING THE MYSTERIES—AND WONDERS—ALL AROUND US EVERY DAY

NATIONAL GEOGRAPHIC

VOL. 234 NO. 4



**The Leuser Ecosystem**  
 This mountainous tropical rain forest is home to several small, scattered populations of Sumatran rhinos.

**LEUSER ECOSYSTEM**  
 Less than 50 rhinos  
 6 subpopulations

**SUMATRA**  
 Less than 75 rhinos  
 10 subpopulations or clusters

# RHINO RECOVERY

**MATING IS A CHALLENGE** for Sumatran rhinos. The critically endangered animals live in four isolated regions scattered across 10,000 square miles of steep, dense forest, and males rarely venture far. A new effort—led by the Indonesian government and supported by an alliance of conservation organizations, including the National Geographic Society—aims to help the species rebound by consolidating the fragmented populations and expanding breeding programs to several rhino sanctuaries within Indonesia.

**Kerinci Seblat N.P.**  
 Last record of wild rhino: 2004

**WAY KAMBAS N.P.**  
 Less than 20 rhinos  
 2 subpopulations

**BUKIT BARISAN SELATAN N.P.**  
 Less than 5 rhinos  
 2 subpopulations

**Sumatran Rhino Sanctuary**  
 In captivity  
 7 (3 males, 4 females)



Height:  
3.3-5 feet



Weight:  
1,320-2,090  
pounds

Sumatran rhino  
(*Dicerorhinus sumatrensis*)

### RHINOCEROS COLLAPSE

The number of Sumatran rhinos has dropped an estimated 70 percent in the past two decades, mostly due to poaching. Fewer than a hundred remain in Indonesia, in isolated pockets. Sumatran rhinos are solitary creatures. They're small compared with other rhino species, and females give birth about every three to five years.

ATLAS BY LAUREN E. JAMES

### A Species in Jeopardy

Isolation is the biggest threat to Sumatran rhinos. In 2015 they were declared extinct in the wild in Malaysia.

- Wild rhino population
- Last observed wild rhino location
- Park or reserve

0 mi 100  
0 km 100

### Low Birth Rate

Small populations mean the Sumatran rhino's potential to reproduce is diminished, putting it at a higher risk for extinction.



### INDONESIAN BORNEO

Less than 10 rhinos  
Rhinos have been seen in the Kutai Barat and Mahakam Ulu Regencies, with other rumored sightings by locals.

### Out of Sight

Sumatran rhinos live in remote areas, so sightings are rare and population figures are often disputed. Camera traps are the primary source of documentation.



---

# STILL LIFE AFTER DEATH



7



11



10



8



12



9



13



**1. Shaving knife**

Preparation involves thinning the animal hide—sometimes with a shaving knife, more often with a fleshing machine.

**2. Files**

Handheld files are used to sculpt muscles and other anatomy on foam mannequins.

**3. Honing steel**

An essential accessory for knife blades, which have to be sharp.

**4. Fake eyeballs**

Long used in taxidermy, glass eyes today are more lifelike than ever.

**5. Clay sculpting tools**

Some taxidermists shape a model in clay to make a mold for the foam mannequins on which hides are mounted.

**6. Calipers**

Instruments for measuring parts of a specimen or sculpture.

**7. Draw knife**

This tool scrapes muscle and fat from the skin.

**8. Tweezers and detailing tools**

Delicate tasks, like preening feathers, require small tools and steady hands.

**9. Scissors**

Large handles are best for de-fleshing near eyes and other tricky spots.

**10. Specimen**

A red-crowned parrot ready to be mounted.

**11. Airbrush**

Used for recoloring bare skin areas.

**12. Hair clips**

For holding feathers in place as a bird dries.

**13. Skinning knives**

Sharp blades are key for skinning, turning ears inside out, and splitting lips.

PHOTOGRAPH BY MARK THIESSEN

**TAXIDERMY ISN'T FOR THE FAINT OF HEART.** Widely considered an art form, the process of mounting animal skins can involve sawing through bone, scraping tissue, and slicing open ears and other features. The resulting hide is usually tanned, mounted on a mannequin, and sewn up. The goal is to preserve the creature in a lifelike state, for use as an educational tool or to commemorate a hunt. Timothy Bovard has preserved countless animals as the taxidermist at the Natural History Museum of Los Angeles County—but some, he says, will always be off-limits: “I won’t do my pets.” —CATHERINE ZUCKERMAN

# HOW EYES MAKE SENSE OF PIXELS

**SHORT FOR "PICTURE ELEMENT,"** a pixel is one of many tiny, illuminated squares on a digital display. A smartphone screen contains thousands of pixels, so densely packed that they seem to disappear inside a smooth, vivid image. But packing pixels is necessary only for up-close viewing. A digital billboard can have fewer pixels than a smartphone yet still appear seamless from afar because the human eye can't perceive individual pixels from great distances.

BY **MANUEL CANALES** AND **RYAN T. WILLIAMS**

## FLEXING MUSCLES

Muscles behind the iris squeeze and stretch the lens to focus light from the center of the eye's gaze onto a pit in the retina called the fovea.

VISUAL FIELD

CORNEA

CENTER OF GAZE

LENS

Pupil

Iris

Muscles

Edge of retina

The blind spot is where the optic nerve hits the retina. The area has no photoreceptors, so the brain fills in what it expects to see.

Optic Nerve

FOVEA

HIGHEST CONE DENSITY

RETINA

As a person ages, the lens stiffens, making it harder to focus.

Eye detail  
Top view

## RETINA STIMULATION

Focused light stimulates the retina's photoreceptors, called cones and rods, sending signals to the optic nerve and into the brain, creating an image.

**Cones**, clustered at the fovea, function in bright light. The surrounding rods function only in dim light.

ROD

CONE

## OPTICAL OVERLAP

If two pixels are close to the eye, the retina sends two signals for the brain to interpret. Farther away, two pixels prompt one signal.

Pixel

IMAGE PROJECTED ONTO RETINA

LENS

Resolution (pixels per inch)

500 — Smartphone

250

Optimum resolution depends on suitable closeness to the screen and a viewer's visual acuity.

Ultra HDTV

Digital signage

0

Farthest viewing distance (feet)

12



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# 'SOMETIMES IT'S LIKE CHASING GHOSTS'

TO INCREASE OUR UNDERSTANDING OF THREATENED OCEAN CREATURES, BRIAN SKERRY TAKES PHOTOS—FOR AS LONG AS HIS LUNGS ALLOW.

BY DANIEL STONE

**FOR UNDERWATER PHOTOGRAPHER** Brian Skerry, there are good days. The sun shines, the water's clear, the surface is calm, the whales come, and Skerry can slip into the ocean fast enough to photograph them as his mask stays unfogged and his camera doesn't malfunction.

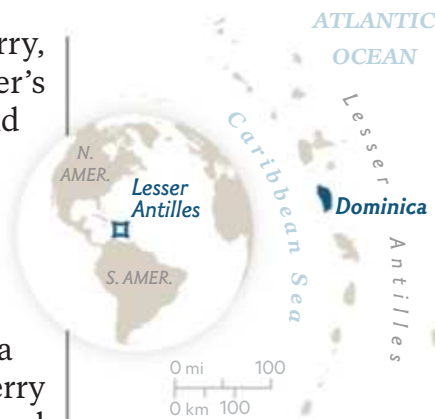
But most days aren't like that. The whales don't show up, or there are particles in the water, or wind roils the waves, or the sun dips behind a cloud at the worst moment. Or, as soon as Skerry gets in the water, the whales dive several thousand feet to feed, and he can chase them only as far as one breath will take him.

A National Geographic photography fellow and the 2017 Rolex National Geographic Explorer of the Year, Skerry free dives—which means no scuba tanks, no buoyancy device, no equipment except his fins, mask, and camera. Over the past two years he's spent nine weeks off the eastern Caribbean island of Dominica in a 30-foot boat chasing sperm whales around their warm-water habitat.

Skerry captures images that are unique, memorable, and award winning—but he has a higher ambition. As “a photojournalist first and foremost, I work with researchers and provide them with photographs that are useful” in their study of ocean flora and fauna, he says.

Sperm whales are majestic, intelligent, and mad-deniably elusive, escaping to ocean depths when pursued or spooked. Still, their ranks have been thinned by whaling, overfishing, and other contact with humans, to the point that the world's conservationists assess them as either vulnerable or endangered. Skerry wants his photos to inform the scientific research and education efforts that will bring whales more attention and potentially some relief. “I feel a sense of responsibility and urgency to make people care” about the marine giants, he says. “I want to give them, for lack of a better word, some humanity.”

Scientists know sperm whales as the ocean's largest toothed predators. They have the biggest brains of any known animal, can weigh up to 45 tons, and have been observed displaying humanlike qualities,



Brian Skerry gets a rare opportunity to photograph a social gathering of six sperm whales near the eastern Caribbean island of Dominica. Researchers with the Dominica Sperm Whale Project work with local officials to protect and study the whales' unique feeding and breeding habits. Dominica and nearby islands were severely damaged by Hurricane Maria in 2017.

such as curiosity and playfulness. But despite their size and their expressiveness, sperm whales remain one of the ocean's biggest mysteries. Do they share complex ideas? What are the dynamics in their family groups? And what goes on in those giant brains?

Almost all whales appear to be disturbed by loud sounds. A boat's motor or a scuba system's bubbles can interfere with the animal's click-based communication system. Free diving, the underwater equivalent of tiptoeing, is the best way for a professional like Skerry to approach them. Still, he says, “sometimes it's like chasing ghosts.”

Skerry lives in Maine, where he practices free diving in cold Atlantic waters, slowing his breathing sometimes for up to three minutes. Holding one's breath is as much the work of the mind as it is the lungs. In addition to staying in good physical shape, Skerry, 56, does meditation exercises to condition himself not to panic when his blood pressure drops and his lungs scream out. It's often in those moments when photographic magic happens. Skerry





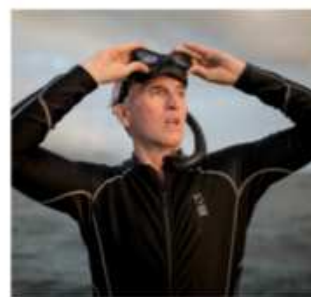
is partway through a three-year story project on whales for *National Geographic*. It has taken him all over the world: to Alaska to photograph humpbacks, to Canada for belugas, and to Norway for orcas. In each location, the conditions are punishing in their own way, and subject to whale-size shifts of fortune.

In Dominica, Skerry followed a research team led by Shane Gero, a biologist at Denmark's Aarhus University and founder of the Dominica Sperm Whale Project. Each year Gero's team tracks families of Caribbean sperm whales to try to decode their communication. The research contributes to a broader understanding of whale behavior, which can influence human activity and conservation strategies to help populations rebound.

Collecting data, however, is slow work. Like other wildlife photographers, Skerry talks a lot about patience, as though that's enough to land a masterful shot. But only when in the boat with him is it possible to understand the mental gymnastics required to wait, trigger ready, for weeks at a time—knowing

that the moment may never come. And yet, every so often, Skerry has not just a good day but an epic one.

One day last spring, after a string of fruitless weeks, Skerry got a tip from a research boat that a pod of whales appeared to be moving toward the surface to socialize. Such behavior is rare for people to witness, let alone photograph. Skerry raced to the site and found six sperm whales under sunny skies. He swam with them for more than an hour, filling two memory cards with 1,500 images. Nature often has good reason to frown on humans—but sometimes it smiles anyway.



Photographer **Brian Skerry**, the 2017 Rolex National Geographic Explorer of the Year, is part of the new partnership that longtime allies Rolex and National Geographic have formed. Its motto, "Committed to a Perpetual Planet," reflects its mission: to promote conservation and exploration of Earth's wonders. Learn more at [natgeo.com/perpetualplanet](http://natgeo.com/perpetualplanet).



## IMFINZI SIGNIFICANTLY REDUCED THE CHANCE OF LUNG CANCER SPREADING

IMFINZI may not work for everyone.

IMFINZI was studied in 713 patients with unresectable Stage 3 NSCLC who completed at least 2 cycles of chemotherapy that contained platinum given at the same time (concurrent) as radiation before starting the trial. Patients in the study had good performance status (WHO 0 or 1). IMFINZI was tested against placebo (no medication).

The main goal of the trial was to measure the length of time people remained progression free (without cancer growing or spreading) and overall survival. At the time of analysis, overall survival comparison was not yet available. This trial is still ongoing.

### WHO IS IMFINZI FOR?

IMFINZI® (durvalumab) is a prescription medicine used to treat a type of lung cancer called non-small cell lung cancer (NSCLC). IMFINZI may be used when your NSCLC has not spread outside your chest, cannot be removed by surgery, **and** has responded or stabilized with initial treatment with chemotherapy that contains platinum, given at the same time as radiation therapy.

It is not known if IMFINZI is safe and effective in children.

### IMPORTANT SAFETY INFORMATION

#### What is the most important information I should know about IMFINZI?

IMFINZI is a medicine that may treat a type of lung cancer by working with your immune system.

IMFINZI can cause your immune system to attack normal organs and tissues and can affect the way they work. These problems can sometimes become serious or life-threatening and can lead to death.

**Call or see your healthcare provider right away if you develop any symptoms of the following problems or if these symptoms get worse:**

**Lung problems (pneumonitis).** Signs and symptoms may include new or worsening cough, shortness of breath, and chest pain.

**Liver problems (hepatitis).** Signs and symptoms may include yellowing of your skin or the whites of your eyes, severe nausea or vomiting, pain on the right side of your stomach area (abdomen), drowsiness, dark urine (tea colored), bleeding or bruising more easily than normal, and feeling less hungry than usual.

**Intestinal problems (colitis).** Signs and symptoms may include diarrhea or more bowel movements than usual; stools that are black, tarry, sticky, or have blood or mucus; and severe stomach-area (abdomen) pain or tenderness.

**Hormone gland problems (especially the thyroid, adrenals, pituitary, and pancreas).** Signs and symptoms that your hormone glands are not working properly may include headaches that will not go away or unusual headaches; extreme tiredness; weight gain or weight loss; dizziness or fainting; feeling more hungry or thirsty than usual; hair loss; feeling cold; constipation; your voice gets deeper; urinating more often than usual; nausea or vomiting; stomach-area (abdomen) pain; and changes in mood or behavior, such as decreased sex drive, irritability, or forgetfulness.

**Kidney problems, including nephritis and kidney failure.** Signs of kidney problems may include decrease in the amount of urine, blood in your urine, swelling of your ankles, and loss of appetite.

**Skin problems.** Signs may include rash, itching, and skin blistering.

**Problems in other organs.** Signs and symptoms may include neck stiffness; headache; confusion; fever; chest pain, shortness of breath, or irregular heartbeat (myocarditis); changes in mood or behavior; low red blood cells (anemia); excessive bleeding or bruising; muscle weakness or muscle pain; blurry vision, double vision, or other vision problems; and eye pain or redness.



WITH STAGE 3 LUNG CANCER

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IMFINZI is an immunotherapy. People receiving IMFINZI had a 48% lower chance of lung cancer growing or spreading than those receiving placebo (no medicine). It was also proven to give people 3x more time without their cancer spreading compared with placebo.\* Before IMFINZI, the last 10 years showed only limited advancements to the current standard of care for unresectable Stage 3 NSCLC.

\*In a clinical trial, the median time tumors did not grow or spread was 16.8 months for the 476 patients receiving IMFINZI compared with 5.6 months for the 237 patients receiving placebo. Median is the middle number in a group of numbers arranged from lowest to highest. Individual results may vary.

**ASK YOUR DOCTOR ABOUT IMFINZI. VISIT IMFINZI.COM**

**Severe infections.** Signs and symptoms may include fever, cough, frequent urination, pain when urinating, and flu-like symptoms.

**Severe infusion reactions.** Signs and symptoms may include chills or shaking, itching or rash, flushing, shortness of breath or wheezing, dizziness, fever, feeling like passing out, back or neck pain, and facial swelling.

**Getting medical treatment right away may help keep these problems from becoming more serious.** Your healthcare provider will check you for these problems during your treatment with IMFINZI. Your healthcare provider may treat you with corticosteroid or hormone replacement medicines. Your healthcare provider may delay or completely stop treatment with IMFINZI if you have severe side effects.

**Before you receive IMFINZI, tell your healthcare provider about all of your medical conditions, including if you** have immune system problems such as Crohn's disease, ulcerative colitis, or lupus; have had an organ transplant; have lung or breathing problems; have liver problems; or are being treated for an infection.

If you are pregnant or plan to become pregnant, tell your healthcare provider. IMFINZI can harm your unborn baby. If you are able to become pregnant, you should use an effective method of birth control during your treatment and for at least 3 months after the last dose of IMFINZI. Talk to your healthcare provider about which birth control methods to use. Tell your healthcare provider right away if you become pregnant during treatment with IMFINZI.

If you are breastfeeding or plan to breastfeed, tell your healthcare provider. It is not known if IMFINZI passes into breast milk. Do not breastfeed during treatment with IMFINZI and for at least 3 months after the last dose of IMFINZI.

**Tell your healthcare provider about all the medicines you take.** This includes prescription and over-the-counter medicines, vitamins, and herbal supplements.

**What are the possible side effects of IMFINZI?**

**IMFINZI can cause serious side effects (see earlier).**

**The most common side effects** in people with non-small cell lung cancer (NSCLC) include cough, feeling tired, inflammation in the lungs (pneumonitis), upper respiratory tract infections, shortness of breath, and rash.

Tell your healthcare provider if you have any side effect that bothers you or that does not go away. These are not all the possible side effects of IMFINZI. Ask your healthcare provider or pharmacist for more information.

**Call your healthcare provider for medical advice about side effects.**

**You are encouraged to report negative side effects of prescription drugs to the FDA. Visit [www.FDA.gov/medwatch](http://www.FDA.gov/medwatch) or call 1-800-FDA-1088.**

**Please see Brief Summary of complete Prescribing Information on the following page.**

If you cannot afford your medications, AstraZeneca may be able to help. Visit [AstraZeneca-us.com](http://AstraZeneca-us.com) to find out how.

 **IMFINZI**<sup>®</sup>  
durvalumab  
Injection for Intravenous Use 50 mg/mL



# IMPORTANT INFORMATION ABOUT IMFINZI® (im-FIN-zee) (durvalumab) INJECTION



## WHAT IS THE MOST IMPORTANT INFORMATION I SHOULD KNOW ABOUT IMFINZI?

IMFINZI is a medicine that may treat a type of lung cancer by working with your immune system.

IMFINZI can cause your immune system to attack normal organs and tissues and can affect the way they work. These problems can sometimes become serious or life-threatening and can lead to death.

**Call or see your healthcare provider right away if you develop any symptoms of the following problems or these symptoms get worse:**

**Lung problems (pneumonitis).** Signs and symptoms of pneumonitis may include:

- new or worsening cough
- shortness of breath
- chest pain

**Liver problems (hepatitis).** Signs and symptoms of hepatitis may include:

- yellowing of your skin or the whites of your eyes
- severe nausea or vomiting
- pain on the right side of your stomach area (abdomen)
- drowsiness
- dark urine (tea colored)
- bleeding or bruising more easily than normal
- feeling less hungry than usual

**Intestinal problems (colitis).** Signs and symptoms of colitis may include:

- diarrhea or more bowel movements than usual
- stools that are black, tarry, sticky, or have blood or mucus
- severe stomach area (abdomen) pain or tenderness

**Hormone gland problems (especially the thyroid, adrenals, pituitary and pancreas).**

Signs and symptoms that your hormone glands are not working properly may include:

- headaches that will not go away or unusual headaches
- extreme tiredness
- weight gain or weight loss
- dizziness or fainting
- feeling more hungry or thirsty than usual
- hair loss
- changes in mood or behavior, such as decreased sex drive, irritability, or forgetfulness
- feeling cold
- constipation
- your voice gets deeper
- urinating more often than usual
- nausea or vomiting
- stomach area (abdomen) pain

**Kidney problems, including nephritis and kidney failure.** Signs of kidney problems may include:

- decrease in the amount of urine
- blood in your urine
- swelling of your ankles
- loss of appetite

**Skin problems.** Signs of these problems may include:

- rash
- itching
- skin blistering

(continued)

**Problems in other organs.** Signs and symptoms may include:

- neck stiffness
- headache
- confusion
- fever
- chest pain, shortness of breath, or irregular heartbeat (myocarditis)
- changes in mood or behavior
- low red blood cells (anemia)
- excessive bleeding or bruising
- muscle weakness or muscle pain
- blurry vision, double vision, or other vision problems
- eye pain or redness

**Severe infections.** Signs and symptoms may include:

- fever
- cough
- frequent urination
- pain when urinating
- flu-like symptoms

**Severe infusion reactions.** Signs and symptoms of severe infusion reactions may include:

- chills or shaking
- itching or rash
- flushing
- shortness of breath or wheezing
- dizziness
- fever
- feel like passing out
- back or neck pain
- facial swelling

**Getting medical treatment right away may help keep these problems from becoming more serious.**

Your healthcare provider will check you for these problems during your treatment with IMFINZI. Your healthcare provider may treat you with corticosteroid or hormone replacement medicines. Your healthcare provider may delay or completely stop treatment with IMFINZI, if you have severe side effects.

## WHAT IS IMFINZI?

**IMFINZI** is a prescription medicine used to treat:

- a type of lung cancer called non-small cell lung cancer (NSCLC). IMFINZI may be used when your NSCLC:
  - has not spread outside your chest
  - cannot be removed by surgery, **and**
  - has responded or stabilized with initial treatment with chemotherapy that contains platinum, given at the same time as radiation therapy.

It is not known if IMFINZI is safe and effective in children.

**Before you receive IMFINZI, tell your healthcare provider about all of your medical conditions, including if you:**

- have immune system problems such as Crohn's disease, ulcerative colitis, or lupus
- have had an organ transplant
- have lung or breathing problems
- have liver problems
- are being treated for an infection
- are pregnant or plan to become pregnant. IMFINZI can harm your unborn baby. If you are able to become pregnant, you should use an

(continued)

effective method of birth control during your treatment and for at least 3 months after the last dose of IMFINZI. Talk to your healthcare provider about birth control methods that you can use during this time. Tell your healthcare provider right away if you become pregnant during treatment with IMFINZI.

- are breastfeeding or plan to breastfeed. It is not known if IMFINZI passes into your breast milk. Do not breastfeed during treatment and for at least 3 months after the last dose of IMFINZI.

**Tell your healthcare provider about all the medicines you take,** including prescription and over-the-counter medicines, vitamins, and herbal supplements.

## HOW WILL I RECEIVE IMFINZI?

- Your healthcare provider will give you IMFINZI into your vein through an intravenous (IV) line over 60 minutes.
- IMFINZI is usually given every 2 weeks.
- Your healthcare provider will decide how many treatments you need.
- Your healthcare provider will test your blood to check you for certain side effects.
- If you miss any appointments, call your healthcare provider as soon as possible to reschedule your appointment.

## WHAT ARE THE POSSIBLE SIDE EFFECTS OF IMFINZI?

**IMFINZI CAN CAUSE SERIOUS SIDE EFFECTS, INCLUDING:**

**SEE "WHAT IS THE MOST IMPORTANT INFORMATION I SHOULD KNOW ABOUT IMFINZI?"**

The most common side effects of IMFINZI in people with NSCLC include:

- cough
- feeling tired
- inflammation in the lungs (pneumonitis)
- upper respiratory tract infections
- shortness of breath
- rash

Tell your healthcare provider if you have any side effect that bothers you or that does not go away. These are not all the possible side effects of IMFINZI. Ask your healthcare provider or pharmacist for more information. Call your healthcare provider for medical advice about side effects. You may report side effects to FDA at 1-800-FDA-1088.

## GENERAL INFORMATION ABOUT THE SAFE AND EFFECTIVE USE OF IMFINZI.

Medicines are sometimes prescribed for purposes other than those listed in a Medication Guide. If you would like more information about IMFINZI, talk with your healthcare provider. You can ask your healthcare provider for information about IMFINZI that is written for health professionals.



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# FEATURES



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72 'MANY OF THE CREATURES LUMPED TOGETHER AS JELLYFISH ARE NO MORE CLOSELY RELATED THAN, SAY, HORSEFLIES ARE TO HORSES.'



# Threatened by the Outside World

IN THE AMAZON FORESTS OF BRAZIL AND PERU,  
MINERS, RANCHERS, AND ILLEGAL LOGGERS ARE INVADING  
THE HOMELANDS OF THE LAST ISOLATED PEOPLES.

STORIES BY SCOTT WALLACE AND CHRIS FAGAN  
PHOTOGRAPHS BY CHARLIE HAMILTON JAMES



Five Awá families from Posto Awá, an outpost created by the Brazilian government's indigenous affairs agency, set out on an overnight excursion into the forest. Awá like them who live in settled communities and miss the

forest—especially older members who grew up there—make these forays to reconnect with their traditional ways. It wasn't until 1987 that Brazil began its current no-contact policy for isolated indigenous groups.





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By SCOTT WALLACE

## BRAZIL

# The tread marks in the blood-red earth are deep—and fresh. Tainaky Tenetehar climbs off his dirt bike for a closer look.

“From this morning,” he says, with the conviction of a veteran tracker attuned to any sign of human movement in these lawless borderlands.

Through binoculars, he scans the rolling hills of fire-scorched savanna that lead out to a tree-crowned ridge in the distance. Here, on one of Brazil’s most hotly contested frontiers—where denuded scrubland pushes up against old-growth forest and private homesteads breach the boundaries of Indian land—the tire tracks bear a singular, ominous meaning.

“Loggers,” Tainaky says. The enemy.

Tainaky, who also goes by his Portuguese name, Laércio Souza Silva Guajajara, turns to his companions, four other Guajajara tribesmen, as they dismount road-beaten motorbikes. The patrol forms a motley crew: patched jeans and camouflage and aviator shades and bandannas to shield their faces from the ubiquitous dry-season dust. Bearing an equally modest array of weapons—a single-shot hunting rifle, a homemade pistol, a few machetes dangling from cinched waistbands—they call to mind a strange, cross-genre film. Think *Mad Max* meets *The Last of the Mohicans*.

“Shall we go after them?” Tainaky asks.

Going after illegal loggers here has become the hallmark of patrols like this. They’ve set logging trucks ablaze, seized weapons and chain saws, and sent irate loggers packing. Patrol leaders, the 33-year-old Tainaky among them, have received multiple death threats. Some patrolmen use fake



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A fire set by settled Awá clears manioc fields outside the government post of Juriti. They practice a mix of farming, fishing, hunting, and foraging, whereas isolated nomadic Awá live mainly by foraging and hunting.

### PREVIOUS PHOTO

At Posto Awá, villagers enjoy a morning bath. The red- and yellow-footed tortoises they’re holding will probably eventually be eaten.





names to mask their identities. Three were murdered in one month's time in 2016.

They belong to a hundred-member, home-grown force of indigenous volunteers who call themselves the Forest Guardians. This group and others like it have sprouted up in recent years to meet a rising tide of illegal logging that is decimating protected woodlands in the eastern Amazonian state of Maranhão, including the 1,600-square-mile Arariboia Indigenous Land. Along with the forests, the wild game that has sustained the Guajajara's hunting culture for generations is vanishing. The lakes that give birth to their rivers and streams are drying up because of deforestation. Fish and birds are dying off.

The stakes are certainly high for the Guajajara, but they've adopted effective survival strategies since their first bloody contacts with

outsiders centuries ago. Most of them know the ways of the outside world; many have lived in it. Far more dire is the plight of another tribe, with which they share the Arariboia reserve: the Awá. Several bands of Awá nomads—the easternmost isolated, or “uncontacted,” people in the Amazon—roam the woodlands in the core of the territory, living in a state of near-constant flight from the whine of winches and chain saws and, in the dry season, the smoke of wildfires.

Confined to a shrinking forest core, the Awá are especially vulnerable. But even in the still largely untouched expanses of rain forest straddling Brazil's western border with Peru, isolated groups must live on the run to escape the depredations of illegal logging, gold prospecting, and now drug trafficking. (See “Peru,” by Chris Fagan, page 66.) All across the Amazon Basin, in fact, threats to

the security of the estimated 50 to 100 isolated and uncontacted tribes—perhaps some 5,000 people in all—are rising. These groups represent most of the world’s remaining isolated tribes. The only so-called uncontacted tribes known to exist today outside the Amazon are in Paraguay’s Chaco scrub forest, on the Andaman Islands in the Indian Ocean, and in western New Guinea, Indonesia. The numbers may seem small, but indigenous-rights advocates say there is something much larger at stake: the preservation of the last vestiges of a way of life that has all but disappeared from the planet, one that has survived apart from our industrial economy.

“When an ethnicity or a human group disappears...the loss is immense,” indigenous-rights activist Sydney Possuelo says. “The face of humanity is left more homogenous, and humanity itself more impoverished.”

THE INTERACTION OF THE AWÁ (also called the Guajá or Awá-Guajá) with the outside world has been defined largely by violence against them. Today perhaps a hundred of the roughly 600 Awá still carry on nomadic lives in the forest. The rest, who have come into contact with modernity in recent decades, are settled in villages in three of four protected indigenous territories, strung out in a contiguous corridor along Maranhão’s western frontier. The presence of the Awá has helped spur legal protection for nearly 4,800 square miles of seasonally dry woodlands that form a critical buffer for the rain forests to the west.

Although isolated groups of Awá are present in three of the four reserves, only in Arariboia are all the Awá—some 60 to 80 of them—essentially uncontacted, keeping to themselves in the core of the reserve. They still hunt with bows and arrows, still gather wild honey and babassu nuts, and still rely almost entirely on the bounty of the primal forest and its sources of water. No settled Awá live around them who might serve as intermediaries in the event of an encounter with outsiders.

Nestled in the hills and plains ringing the reserve’s heartland are dozens of towns and hamlets where some 5,300 Guajajara live. And beyond the boundaries of the reserve, in a kind of third concentric ring, are five major municipalities where timber remains the primary economic driver. With 75 percent of Maranhão’s original forest cover already lost, most of the valuable timber stands left are in Arariboia, the three

other indigenous lands where Awá live (Alto Turiaçu, Caru, and Awá), and an adjacent biological reserve. Timber extraction is banned in these areas, making nearly the entire logging business in the state a de facto criminal enterprise.

But that doesn’t deter poachers, who undermine enforcement efforts with lookouts and phony documents. Logging trucks, often without plates, ply back roads unpatrolled by police, delivering their payloads to secret sawmills beyond Indian lands. This network has made the Awá’s existence so precarious that the tribal peoples’ rights group Survival International called the Awá “Earth’s most threatened tribe” in launching a global campaign on their behalf in 2012.

In Maranhão the Guajajara have made common cause with *os isolados*—“the isolated ones”—believing their own survival to be inextricably bound to that of their Awá neighbors. “The struggle to save the Awá and the forest is one and the same,” says Sônia Guajajara, the former executive director of the Articulation of Indigenous Peoples of Brazil, which seeks to give a voice to the country’s more than 300 indigenous groups. She’s also a candidate for national office in this year’s elections.

As Tainaky’s Forest Guardians huddle to decide on their next move, a helmeted figure emerges from a nearby farmhouse, kick-starts a dirt bike, and zooms past at full throttle, his face shrouded by a polarized visor.

“*Olheiro!*” the men shout. Spy!

Besides intimidation by the loggers, the Guardians also must contend with a network of infiltrators among their own people. Informants keep an eye out for the patrols and rush to relay intelligence to their paymasters, who in turn alert logging crews in the field via two-way radio.

“We’ve got to get out of here!” Tainaky commands, watching the bike recede in a cloud of dust. “He’s going to inform on us!”

The element of surprise is crucial to the success of a mission; the Guardians must catch the loggers unawares, lest they end up driving into an ambush. Even federal agents have come under attack from well-armed loggers in the backwoods. In an instant the hunters can become the hunted.

“Who’s going to fight for the isolated ones, if not us?” Tainaky told me in his kitchen the night before the patrol. He unfurled a map of the Arariboia territory and traced a finger around its edges. “The loggers are entering all around

the perimeter of the indigenous land,” he said. Then he stabbed at the middle of the map. “Their intention is to reach the center—where the *isolados* are. They have no choice but to flee when the loggers come.”

The government agency responsible for indigenous affairs is Fundação Nacional do Índio, or FUNAI. The agency’s Department of Isolated and Recently Contacted Indians has placed Arariboia at the top of a list of Amazonian flash points, where tribes are at greatest risk of imminent contact. But severe cuts to FUNAI’s budget have made it all the more challenging to safeguard isolated tribes such as the Awá from the inexorable pressures of a resource-hungry global economy. Since the impeachment of then president Dilma Rousseff in 2016, pro-business politicians in congress have pushed through measures to roll back protections of indigenous lands across the Amazon. In the process, veteran FUNAI agents have been laid off and field posts shuttered, heightening the dangers for Brazil’s tribal communities and isolated indigenous communities.

Pleas for help by the Guajajara have produced occasional government raids on clandestine sawmills in the surrounding towns, as well as sporadic police forays into the bush to clear out loggers. But mostly the Guardians have been abandoned to their fate, left either to watch the logging trucks haul off their patrimony or to obstruct the lumberjacks however they can.

EVERY HOUR OF EVERY DAY, freight trains brimming with iron ore thunder past the Awá settlements at Tiracambu and Posto Awá on the southeastern edge of the 670-square-mile Caru Indigenous Land. They’re on a 550-mile journey from the world’s largest open-pit iron ore mine to the Atlantic port of São Luís, the capital of Maranhão. Once there, the ore—162 million tons in 2017—is loaded aboard seagoing ships bound mainly for China.

The extraction of ore from the Carajás mine and its delivery to steel mills on the far side of the planet represent a triumph of technology and a capital investment worth billions of dollars. It also makes for a jarring juxtaposition—this potent symbol of global commerce passing within earshot of a people who still hunt much of their food with bow and arrow and where some of their tribe, perhaps a dozen people, still wander the jungles of the Caru reserve as isolated nomads.

The railroad’s construction in the late 1970s

and early 1980s disrupted scores of indigenous communities and split the Awá’s once sprawling territory in two. Settlers and land speculators flooded in. Cattle ranches, factories, and even entire cities would grow up around the Awá, who soon found themselves fenced out of the land they’d roamed for generations.

“The first sign of the *karaí* was the barbed wire,” said Takamãtxia, using the Awá word for white man or outsider. I was sitting amid dozens of Awá with Marco Lima, my guide and driver, in an open-air pavilion in Posto Awá, which FUNAI established in 1980 as a refuge for the tribe.

“We were frightened by gunshots,” Takamãtxia continued, as a young man named Tatuxa’a translated into Portuguese. “We’d never heard that sound before.” That was the day outsiders stalked his family through the woods with an unleashed dog. His grandfather was mauled to death, he said. “He couldn’t run fast enough.”

## **They all told remarkably similar tales: their panicked escape from intruders, their eventual rescue by FUNAI, the fatal epidemics of flu and measles that swept through in the wake of contact.**

The group scattered in all directions. Some retreated to the north. Others went south, including a number of his relatives. He never saw them again.

“Could it be that my uncle is still out in the forest?” He paused. “I think so.”

As more elders leaped to their feet, the entire pavilion erupted in chatter, and Tatuxa’a struggled to keep up. They all told remarkably similar tales: their panicked escape from intruders, their eventual rescue by FUNAI, the fatal epidemics of flu and measles that swept through the outpost in the wake of contact.

At the time FUNAI still embraced the mission of contacting tribes and settling them in outposts to make way for development. It wasn’t until 1987 that FUNAI adopted its current no-contact policy, informed in part by the tragedy that befell the Awá. It was and still is a



An Awá hunter returns home with a small brocket deer. Sometimes hunters see signs of the *isolados*, their isolated brethren. As many as a hundred Awá still live as nomads in the Amazon forest, despite increasing pressure from illegal loggers and settlers.



When settled Awá, like these five families from Posto Awá, spend time in the forest, they shed their Western clothing so that any isolated Awá who encounter them won't think they're outsiders and attack them. The women make camp and watch the children, and later the men will go on a nighttime hunt with their bows and arrows.







Five-year-old Kaiu carries a baby black-bearded saki monkey on his head. The Awá hunt monkeys for their meat, and when a mother with a baby is killed, they may raise the orphan as a pet, carrying the animal around with them.



Ayrua, 39, with her pet black-bearded saki, was contacted by indigenous affairs agents in 1989. Awá at the government outposts still hunt for animals such as tapirs and peccaries, as well as various monkeys, to supplement their diet.





A Ka'apor capuchin crowns Ximirapi, 47, who left the settlement at Posto Awá in the 1990s for another at Tiracambu, drawn by the prospect of better hunting and less crowded living conditions.



An Awá woman cleans and butchers an armadillo in the village of Posto Awá. Today most Awá live in settled communities near government outposts where they have greater access to manufactured goods such as metal tools, guns, medicine, and even smartphones.

**NEXT PHOTO**

Members of the Guajajara tribe serve as volunteer Forest Guardians. The homegrown force is dedicated to protecting the Arariboia Indigenous Land from incessant invasions by illegal loggers—and to safeguarding several isolated Awá families who still roam the reserve.



landmark policy recognizing the rights of tribal people to pursue their traditional ways of life, free from persecution by outsiders. (Contact teams are very occasionally dispatched if an isolated indigenous group is in imminent peril.)

That evening, Tatuxa'a led me from the pavilion toward the edge of the village. Under a low-hanging silver sliver of moon, a sacred ceremony to commune with the Awá's ancestors was about to begin. The pungent scent of wood smoke hung in the air. Dogs yapped. From the distance came the clatter of the Carajás train.

In the shadows of a porch, women pasted tufts of harpy eagle and king vulture feathers to the heads, limbs, and chests of a half dozen otherwise naked men, all of them village elders. The patterns of the white feathers seemed to throb in the darkness, giving the men a spectral,

otherworldly appearance.

"They wear the feathers so the *karawara* will recognize them as real people—as Awá," Tatuxa'a explained, referring to the ancestors who watch over the forest and protect the earth-bound Awá. "Otherwise they might mistake them for white men and kill them."

Amid eerie, ululating chants, the men danced around an enclosed hut as if in a trance. One by one, they entered and exited the hut, stamping their feet as if to launch themselves into the spirit world overhead. Still dancing and singing, they returned to their women and children, cupping their mouths to blow blessings on their loved ones from the spirits they'd just encountered on their journey to the heavens.

"The ceremony takes us back to the time when we all lived in the forest," Tatuxa'a said. "It helps



us keep our culture alive and protect our land.”

It wasn't clear whether he, a literate, bilingual young man, believed in the spirit world. But as I watched this spectacle beneath the star-studded sky—amid the reverberating, high-pitched wails, the naked men dipping and bending as if possessed by unseen powers—I couldn't escape the sense that an ancient and irreplaceable way of life hung in the balance.

As I traveled through Awá territories, I perceived widespread fear that the government institutions created to protect Brazil's tribes also were in danger of disintegrating—a fear that the Awá could be cast adrift in a largely hostile world.

An hour down the road in the village of Tiracambu, all of its 85 people turned out to welcome us, singing and dancing as they came. A young man named Xiperendjia asked me to sit. “The

government doesn't like Indians,” he said. “We're afraid they're going to give away our land.”

People gathered in a circle three-deep to listen. “The loggers have burned our forests,” Xiperendjia continued. “All the animals—tortoises, monkeys, peccaries—are dying off. Our fruits have all burned. We need help.”

I said I had come to hear their concerns and share them with readers far and wide. Marco Lima grabbed my pen and held it aloft. “You see this pen?” he shouted for all to hear. “This is Scott's weapon. With this he will tell the world about the Awá!”

“Do you want to see the Awá's weapons?” Xiperendjia replied. He barked a command to the crowd. People vanished into their huts. Moments later they returned—men and women alike—brandishing long bows and clutches of arrows with fire-hardened bamboo points. “See?” Xiperendjia said. “These are *our* weapons.”

Many FUNAI officials agree with the Awá: The government seems to be deliberately starving the agency of funds. “FUNAI doesn't have the resources to do its job,” said one supervisor who asked not to be named. “It's like a patient in intensive care.”

**THE CUTBACKS TO FUNAI'S BUDGET** have left the lonely hilltop post guarding the main entrance to the 450-square-mile Awá Indigenous Land staffed with a skeleton crew of only three unarmed civilians. This territory is home to roughly a hundred Awá, including a few small bands of uncontacted nomads.

Marco and I followed a washed-out road leading down from the guard post. Here and there the rusting hulks of bulldozers littered the roadside, left behind in 2014 when army troops expelled loggers and settlers who had invaded the reserve en masse. At the bottom of a long hill, we entered the intended target of those powerful machines, a silent world of deep shadows and dazzling shafts of light split by a canopy of towering trees and thick lianas. Macaws shrieked in the distance, their calls punctuated by the shrill cry of a screaming piha bird.

We pulled up before a whitewashed house shaded by a stout jackfruit tree. We'd arrived at the FUNAI base of Juriti. A tall man with curly grayish hair and an arched brow sauntered over and shook my hand. His name was Patriolino Garreto Viana, a FUNAI veteran of 35 years and administrator of the Juriti post since 1995.





When I mentioned the abandoned bulldozers, Viana nodded gravely. “They removed 3,000 invaders from the territory,” he said, recalling the 2014 expulsions. “Whites had arrived very close to here—it was very dangerous.” The evictions stirred bitter resentment in nearby frontier towns such as São João do Caru. For months afterward, Viana couldn’t show his face there. “I was *um homem marcado*,” he said. A marked man.

He showed us into the five-room building that served as his quarters and as an improvised clinic for a pair of government health workers. A stream of Awá patients—young women in flower-print dresses breastfeeding infants, men in loose-fitting T-shirts and flip-flops—wandered in and out through an open door in the back.

Despite the incursions by outsiders, Viana said, Juriti remained in many ways the most sheltered of the four settled Awá communities. The elder generation among its 89 residents—men and women now in their 50s and 60s—were brought here from a succession of FUNAI contact expeditions in the 1980s and 1990s. They’ve spent most of their lives in the bush, and the men especially still feel most at home there. “They barely stay at the post for a few days before they’re off again,” Viana said.

The men return from their forays with deer, peccaries, and tapirs. On the veranda, before a small crowd, an elder named Takya performed an astonishing imitation of the deep, throaty growls of a howler monkey. The Awá use such calls to lure animals while on the hunt—part of a vast storehouse of knowledge that has ensured the tribe’s survival for hundreds, if not thousands, of years.

**PERHAPS NOWHERE** is that legacy more threatened than in the Arariboia reserve. Not even with support of environmental police have the valiant efforts of Tainaky Tenetehar and the Forest Guardians been able to halt the logging scourge.

With wildfires—some of them set by loggers as a diversionary tactic—running rampant in late 2017, FUNAI’s Department of Isolated and Recently Contacted Indians hurriedly erected a field post on the reserve’s eastern flatlands. Isolated Awá nomads had been spotted dangerously close to a major road, and it was feared that forced contact—a last resort—might be required to save them.

“The idea of no contact continues,” said Bruno de Lima e Silva, the department’s Maranhão



coordinator, seeking to dispel rumors that the post signaled a shift in FUNAI policy. He said it was simply part of a contingency plan.

The Awá show no signs that they’re ready to give up living in the wild, Lima said. At least for now, they appear to be healthy, and they’re having children, a strong indicator of a sense of security. “If they wanted contact, they would reach out.”

On my last day in Brazil, photographer Charlie Hamilton James and I chartered a bush plane out of Imperatriz to do an overflight of the Arariboia reserve with Bruno Lima. Soon we were passing over undulating ridgelines that receded into the distance in a bluish gray haze. Scorched trees stood alone in smoldering fields. Up ahead loomed the wooded hills at the center of the reserve. The aircraft banked sharply, and



Mile-long trains brimming with iron ore clatter past the indigenous communities of Posto Awá and Tira-cambu en route from the world's largest open-pit iron ore mine to the Atlantic port of São Luís, where the ore is loaded onto ships, many bound for China. When the railroad was built in the 1970s and '80s, it cut through traditional Awá lands.

we looked down on the jungle canopy—a fantastically mottled quilt of rich greens and muted browns punctuated by brilliant yellow bursts of flowering ipê trees. Somewhere down there were the isolados. Perhaps they stopped at the sound of the droning aircraft and were peering up at us through the trees.

“Look!” Lima said, pointing down into the forest. “A logging road!” At first I didn’t see it, but then there it was, a brown strip snaking along a hillside, disappearing beneath a cluster of trees, then reappearing a short way on. “The loggers are perfecting the crime of timber theft,” Lima said over the roar of the aircraft. “They make roads under the canopy that are hard to see.” He looked out the window, then continued: “Municipalities all around the indigenous lands depend on timber. All the local power elites are involved,

directly or indirectly, in the criminal activity.” (Local politicians take issue with that assessment, arguing that enforcement efforts have already brought the illegal logging business to its knees.)

Reaching the northeastern limits of the reserve on our overflight, we caught sight of a white-cabbed truck bouncing along the serpentine trail. Its flatbed was loaded with timber, like some predatory insect hauling prey back to its nest. And as it moved east toward the sawmills beyond the reserve, I could see nothing that stood in its way. □

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**Scott Wallace** teaches journalism at the University of Connecticut and is author of *The Unconquered: In Search of the Amazon's Last Uncontacted Tribes*. **Charlie Hamilton James** has spent 20 years documenting life in the Amazon. This is his eighth *National Geographic* story.

*Mouths of the Amazon*

**Marajó Island**

**Deforestation**

Deforestation in the Brazilian Amazon declined by 84 percent from 2004 to 2012, but progress has slowed since the government eased restrictions on clearing forests, especially for agriculture and ranching.

- Indigenous land
- Awá tribe on indigenous land
- Indigenous outpost
- Forest cover, 2017
- Forest loss, 2000-2017
- Land subject to flooding
- Major fire, September 2017
- Mining block
- Oil and gas block

0 mi 40  
0 km 40

TRINCHEIRA/  
BACAJÁ

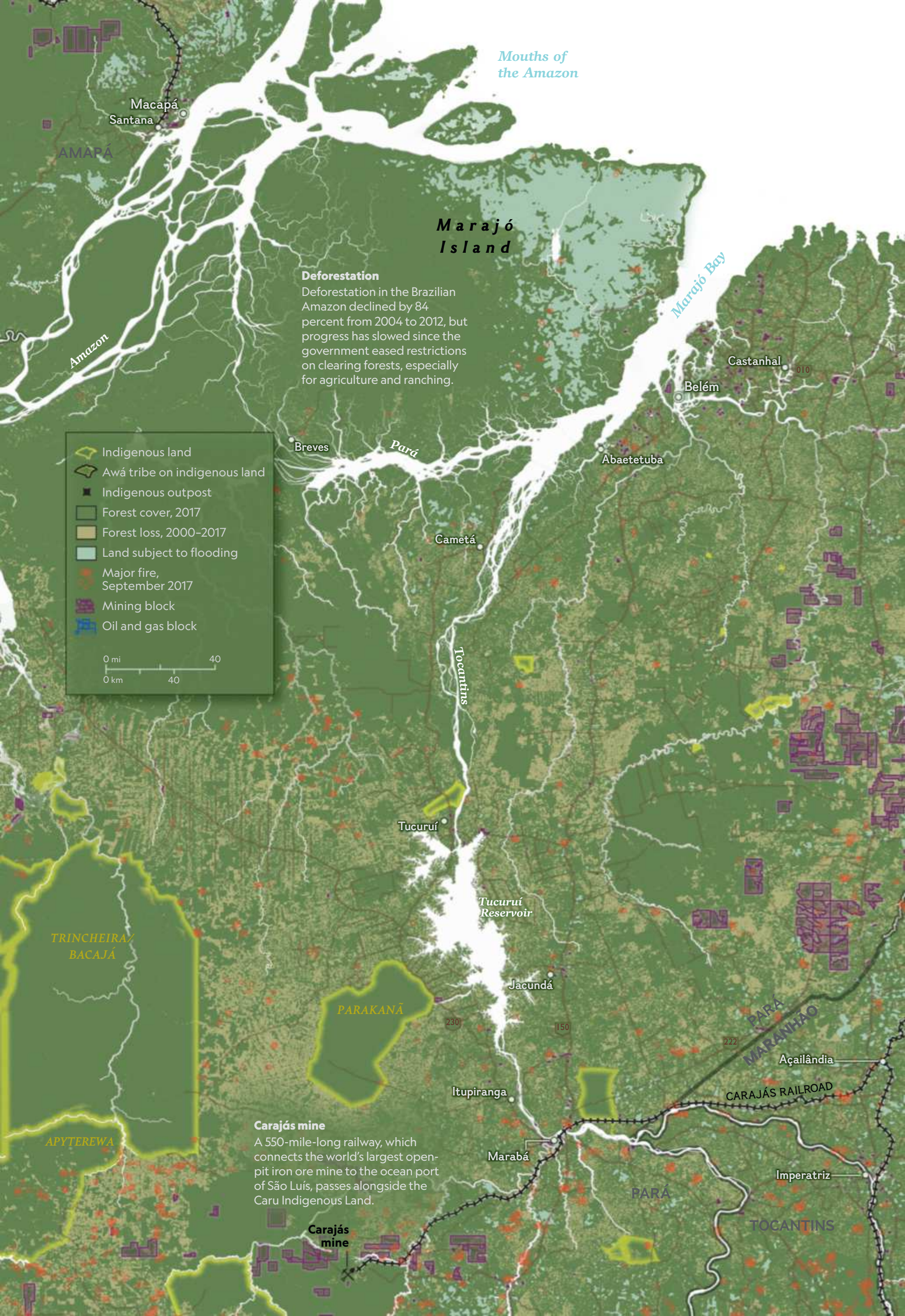
PARAKANÁ

APYTEREWA

**Carajás mine**

A 550-mile-long railway, which connects the world's largest open-pit iron ore mine to the ocean port of São Luís, passes alongside the Caru Indigenous Land.

Carajás mine





# Losing Ground

In the eastern Amazon, the largest stands of old-growth forest are found in designated indigenous lands. Logging is banned there, but the practice continues to threaten the forests and the indigenous communities that depend on them, such as the last isolated groups of nomadic Awá.



By CHRIS FAGAN

## PERU

# Shuri carries a wooden bow and two six-foot arrows topped with razor-sharp bamboo.

He's about 60 years old, and his deeply furrowed brow hints at a hard life in the jungle. Stopping at the top of a hill, he turns to me and lifts his faded red shirt to show a six-inch scar on his side just below his ribs. "Mashco," he says quietly, referring to the Mashco-Piro tribe. He holds up his bow as if shooting, then moves his hand to the scar, closes his eyes, and grimaces to mimic pain.

Shuri is a Mastanahua, one of several tribes that inhabit the remote southern Peru-Brazil borderlands. Fifteen years ago, evangelical missionaries came to the Curanja River to lure his people out of the forest. The missionaries built a village, cleared land for a farm, recruited interpreters from local tribes, and left gifts along hunting trails. Eventually Shuri and his two wives (who are sisters) and mother-in-law joined the missionaries. The rest of his group, perhaps 20 people, chose to stay in the forest with other isolated tribes—including their mortal enemies, the Mashco-Piro.

We reach a clearing, and Elena, the younger of Shuri's wives, emerges from a perfectly camouflaged palm-frond shelter. She's wearing a red soccer shirt advertising the U.K.'s Arsenal team, a gift from guards with the Ministry of Culture, stationed downstream. Her face is painted with indigo dots from huito fruit, and like Shuri, she wears a metal nose ornament and the top of her head has been shaved like that of a Franciscan monk. She shouts something at Celia, our interpreter. "She's hungry, and her stomach hurts," Celia says. "She wants pills."

I've known Shuri and Elena since 2006, through my work implementing conservation and sustainable development projects in indigenous communities downstream. I've been witness to their ongoing struggle to assimilate into modern society with minimal support.

On this occasion photographer Charlie Hamilton James and I have come to the Curanja River, some 15 miles south of Peru's border with Brazil, to document the lives of remote tribes and the pressures facing those still holding on in isolation. We are close to the Alto Purús National Park, which is overlapped by the Mashco Piro Indigenous Reserve for isolated tribes. The park, at nearly 9,700 square miles, is Peru's largest, and it shares a border with the biodiverse Manú National Park to the south.

This massive Purús-Manú landscape is home to one of the highest



When missionaries contacted some of the Mastanahua tribe in 2003, only Shuri, his two wives, and his mother-in-law chose to end their isolation in the forest. They trade with local villagers and stay in touch with the 20 or so migratory members of their group.







The Yurúa River meanders near the Peru-Brazil border. Illicit logging in the area's protected forests feeds timber such as big-leaf mahogany to global markets. Logging also threatens the survival of the country's estimated 15 remaining isolated tribes.

On the Yurúa River, Gerson Mañaningo Odicio lives in the path of nomads who sometimes steal villagers' crops and goods, like machetes and clothes. Peru doesn't compensate for such losses, causing resentment that can spark violence against the nomads.



concentrations of isolated indigenous people left anywhere on Earth, as well as several groups like Shuri's who are in the early stages of contact. While threatened by various causes of deforestation, including logging and road construction, this remote and relatively intact area stands in stark contrast with the diminished forests of eastern Brazil where the Awá live.

**THE WORD "ISOLATION"** is relative: The tribes are astutely aware of their surroundings, and all but the remotest groups have used metal tools for decades and therefore have had some contact with the outside world. Many are descendants of those who fled to remote headwaters to escape enslavement and devastating epidemics during the rubber boom more than a century ago. Subsequent contact with missionaries, loggers, oil and gas workers, and other outsiders often resulted in more violence and disease. That they continue to live in isolation is a conscious decision, in their view essential for survival.

In recent years, despite this hard history, more isolated people have been venturing out of the deep forest to initiate contact. They're being seen on the banks of major rivers, and they've increased their raids on remote indigenous villages and government outposts in protected areas. What explains this? Is curiosity about settled life or the desire for manufactured items finally overtaking the tribes' fear of outsiders? Or are these forays more a result of external threats compromising their territories?

The most recent tribe to initiate permanent contact is the Txapanawa, or People of the Xinane, on the Envira River, across the border in Brazil, less than 50 miles from Shuri and Elena's shelter. In June 2014 a group of five young men and two women entered the village of Simpatia complaining of hunger and asking for bananas. Later they described a recent attack, most likely by drug traffickers—*narcos*—in which many of their tribe had been killed. For several years *narcos* had been using a nearby government post as their own base.

Situations like the one in Simpatia bring up important questions about governments' ethical responsibilities to protect tribes while respecting their rights to self-determination. Peru, like Brazil, has a no-contact policy for isolated tribes. The strategy is to create protected areas off-limits to outsiders, control access to these areas, and be prepared to respond when tribes initiate

contact. The process of contact, however, can be drawn out over many years. At what point should the government intervene? Critics of the no-contact policy argue that the government should be more proactive and initiate controlled contact with emerging tribes to prevent violence and deadly epidemics. One thing everyone agrees on is that the number of contact events will increase if Peru continues to promote policies to open up more of the forest for extractive industries.

Case in point: In January 2018 Peru's Congress passed a controversial law declaring the construction of roads in remote parts of the Amazon to be "of priority and national interest." Yet less than two months later, the Ministries of Transportation, Culture, and the Environment signed a supreme decree in opposition to the law, which clarified that all new roads must respect environmental laws, natural protected areas, and reserves for isolated tribes.

The ministries' swift response indicates that after decades of ignoring the rights of its isolated tribes, even doubting their very existence, Peru is making progress in balancing the need for development with protecting their territories. The Ministry of Culture, which is responsible for indigenous affairs, has proposed five new reserves for isolated tribes and is developing first ever protection plans for four existing reserves. Meanwhile, a consortium of indigenous NGOs led by the Interethnic Association for the Development of the Peruvian Rainforest is proposing a more than 34,000-square-mile protected corridor for tribes in isolation and initial contact, with the Purús-Manú landscape as its core.

While most of the corridor is already protected, legal recognition of it would consolidate the area, facilitating new legislation and on-the-ground protection measures. Furthermore, it would raise international awareness about this truly remarkable place. Against this hopeful backdrop, I think of Shuri and Elena and whether, when I visit them again, their extended family will still be choosing to live in isolation in the forest.

Will Peru take advantage of this momentum to give some of the world's last isolated tribes the ability, at last, to control their future? □

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**Chris Fagan** is the founder and executive director of the Upper Amazon Conservancy. He has been working to protect the people and forests of the Peruvian Amazon since 2002.

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# SCARY, SQUISHY, BRAINLESS, BEAUTIFUL

What makes  
jellyfish so  
fascinating?

They aren't  
actually fish.  
They can make  
copies of  
themselves.  
And some older  
ones can become  
young again.



BY **ELIZABETH KOLBERT**

PHOTOGRAPHS BY  
**DAVID LIITTSCHWAGER**







**Flower hat jellies**

exemplify the paradox of the medusas, or bell-shaped jellyfish: They're both delicate and menacing. Sitting on the seafloor, waving colorful tentacles, they lure fish, sting them, and eat them.

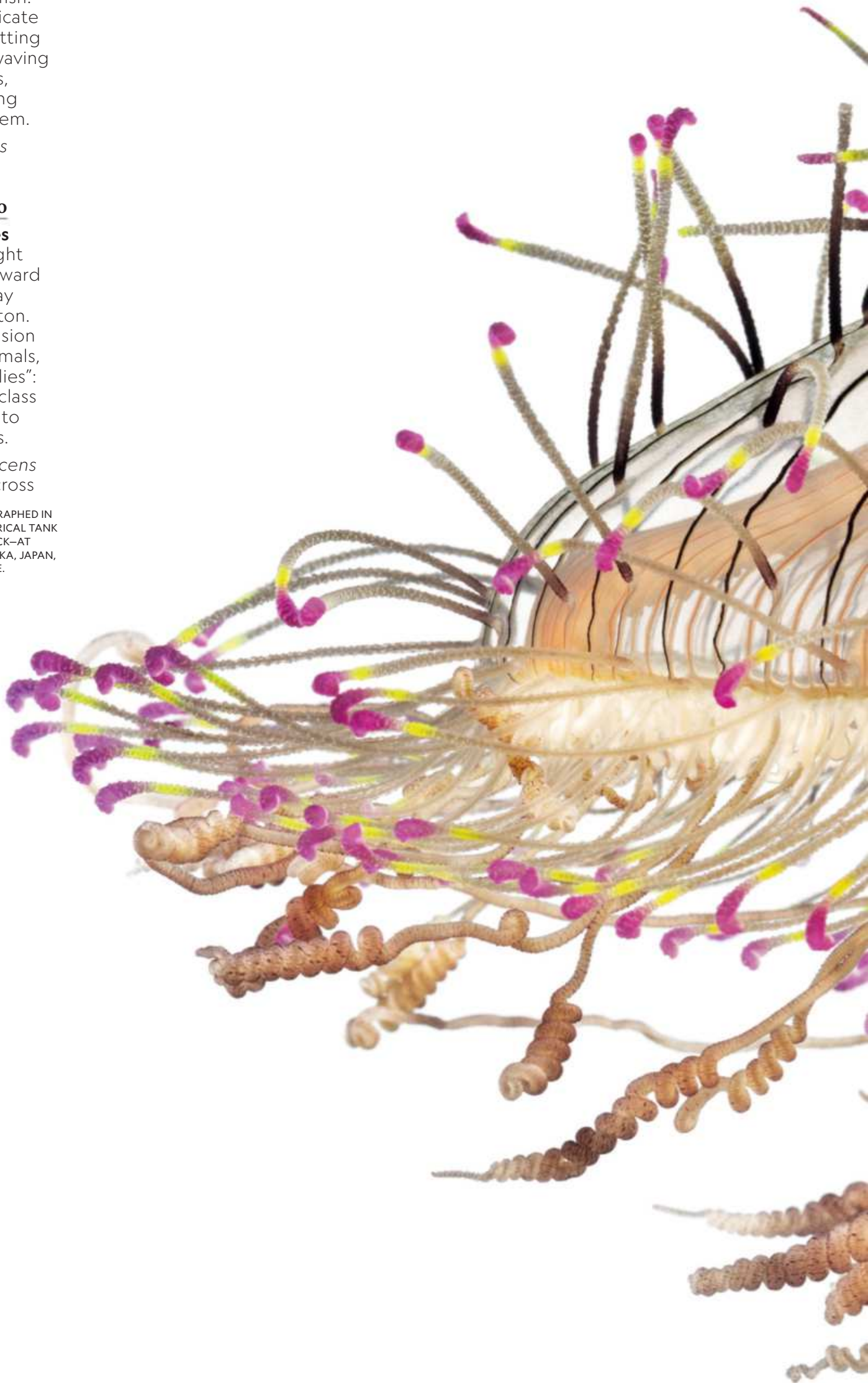
*Olindias formosus*  
3.9 inches across

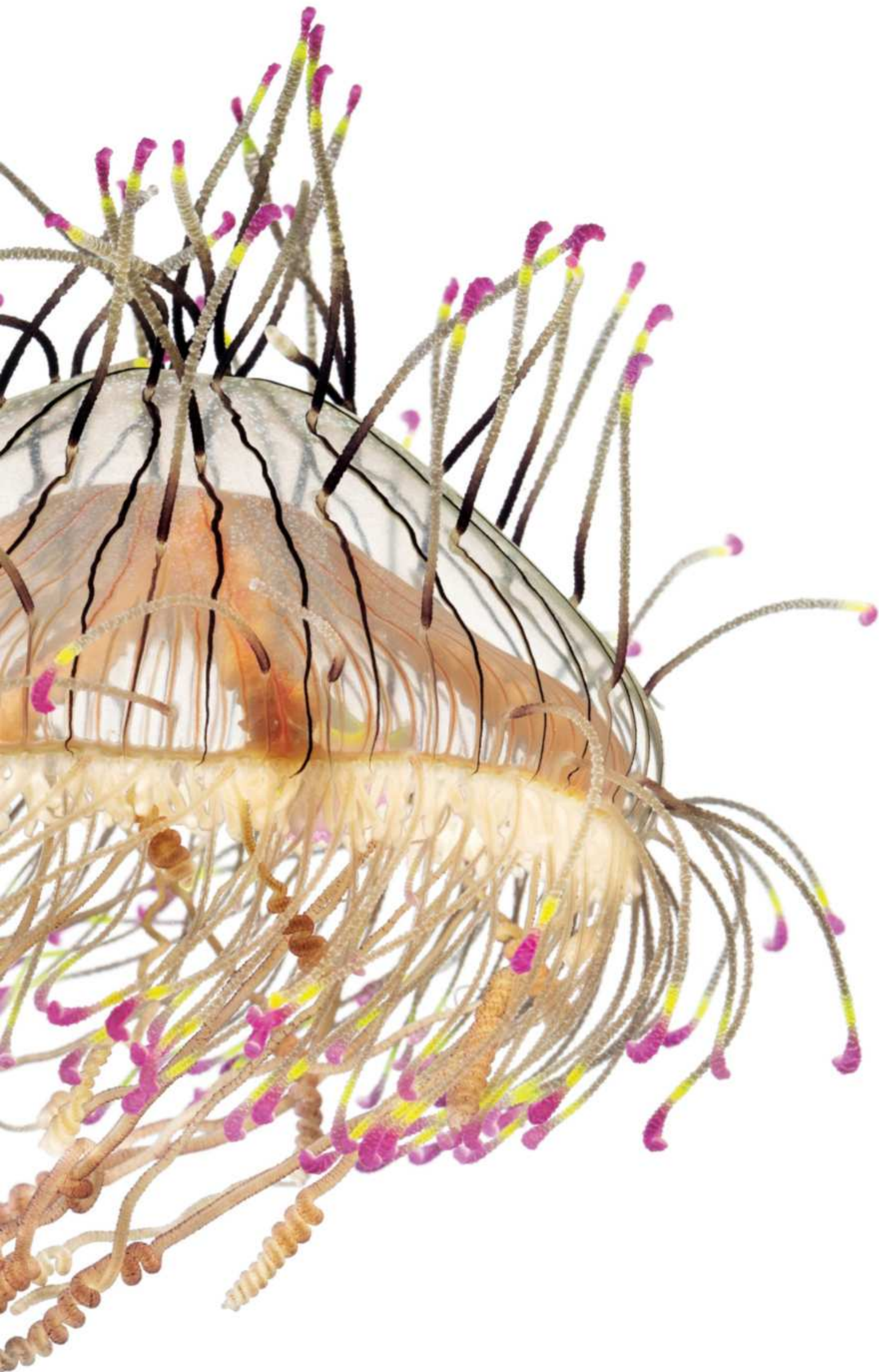
**PREVIOUS PHOTO****Pacific sea nettles**

swim down at night to rest and up toward the surface by day to feed on plankton. In the sea's confusion of gelatinous animals, they are "true jellies": members of the class we're most likely to meet on beaches.

*Chrysaora fuscescens*  
Up to 8 inches across

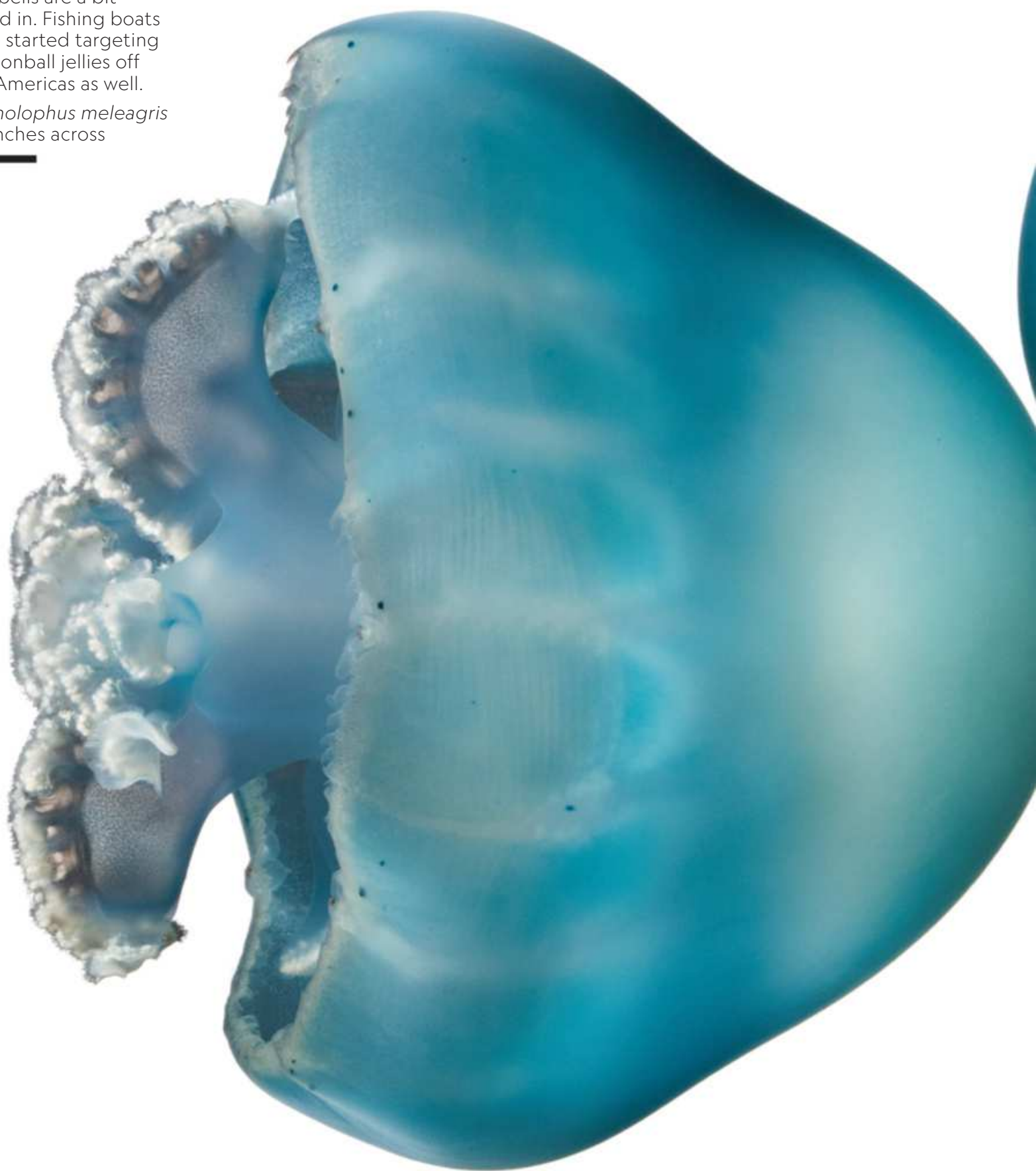
ALL JELLIES WERE PHOTOGRAPHED IN A KREISEL TANK—A CYLINDRICAL TANK WITH FLAT FRONT AND BACK—AT KAMO AQUARIUM, TSURUOKA, JAPAN, UNLESS STATED OTHERWISE.





Humans eat **cannonball jellyfish** mostly in Asia, in such dishes as "rubber band salad." Endangered leatherback turtles devour them too. Like other jellies, cannonballs swim by contracting their bell, which in their case is relatively muscular. These specimens, however, are aging: The bells are a bit caved in. Fishing boats have started targeting cannonball jellies off the Americas as well.

*Stomolophus meleagris*  
2.8 inches across





**M**oon jellies, which are found in shallow bays around the world, look like small, not entirely friendly ghosts. They have translucent bells fringed with pale tentacles, and as they pulse along, it almost seems as if the water itself has come alive.

At the National Aquarium in Baltimore, when visitors are invited to touch moon jellies, their first reaction is usually fear. Assured the jellies won't hurt them, the visitors roll up their sleeves and hesitantly reach into the tank.

"They're squishy!" I hear one boy squeal.

"They're cool!" a girl exclaims.

"I think they're just mesmerizing," Jennie Jansen, the assistant curator who oversees the care of the aquarium's jellyfish, tells me. "They don't have a brain, and yet they're able to survive—to thrive—generation after generation."

Scary, squishy, cool, brainless, mesmerizing—jellyfish are all of these and a whole lot more. Anatomically they're relatively simple animals; they lack not just brains, but also blood and bones, and possess only rudimentary sense organs. Despite their name, jellyfish aren't, of course, fish. In fact they aren't any one thing.

Many of the creatures lumped together as jellyfish are no more closely related than, say, horseflies are to horses. Not only do they occupy disparate branches of the animal family tree, but they also live in different habitats; some like the ocean surface, others the depths, and a few prefer freshwater. What unites them is that they've converged on a similarly successful strategy for floating through life: Their bodies are gelatinous.

**NOT SURPRISINGLY**, given their diverse evolutionary history, jellies exhibit a fantastic range of shapes, sizes, and behaviors. When it comes to reproduction, they're some of the most versatile creatures on the planet. Jellyfish can produce offspring both sexually and asexually; depending on the species, they may be able to create copies of themselves by dividing in two, or laying down little pods of cells, or spinning off tiny snowflake-shaped clones in a process known as strobilation. Most astonishing of all, some jellies seem able to reproduce from beyond the grave.

The so-called immortal jellyfish resembles a tiny, hairy thimble and lives in the Mediterranean Sea and also off Japan. Members of the species can reverse the aging process so that instead of expiring, they reconstitute themselves

as juveniles. The juvenile then starts the jellyfish's life cycle all over again. It's as if a frog, say, were to revert to a tadpole or a butterfly to a caterpillar. Scientists call the near-miraculous process transdifferentiation.

Moon jellies and their cousins, which include lion's mane jellies and sea nettles, are known as true jellies. They belong to the class Scyphozoa, in the phylum Cnidaria, which also includes corals. (A phylum is such a broad taxonomic category that humans, fish, snakes, frogs, and all other animals with a backbone belong to the same one—the chordates—as do salps, which are sometimes lumped with jellies.) As adults, true jellies are shaped like upside-down saucers or billowing parachutes. They propel themselves through the water by contracting the muscles of their bells, and their tentacles are equipped with stinging cells that shoot out tiny barbed





True jellies in youth are boring stick-to-the-rock polyps, like their relatives the corals. They reproduce asexually by strobilation, spinning off tiny snowflake-like clones. The clones float off and grow into the tentacled medusas we know and sometimes hate—which proceed to have sex afloat and rain future larval polyps onto the seafloor. Overall then, not so boring. The polyps here are **moon jellies**, a common type.

*Aurelia coerulea*  
Snowflake-like clone is about 0.1 inches across.

#### **NEXT PHOTO**

**Spotted jellies**, which drift in South Pacific bays and lagoons, swim up during the day so that tiny plant-like organisms that live inside them and nourish them can catch the sun. The jellies don't live off those symbionts alone, however. Their feathery arms are lined with stinging cells and mini-mouths that gobble animal plankton.

*Mastigias papua*  
Biggest in photo is just over 3 inches across.

tubes to harpoon floating prey. To reel it into their mouths, they use streamer-like appendages known as oral arms. In some species the oral arms have mouths of their own.

Jellyfish like the dreaded Portuguese man-of-war are also related to corals, but they're part of a different subgroup, the siphonophores, which practice an unusual form of collective living. What looks like a single man-of-war is technically a colony that developed from the same embryo. Instead of simply growing larger, the embryo sprouts new "bodies," which take on different functions. Some develop into tentacles, for example; others become reproductive organs.

"In the human life cycle, our body, when we're born, has all the pieces that are going to be there as an adult," observes Casey Dunn, a professor of evolutionary biology at Yale University. "The really cool thing about siphonophores is they've

gone about things in a very different way."

Then there are the ctenophores (pronounced TEH-nuh-fores), which are such oddballs they've been placed in a phylum of their own. Also known as comb jellies, for the comblike rows of tiny paddles they use to swim, they tend to be small, delicate, and hard to study. They come in an array of weird body types: Some are flat and ribbonlike; others look more like pockets or little crowns. Most use an adhesive to nab their prey. "They have what's like exploding glue packets embedded in their tentacles," explains Steve Haddock, a senior scientist at the Monterey Bay Aquarium Research Institute.

**IN RECENT DECADES** jellyfish populations in some parts of the world have boomed. In the 1980s a comb jelly that's known formally as *Mnemiopsis leidyi* and informally as the sea walnut showed

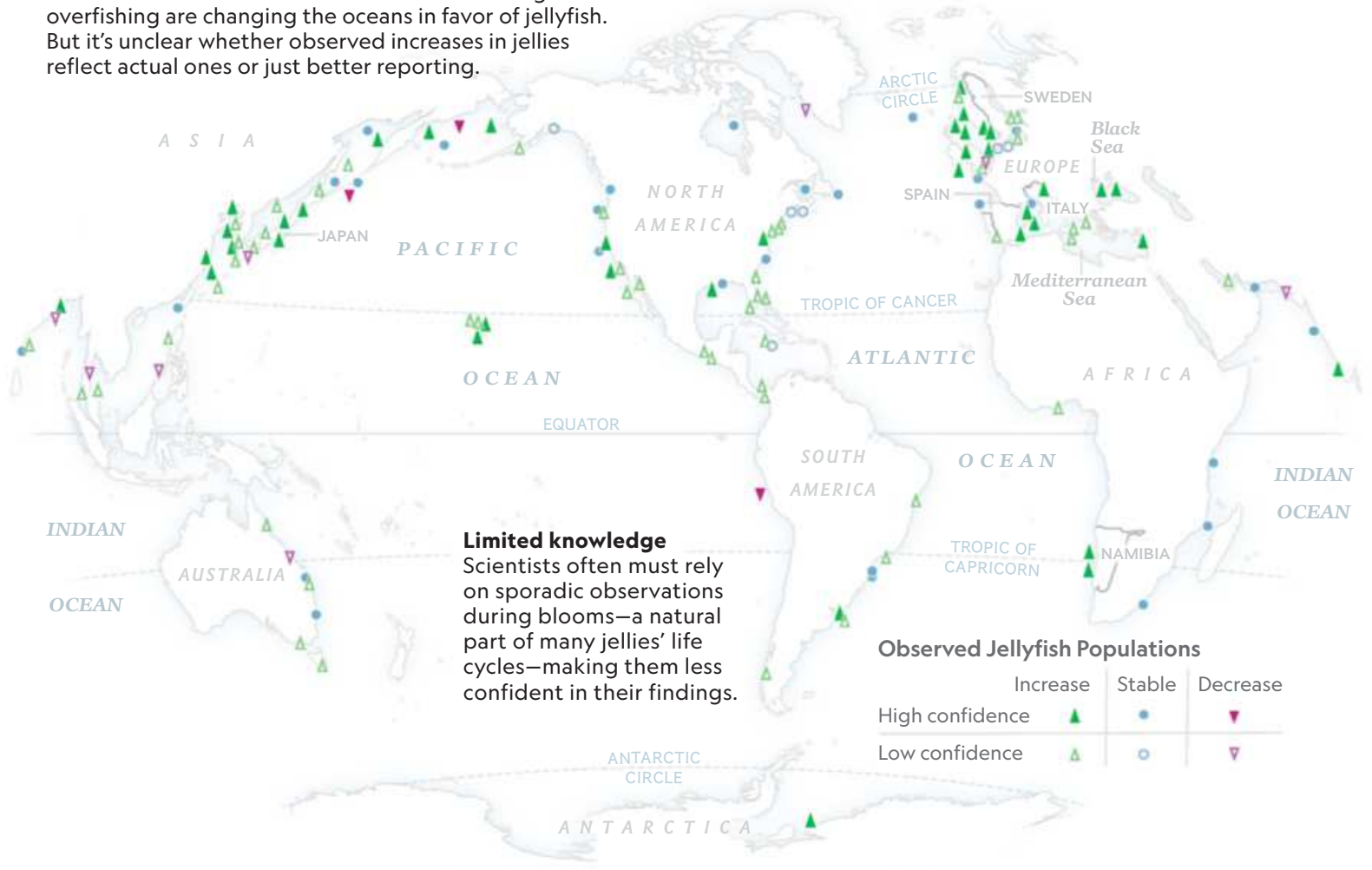






# JELLYFISH INVASION?

Some scientists are concerned that climate change and overfishing are changing the oceans in favor of jellyfish. But it's unclear whether observed increases in jellies reflect actual ones or just better reporting.



up in the Black Sea. A native of the western Atlantic, it presumably had been transported in a ship's ballast water and then been discharged. In the Black Sea it reproduced so prolifically that by 1989 it had reached densities of up to 11 per cubic foot of water. Fish couldn't compete with the jellies for food—sea walnuts eat as much as 10 times their body weight a day—and many fish became food for the jellies. Local fisheries collapsed.

In other parts of the world, swarms of jellyfish have menaced swimmers and clogged fishing nets. In 2006, beaches in Italy and Spain were closed because of a bloom of jellyfish known as mauve stingers. In 2013 a Swedish nuclear plant temporarily shut down because moon jellies were blocking its intake pipes.

Situations like these led to a spate of reports that jellyfish were taking over the seas. One website warned of the "attack of the blob." Another predicted "goomageddon."

But scientists say the situation is more complicated than such headlines suggest. Jellyfish populations fluctuate naturally, and people tend to notice only the boom part of the cycle.

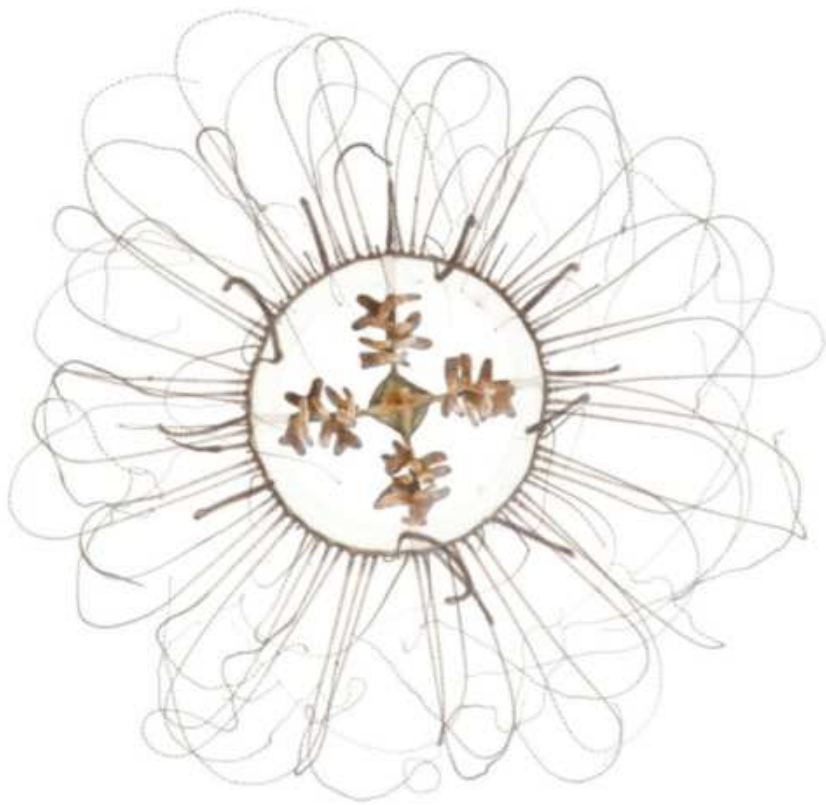
"A big jellyfish bloom makes the headlines, while a lack of a jellyfish bloom isn't even

worth reporting," says Lucas Brotz, a marine zoologist at the University of British Columbia. While some jellyfish species seem to thrive on human disturbance—off the coast of Namibia, for example, overfishing may have tipped the ecosystem into a new state dominated by compass and crystal jellyfish—other more finicky species appear to be declining. Researchers in a couple parts of the world have reported a drop in the number of jellyfish species they are encountering.

Meanwhile, if people are having more unpleasant encounters with jellyfish, is it because they're taking over the seas or because we are?

"Anytime we have an adverse encounter with jellyfish, it's because humans have invaded the oceans," Haddock says. "We're the ones who are encroaching into their habitat." Jellyfish are only doing what they've been doing generation after generation for hundreds of millions of years—just pulsing along, silently, brainlessly, and, seen in the right light, gorgeously. □

**Elizabeth Kolbert's** book *The Sixth Extinction* won a Pulitzer Prize; she wrote about race and genetics in the April issue. **David Liittschwager**, the Richard Avedon of obscure but beautiful creatures, has shot 13 features for the magazine.



**Hydrozoans** are in a class apart from true jellies. Some species never grow up; they remain branching colonies of polyps (bottom, *Nemacium lighti*). Others form medusas and resemble true jellies (top left, *Vallentinia gabriellae*). And one hydrozoan, the **immortal jellyfish** (*Turritopsis dohrnii*), seen above in a water drop, has a life cycle that skips death: It reverts from a medusa back to a polyp. How, no one knows.

Clockwise from bottom: 0.5 inches tall, 0.4 inches across (bell), 0.03 inches across (bell)

PHOTOGRAPHED AT SMITHSONIAN MARINE STATION, FORT PIERCE, FLORIDA (TOP LEFT AND RIGHT); COUNCIL ON INTERNATIONAL EDUCATIONAL EXCHANGE RESEARCH STATION BONAIRE (BOTTOM)

Some **2,000** species are known to have a medusa (swimming) phase of their life cycle. A sample of their diversity is shown here.



**Lion's mane jellyfish**  
*Cyanea capillata*  
The largest of this cold-water species live in Arctic waters.



**Nomura's jellyfish**  
*Nemopilema nomurai*  
Swarmers have a

### HOW THEY FEED

Atlantic bay nettles only swim to find food. Currents help bring them in contact with their prey: zooplankton, crustaceans, and even other jellies.

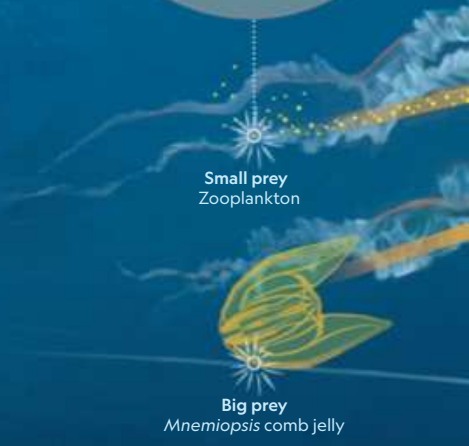
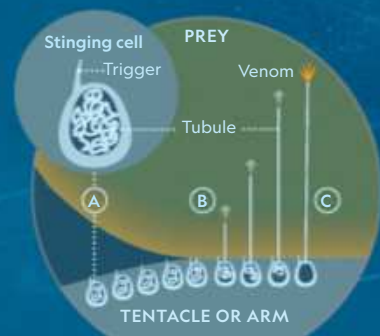
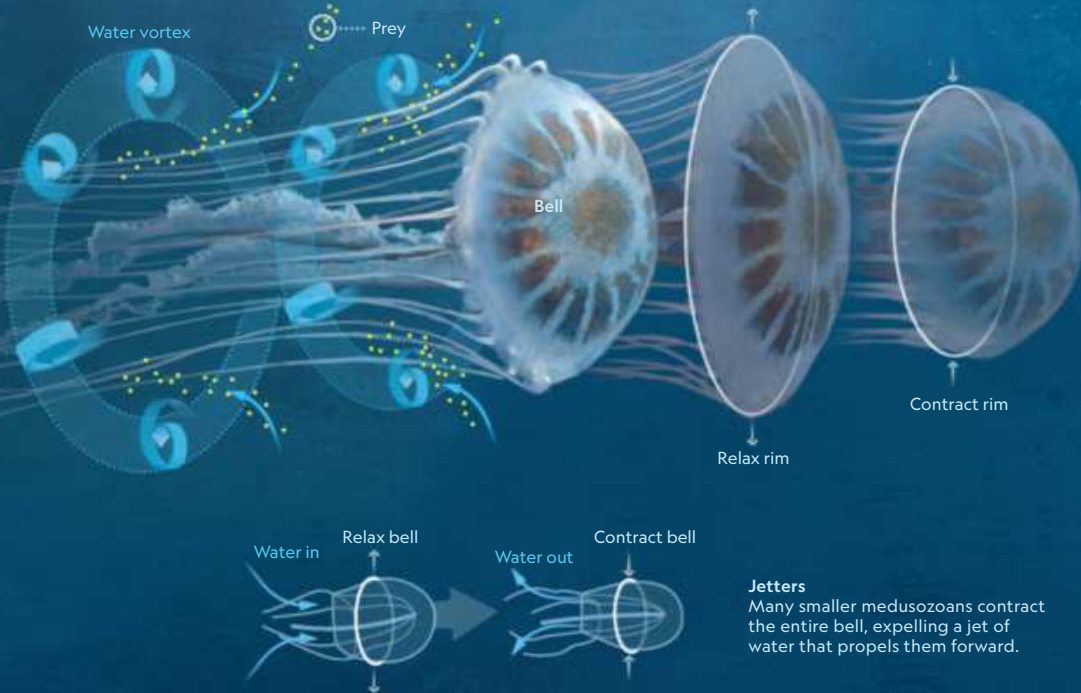
### 1 Swimming

Like other jellies, the Atlantic bay nettle hunts not by sight but by direct contact, spreading its oral arms and tentacles wide. Vortices help draw in prey.

### 2 Stinging

Millions of stinging cells (A) line the tentacles and arms. Some have coiled, barbed tubules that, when triggered, (B) uncoil with enough force to pierce shells or flesh to (C) inject venom.

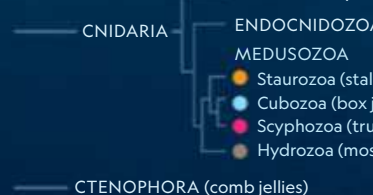
#### Atlantic bay nettle



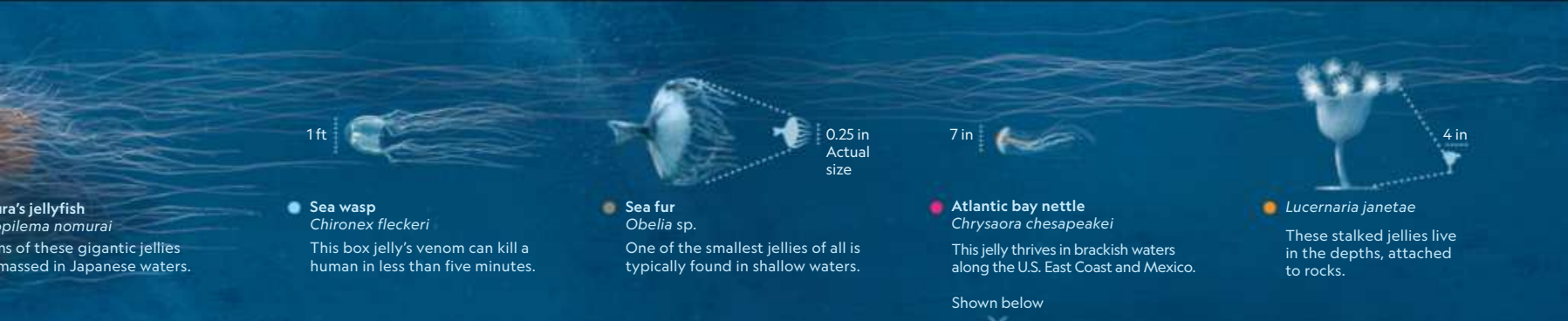
# BONELESS BEAUTIES

Being 95 percent water and gelatinous is a good strategy on an ocean planet, which is why jellyfish have survived for hundreds of millions of years. The term covers thousands of species in two barely related categories: the comb jellies and the medusozoans, such as the Atlantic bay nettle, featured here. It's a familiar menace to swimmers in the Chesapeake Bay.

### FAMILY TREE



FERNANDO G. BAPTISTA, EVE CONANT, KATHERINE APPEL, A



**Box jellyfish**  
*Cyanea lamarckii*  
These gigantic jellies  
massed in Japanese waters.

**Sea wasp**  
*Chironex fleckeri*  
This box jelly's venom can kill a  
human in less than five minutes.

**Sea fur**  
*Obelia* sp.  
One of the smallest jellies of all is  
typically found in shallow waters.

**Atlantic bay nettle**  
*Chrysaora chesapeakei*  
This jelly thrives in brackish waters  
along the U.S. East Coast and Mexico.

**Lucernaria janetae**  
These stalked jellies live  
in the depths, attached  
to rocks.

Shown below

### 3 Ingesting

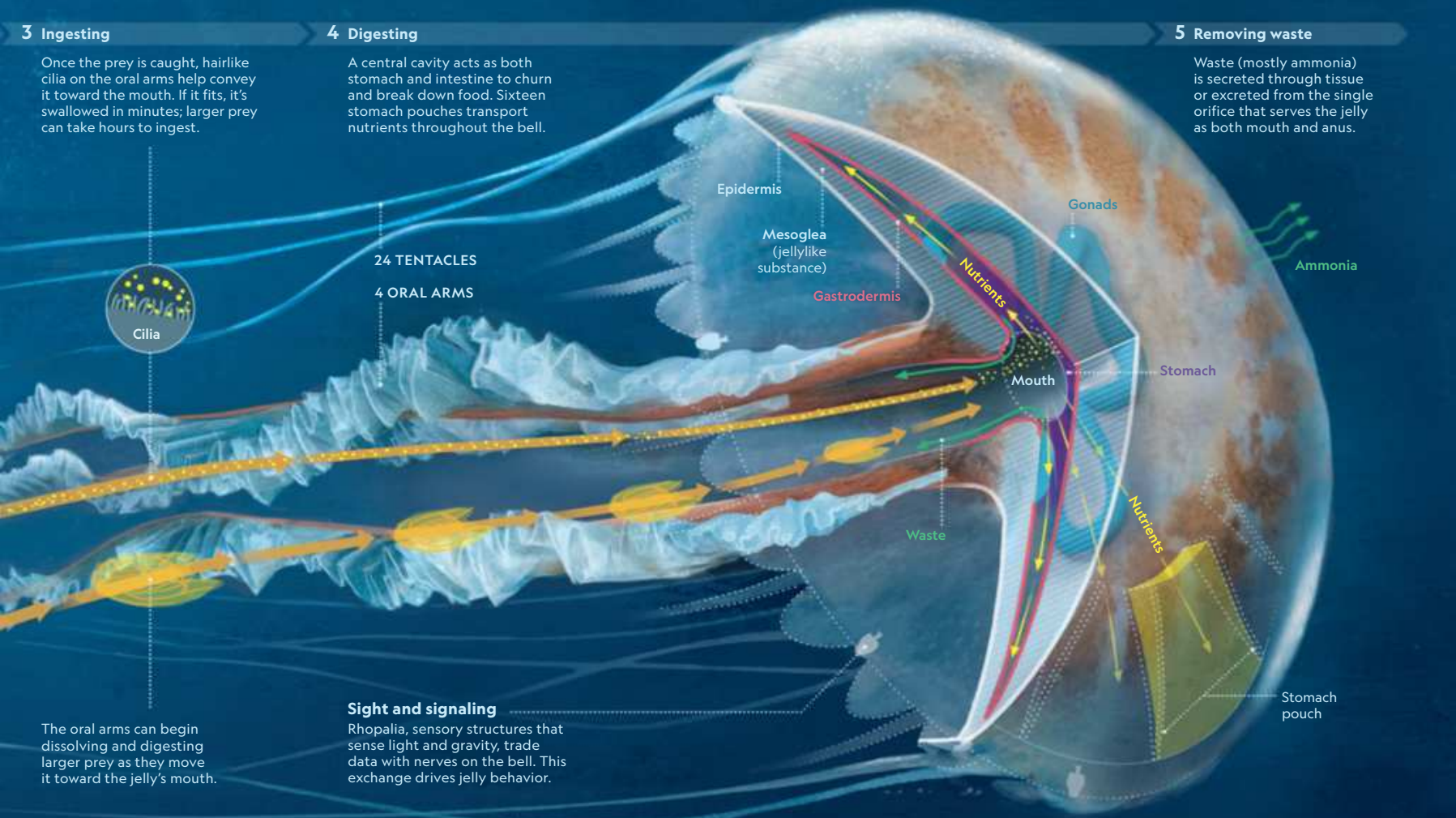
Once the prey is caught, hairlike cilia on the oral arms help convey it toward the mouth. If it fits, it's swallowed in minutes; larger prey can take hours to ingest.

### 4 Digesting

A central cavity acts as both stomach and intestine to churn and break down food. Sixteen stomach pouches transport nutrients throughout the bell.

### 5 Removing waste

Waste (mostly ammonia) is secreted through tissue or excreted from the single orifice that serves the jelly as both mouth and anus.



The oral arms can begin dissolving and digesting larger prey as they move it toward the jelly's mouth.

**Sight and signaling**  
Rhopalia, sensory structures that sense light and gravity, trade data with nerves on the bell. This exchange drives jelly behavior.

anemones, corals, sea pens)

A (parasites)

ked jellyfish)

ellies)

ie jellies)

st species remain in polyp form)

### THE MAKING OF A MEDUSA



**Gonads** look the same in both sexes, producing sperm in males and eggs in females.

Mature medusas release **sperm** or up to 40,000 **eggs** a day into the water.

Fertilized eggs grow into **larvae** that attach to a hard surface.

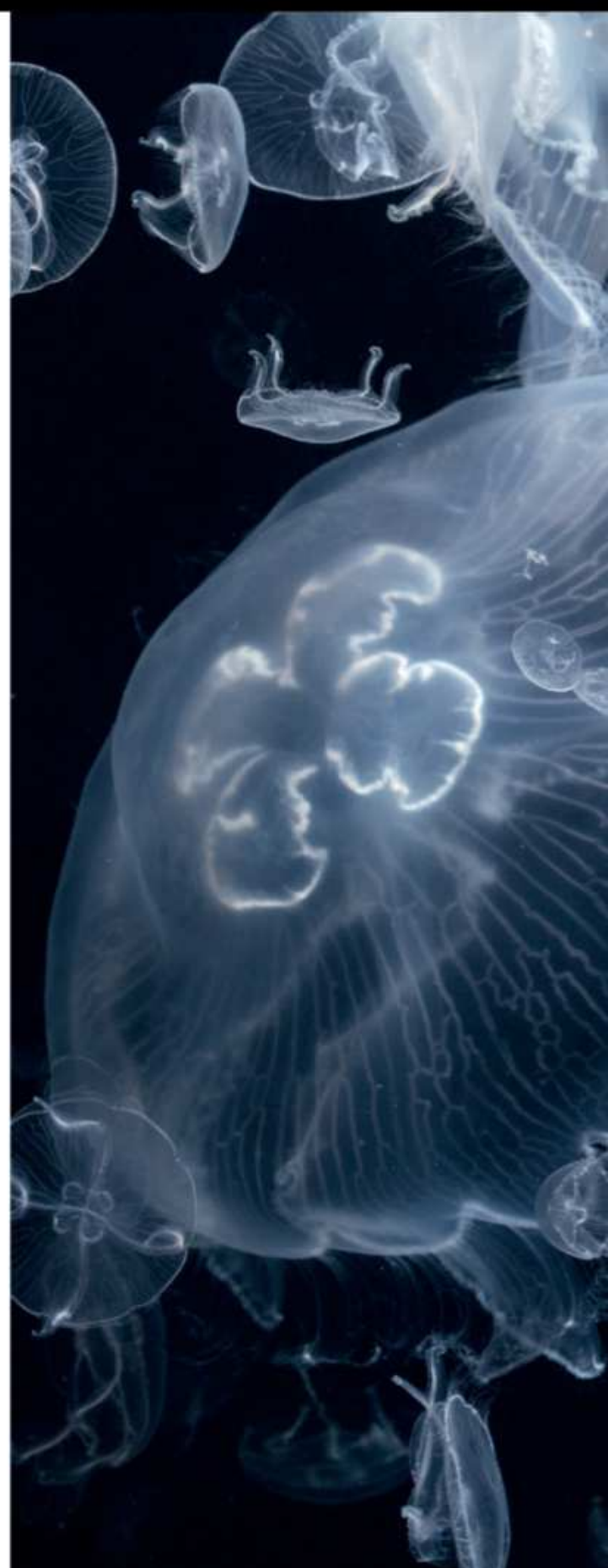
The larvae become stationary **polyps**, waiting days or years to reproduce.

Polyps grow and reproduce asexually, budding off **clones**.

The clones develop rapidly into **adult medusas**.

**Comb jellies** may be the most ancient living animal. They have a nervous system and—this shocked specialists—two tiny anuses. They aren't related to true jellies, which poop out of their mouths. Comb jellies' eight rows of comblike cilia act as paddles. In the 1980s a rapidly multiplying species decimated Black Sea fisheries.

*Beroe abyssicola*  
4.7 inches long





Worldwide more than 825,000 tons of jellyfish are harvested each year for human consumption. Jellies like this one, of the genus *Rhopilema*, make up nearly a third of the total. The sturdy arms are packed with nematocysts, cells that blast spiral barbed tubes laced with venom at victims—fishermen, for example. But eating these jellies dried or cooked is safe.

*Rhopilema* sp.  
2 inches across

#### **PREVIOUS PHOTO**

**Moon jellies**, found all over the world, are named for their otherworldly, translucent bells. The fringe of hairlike cilia sweeps food—mostly plankton—toward their mouths. The jellies change color depending on what they eat.

*Aurelia* sp.  
Biggest in photo is 6.7 inches across.









DISPATCHES | IRAN

# Iran's Nomads, Fading Away

AS MODERN LIFE LURES A GENERATION TO CITIES,  
SOME LEFT BEHIND WONDER: WHAT KIND OF LIFE IS THIS?

BY **THOMAS ERDBRINK** PHOTOGRAPHS BY **NEWSHA TAVAKOLIAN**





32°28'00" N, 50°07'23" E

**THE PEAKS OF THE ZAGROS** mountain range are still dusted with snow. Long, twisting roads draw lines over the valleys and slopes here in western Iran. They are ancient paths, trodden by feet and hooves for thousands of years in the ever repeating movement of migration.

These days cars and rented trucks, rather than horses, bring the remaining Iranian nomads and their flocks to their summer pastures high up in the Iranian highlands near the city of Chelgard. Instead of making daylong hikes for news to the long-abandoned nomadic communication center, local Bakhtiari tribe members carry cell phones and complain about bad reception.

Iran's nomads have been making the same migration for millennia. In spring they headed for the cooler pastures of the Zagros, where grass for their flocks of sheep and goats was abundant. At the end of autumn they would return to Iran's oil-rich Khuzestan Province, their animals strong and well fed to make it through the winter.

Iran's more than one million nomads have long resisted modernity through the isolation that comes with their lifestyle. Deep traditions and patriarchy also have kept change out. But the combination of persistent drought, dust storms that turn the skies orange, widespread urbanization, mobile internet, and the spread of higher education has made their numbers dwindle. The elderly couples still setting up their tents on the flanks of the Zagros admit that they might be the final chapter in the history of

one of the largest remaining nomadic communities on Earth.

In the distance a thunderstorm was brewing as one couple huddled in their tent. Dark clouds drifted over the valley, pouring out gray stripes of rain. Bibi Naz Ghanbari, 73, and her husband, Nejat, had set up their black tent in the same place where their family had migrated for 200 years. There used to be dozens of family members around. Now there was just one other tent, home to a distant cousin. The couple said unexpected spring cold and rains had gotten into their bones, after they managed to save their tent twice during storms. They had migrated early, to make sure their flock would be able to graze on the spring grass, after a winter with barely any precipitation. None of their eight children had joined them. The battery in Bibi Naz Ghanbari's phone was out of power, so she couldn't even reach them.

"They all live in cities now. What was the point of having them?" she said of her children, who had sold off their flocks to live in houses. "What kind of life is this?" she asked, pointing at the holes in the tent. "We had to sleep under three blankets last night, and it was still cold. I wish I lived in a house too."

**AS THE NUMBER OF NOMADS** has fallen, the strongest advocates of settling down have been the nomadic women. Their lives are tough, and they know it. Zahra Amiri, 61 and the mother of nine, wakes up at dawn and brings water from a well, a long walk. After that she bakes bread and prepares breakfast. Often she joins her husband while shepherding, milks the sheep, makes yogurt and cheese. Her hands and face are darkened by the sun. If there is any time between chores, she works on a kilim, or carpet. To reach their summer destination, her 24-year-old daughter, Forouzan, rode a horse, guiding her two sisters and eight mules carrying their belongings and a tent.

"After all these years of hard working, I have nothing to show for it, except these children and the sun," Amiri said. "Our only joy is to drink tea." Inheritance laws for nomads are officially no different from those for other Iranians, but in practice women rarely inherit anything. The nomadic

**TOP RIGHT**

In Khuzestan Province, Masoumeh Ahmadi, 14, holds her mother's rifle. After a woman marries, she receives a firearm—with the approval of her husband and her father. Many women get one as a gift from their husbands after giving birth to their first son.

**BOTTOM RIGHT**

Girls spend nearly two hours en route to Bibi Maryam Boarding School. Most of their families are nomads who move into village houses to enable the students to attend school during the week.

**PREVIOUS PHOTO**

Shirin Khodadadi, 26, makes tea with her son. The family spent the night near the road after a driver they'd hired said he couldn't drive any farther and put them out of his car.

The Pulitzer Center on Crisis Reporting provided a grant to support this story.







**TOP**

Drought in Sikvand village in Khuzestan Province has forced shepherds to move their flocks in search of grassland. Many nomadic families are seeking a way of life that will allow their children to go to school.



**BOTTOM LEFT**

Stopping for the night, the Zamani family shares a meal laid out on colorful rugs.

**BOTTOM RIGHT**

Unable to afford the cost of renting a large truck to make their move easier, some Zamani family members must walk while a pickup carries their belongings, the elderly, and kids. In recent years many families have stopped moving and living as nomads because of the hardships. For others, raising animals provides the only income.

custom is that women give away their inheritance rights to their brothers. On the other hand, women are allowed to ride horses and carry guns, and Amiri had both. Many Iranian nomadic men say that milking, getting water, and giving inheritances to women are *eib*, or improper, for men to do. Marzieh Esmaelipour, 33, said she wouldn't even consider asking for a share of an inheritance. "Everybody will talk bad about you if you do that," she said.

The hard work, the lack of rights, and the knowledge that other Iranian women have easier lives have made many nomadic women agents of change. Mahnaz Gheybpour, 41, moved out of tents a decade ago. She and her husband migrate between two modest houses, one in the oil-rich province of Khuzestan, for winter, the other a place near Chelgard for the summer. "I won't let my daughters marry a nomad," she said. "Our lifestyle is horrible. I want them to live in a city and study."

Gheybpour got married when she was 16. "I was a child," she said. "My 17-year-old daughter doesn't want to marry. She tells me, 'Why should I make my life miserable, like yours?'"

**THE GENDER ISSUES** are exacerbated by a 15-year-long drought that has dried up many of the main rivers and lakes and made it difficult for nomads to find water for their flocks. Increasing development has created fences, roads, and dams that now block passage.

On the edge of Lali town, a place where many former Bakhtiari nomads end up in simple dwellings, Mehdi Ghafari and his friend Aidi Shams shared a water pipe. The sun was setting as they reminisced about their past as nomads. Their wives are happier now, they admitted, and their children go to school. "There was no way but to adjust," Ghafari said.

One of the last on the mountain, Nejat Ghanbari, the 76-year-old husband of Bibi Naz, insisted that nomads stem from the pre-Islamic Iranian kings.

"We are descendants of the great Kouros Kabir," he said, meaning the legendary Persian king Cyrus the Great, who ruled a world empire around 550 B.C. Now he and his wife are the last. "And when we die, this will be the end of us. It makes me sad to realize this." □

# R U L E R S O F







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**LEFT**

A female saker falcon guards her chicks—called eyases—in their nest overlooking the Mongolian plain. Genghis Khan is said to have kept hundreds of the birds for hunting. Today sakers are considered endangered because of habitat loss and the illegal wildlife trade.

**ON FLAP**

Sheikh Butti bin Maktoum bin Juma al Maktoum, a senior member of the Dubai royal family, poses with some of his favorite falcons. The sheikh has helped pioneer important changes in Middle Eastern falconry, eschewing wild birds for those he breeds himself.

# THE SKY

FOR CENTURIES, HUMANS HAVE FORMED UNIQUE BONDS WITH FALCONS, THE WORLD'S FASTEST ANIMALS.

NOW A SHEIKH AND HIS FALCONER ARE RAISING AND TRAINING THE BIRDS IN A WAY THAT COULD BE A MODEL FOR PROTECTING THEM.

BY PETER GWIN PHOTOGRAPHS BY BRENT STIRTON





The sheikh has several facilities, including outdoor aviaries where he, his sons, and his staff care for a few hundred falcons—gyrfalcons, peregrines, sakers, and other species. Each fall he chooses a dozen or so of the best to train for the hunting season.



**T**

he blue light of dawn reveals the shadowed contours of the Arabian desert as Sheikh Butti bin Maktoum bin Juma al Maktoum and his son kneel in prayer. The velvet sand is cool, and the tracks from the night wanderings of a desert fox crisscross the area. Nearby, the silhouettes of 12 small pillars mark the foot of a dune, at the top of which a man is setting up a folding table to serve tea. On the horizon it's possible to see the shimmer of the Dubai skyline, a place transformed from a tiny backwater into a hypermodern port city by the sheikh's grandfather, Sheikh Rashid bin Saeed al Maktoum.



The peregrine falcon's ability to dive for prey at over 240 miles an hour has long captivated humans. In the 1970s falconers helped save the species from extinction.

BRIDGEMAN IMAGES

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#### CELEBRATING THE YEAR OF THE BIRD

National Geographic is partnering with the National Audubon Society, BirdLife International, and the Cornell Lab of Ornithology to celebrate the centennial of the Migratory Bird Treaty Act. Watch for more stories, books, and events throughout the year.

There, a cascade of concerns and obligations awaits Sheikh Butti—corporate board decisions, real estate deals, royal family matters, requests for counsel from across the Middle East, Europe, and beyond. But all of that is a world away. Here in the silent landscape of his ancient Bedouin forebears, the sheikh finds peace with his falcons.

It is October, and falconers in the United Arab Emirates (U.A.E.) are busy training their birds for hunting and the upcoming racing season. Each day Sheikh Butti (pronounced BOO-tee), his son Maktoum, and their retinue rise at four in the morning and drive more than an hour into the desert to train their birds before the scorching heat of the day.

As the sky brightens, I see that the 12 pillars are hooded falcons on perches, silently awaiting the day's training. There are chocolate and cream peregrines, white speckled gyrfalcons, dusky brown sakers, and hybrids of different species. Together the group contains lineages that cut across Europe, Asia, and the wilds of the Arctic. They represent only a few of the hundreds of birds the sheikh owns, which arguably compose one of the most exquisite collections of falcons ever assembled. (Considering that falcons have been zealously collected throughout history by Assyrian rulers, Viking chiefs, Russian tsars, Mongol khans, and practically every English monarch from Alfred the Great to George III, this is indeed quite a claim. More about this history later.)

Pani, one of the sheikh's aides, hands me a cup of tea and hustles to prepare the lure for the first trainee. "Good morning, Howard," the sheikh calls out to the lanky, bald man in glasses standing next to me. Howard Waller, 57, is his falcon breeder, friend, and confidant. The sheikh's voice is bright and full of enthusiasm, and the two men immediately spiral into a spirited, hopscotching discussion of falcon esoterica.

They discuss the birds arrayed before them and others in the sheikh's several aviaries. They comment on the merits of quail and pigeon diets, the proper way to build muscle mass, the nuances of diseases such as aspergillosis and bumblefoot. They note the young birds that exhibit aggressive personalities and those that seem passive. They sprinkle in bits of gossip about acquisitions by other Dubai falconers and news from falconry communities in neighboring Saudi Arabia, Qatar, and Bahrain. Almost like a long-married couple, they eagerly anticipate each other's answers and communicate using a shorthand inscrutable to nearly everyone else: "The gray whose father was the one we hunted with two years ago." "The gyr with the broken tail feather that we fixed."

They speak of favorite birds: Delua, White Finger, Old Bedford, and of course, the late Hasheem—dear Hasheem—and the lineages they produced, each with its own genetic bundle of surprising color schemes and personality traits. And then there is the White One. Their voices vibrate with excitement when they mention the White One, a yearling that may be the most beautiful falcon either has ever seen.

It's been this way each morning for the nearly two weeks the sheikh has graciously allowed photographer Brent Stirton and me to observe the training sessions. Before the first rays of sun creased the horizon, the two falconers would wander off into the dark desert, just the two of them, lost in conversation.

Over the past 20 years, Sheikh Butti and Howard have helped pioneer important changes in Arab falconry. Most notably, they breed and hand raise every bird they fly—a practice that was thought impossible



An Indian painting portrays Sultana Chand Bibi using raptors to hunt cranes. Throughout history powerful women have practiced falconry—from Russian tsarinas and English queens to Bavarian noblewomen.

BRITISH LIBRARY BOARD/ROBANA/  
ART RESOURCE, NY

before captive peregrine falcons were first successfully bred in 1942 by Nazi leader Hermann Göring's falconer, Renz Waller (no relation to Howard). It's also a practice Howard and Sheikh Butti believe can have a major impact on falcon conservation at a time when several species are facing threats from habitat loss and the illegal wildlife trade. And though the vast majority of U.A.E. falconers now fly captive-bred birds, some traditional falconers in other parts of the Middle East still prefer wild birds captured after they've learned to catch prey on their own.

As soon as the sun becomes a soft orange ball on the horizon, the chitchat abruptly ends and the training begins in earnest. Maktoum, 27, wearing a heavy leather glove, gently takes one of the hooded falcons, a young peregrine, from its perch, gets into a Toyota four-by-four, and drives a few hundred yards away. Sheikh Butti holds what looks like a fishing pole with a rope tied to the tip and a quail wing tied to the end of the rope. He begins waving the pole, making wide, sweeping arcs with the fluttering wing.

In the distance Maktoum slips the leather hood off the falcon's head and releases it. The bird beats its large, powerful wings and climbs high into the crisp air, immediately spots the lure, and flies toward it, its head following the arcs of the swinging wing. Sheikh Butti calls to it: "Hah!" The falcon swiftly gains altitude, banks hard, and dives on the lure, but at the last second, the sheikh jerks the wing away. "Hah!" calls the sheikh. The falcon seesaws awkwardly as it regroups. It passes overhead, and I can hear the soft whistle of its wings paddling the air. Its eyes—eight times as sharp as a human's—are fixed like laser sights on the lure. It gains altitude and dives. The sheikh again pulls the lure at the last second.

Finally, on the third try, Sheikh Butti allows the bird to catch the wing and take it down onto the powdery sand. Pani quickly substitutes

the lure for a quail breast, and the falcon begins stripping off the fresh meat. The sheikh gives explicit instructions for exactly how much to let the bird eat. Too much and the peregrine will get fat and slow; too little and it won't gain muscle.

"That's a young male," Howard says. "It's still figuring out how to hunt. The key is to not let it get frustrated. You want to make sure you let it catch the lure before it gives up."

The sheikh and his son put each of the falcons through its paces. The older birds make the young male look amateurish by comparison. Maktoum takes them farther into the desert, releasing some from nearly a mile away. They rise effortlessly, as if impervious to gravity. Their flight paths are much more efficient and strategic, their wings flattening, flaring, cupping the air to twist and plunge in pursuit of the spinning lure. Like fighter pilots, some approach with the rising sun at their backs, using the glare to blind the "prey." Others fly barely off the ground, approaching from behind the parked Toyotas, using them to block the prey's field of vision before a final flash of speed.

Delua, a gray gyr (pronounced jer), even uses Brent as cover. Hunched on his knees in the sand, Brent is photographing Sheikh Butti when the falcon whips over his shoulder, a wing tip grazing his hair as she strikes the lure.

Sheikh Butti laughs. "They will knock you down," he says. "It's happened to me several times."

It's a visceral example of why falcons are such deadly hunters. In the wild, the gyr can surpass 60 miles an hour flying straight ahead. A diving peregrine can exceed 240 miles an hour, making it the fastest creature on the planet. At such velocities, even a bird weighing only a few pounds can deliver a violent blow.

"Like a lightning bolt with feathers," Howard says.

# H

**ISTORIANS AREN'T SURE** when humans first began capturing and training birds of prey to hunt animals they couldn't kill with arrows or catch with snares. References in the ancient poem *The Epic of Gilgamesh* suggest that falconry existed in what is now Iraq as early as 4,000 years ago. Over centuries, the practice of catching and training falcons proliferated in cultures throughout the known world. King Tut was buried wearing a falcon pendant. The Greeks struck coins depicting Zeus with a fal-

con. One of the earliest Japanese falconers, a woman, wrote a treatise on the subject. Norse merchants traded gyrfalcons from Iceland throughout Europe, and the economy of the Dutch city Valkenswaard depended almost exclusively on the trade of falcons.

By the time Marco Polo encountered Kublai Khan in the 13th century, the Mongol ruler employed 60 managers to oversee 10,000 falconers. Meanwhile, in Europe, the Holy Roman Emperor, King Frederick II, spent 30 years personally compiling an exhaustive scientific study of falconry that even now is regarded among the most authoritative tomes on the history and techniques of the sport.

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AT HIGH  
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SAYS  
FALCONER  
HOWARD  
WALLER.

Howard Waller wears a breeding hat and mimics a female gyrfalcon's chirping to coax sperm from a male gyr. Waller raised the falcon from a chick, a process called imprinting. "First it sees me as its parent," he says. "And once it's mature, it regards me as its mate." Later he'll use a syringe to put the semen into a female imprint.

**NEXT PHOTO**

Officials in Mongolia collected carcasses of sakers killed on uninsulated power lines. Some 4,000 raptors are electrocuted there each year. The United Arab Emirates has pledged \$20 million for raptor conservation, including retrofitting power lines.













A 19th-century Bedouin poses on horseback with his falcons. For millennia, nomadic Bedouins caught falcons as they migrated across the Arabian Peninsula, en route from Asia to winter nesting grounds in Africa. The nomads trained them to hunt game for a season and then set them free.

ADOC-PHOTOS/ART RESOURCE, NY

#### **NEXT PHOTO**

Veterinarians and assistants at Abu Dhabi Falcon Hospital treat some 11,000 birds a year, making it the world's largest avian hospital. Falconers bring in birds for everything from check-ups to broken wings.

But no region has a stronger claim to the practice than Arabia, where today more than half the world's falconers reside. While falconry (which also includes hawks, eagles, and other birds of prey) was largely the sport of kings in Europe, it was a critical tool for survival in the Arabian Desert.

Bedouins would catch migrating falcons and train them to hunt game, such as houbara bustards and desert hares. Before the arrival of guns, the birds greatly increased the Bedouins' ability to provide food for their families, and in the harsh desert environment, every ounce of protein was crucial. Falconry was so important to Arab culture by the advent of Islam that the Prophet Muhammad specifically mentions it in the Quran, declaring food caught by falcons to be clean for Muslims to eat.

But in the 20th century the rapid development of Dubai and the other emirates almost wiped out the practice in the U.A.E. The houbara declined precipitously as humans encroached on its habitat, and hunting the large bird eventually was banned. Only the wealthy could afford to keep falcons and travel abroad to hunt houbara in Central Asia and North Africa.

Then in the early 2000s, Crown Prince Sheikh Hamdan bin Mohammed bin Rashid al Maktoum introduced falcon racing as a way to make falconry accessible to the average Emirati. The birds are timed as they chase a lure over a specified distance. The season, which lasts from December through January, is highlighted by the President's Cup, a competition in which more than 2,000 falcons compete for nearly seven million dollars in prize money.

The impact of racing is evident all over Dubai, where falcon ownership has skyrocketed. Perches can be found in hotel lobbies and office buildings throughout the city. Falconers bring ailing birds to a falcon hospital and shop for their needs at a mall dedicated to the sport.

One afternoon, Howard and I visit the falcon mall. Swarms of customers, many carrying hooded birds on their gloved fists, peruse the offerings of vendors selling everything from falcon food (frozen pigeons and quail) and falcon vitamins to tiny transmitters for tracking lost birds and hand-dyed leather hoods from Spain and Morocco. There is even a store specializing in radio-controlled model airplanes painted to look like houbaras for young falcons to learn to chase.

The mall also has its own falcon clinic, where I meet a young man in a traditional long white dishdasha with a peregrine on his arm, his two young sons trailing behind him. "Is the falcon sick?" I ask. "No, he is getting a checkup," the man says. "He is going to race!" one of the boys says. "He is going to *win!*" says his brother. The man beams proudly.

Howard and I walk over to a section of the mall where dealers sell live falcons, and Howard moves slowly among the perches, inspecting the hooded birds. There are peregrines and sakers, the traditional favorites of Saudi falconers, and a few tiny striped kestrels: starter birds. He asks

the proprietors where the birds come from, and each vendor points to papers bearing official stamps showing the bird's country of origin.

Howard nods in approval. "It's a lot better now," he says. He strokes the falcons' breast feathers and inspects their feet. "These birds seem pretty healthy, not too stressed. I used to see a lot of birds in bad shape that had been smuggled in from Pakistan or from Russia, through Syria," he says. "But the government has cracked down on that. Now each bird that comes in or out of the U.A.E. must have its own passport."

The U.A.E.'s efforts notwithstanding, falcon smuggling remains a concern in many parts of the world. Conservationists report that saker and peregrine falcons are trapped during their migrations through Pakistan and smuggled to wealthy buyers in the Middle East. Gyrs from the Arctic regions of Russia are also poached. Of those species only the saker is currently listed as threatened or endangered, though there are reports that some populations of gyrs appear to be decreasing in parts of the wild. Conservationists are worried that the illegal trade, combined with shrinking falcon habitat—especially in the Arctic because of climate change—could imperil the birds' long-term survival.

These concerns, Howard says, are a major reason Sheikh Butti is so committed to breeding falcons, an operation he recently expanded in Scotland. "You should come visit," Howard says.

# H

**OWARD IS IN A HURRY** because it's feeding time and he's got some 200 hungry falcons waiting for him. It's late May, nearing the end of the breeding season, and we're driving to Sheikh Butti's falcon farm, situated among the verdant hills and rugged moors of coastal Scotland. As he navigates the narrow roads, Howard describes how as a boy in Rhodesia, he'd devoured every book about birds that he could get his hands on, and later after immigrating to South Africa, he had begun taking in raptors that had been injured or orphaned—peregrines, lanners, black eagles, African merlins, tiny little sparrow hawks ("fierce little songbird hunters"), even an owl ("the dumbest bird I ever worked with"). Over time he became a dedicated falconer.

It was on a trip to Dubai in 1998 when a friend introduced him to Sheikh Butti, who was intrigued that Howard thought he could breed and train falcons in the U.A.E. "All the veterinarians I talked to said it was impossible to breed falcons in the desert, let alone teach [captive-bred birds] to hunt there," Howard says. A few other falconers in the U.A.E. were also attempting to breed but with limited success, and the sheikh and Howard set out to prove the experts wrong. During their first breeding season, they hatched more than 20 saker eggs and raised 15 to maturity. The next year they doubled the number.

As word of their success spread, local falconers began sending them cast-off birds—falcons deemed untrainable or those with diseases such as severe bumblefoot (a potentially fatal infection in the feet) or hopelessly mangled flight feathers. Howard refused to give up on any bird. He figured out their individual personalities one by one,

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DUBAI BOASTS  
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AND RACING  
FALCONS.





After training in the desert, falcons are tied to perches for the drive back to Dubai. The birds' vision is so acute that subtle movements or changes in light can startle them. Hooding, a technique developed by ancient Arabs, keeps them calm.

**NEXT PHOTO**

Sheikh Butti's son Rashid ties a falcon to a perch at a camp near Abu Dhabi. For centuries Arab falconers have hunted houbara, a large and delicious game bird. Falconers may pursue only captive-bred houbaras in the U.A.E. or hunt them in the wild in places such as Uzbekistan and Morocco. The U.A.E. funds a large-scale breeding program to repopulate the species.











carefully superglued broken wing feathers, and patiently treated the bumblefoot. (“Most falconers don’t understand it’s really about stress,” he says.) Several of the donated falcons became skilled hunters and joined the sheikh’s breeding population.

A few years ago, the sheikh and Howard decided to expand their operation with a second facility in Scotland, closer to the native climates of peregrines and gyrs, and near other high-quality falcon breeders with whom they could exchange genetic lines. The sheikh keeps several of the new birds each year to train for hunting and others to breed, gives some to family and friends, and sells the rest to other falconers.

We reach Howard’s house, which sits on a rise with a view of the North Sea on the far horizon. The hungry falcons are waiting, and the air echoes with their piercing screeches. We head to a small complex of buildings behind the house and enter one that holds a walk-in freezer filled with locally sourced quail and pigeon. Howard gathers a generous bucketful of breasts, and we visit dozens of rooms containing breeding pairs of peregrines and gyrs, each with a clutch of two or three nestlings. Howard puts the meat on a small shelf, and we watch the males fly over, pick up the meat, and take it to the females. The pair then take turns feeding the squawking nestlings.

Howard also breeds hybrids—part peregrine, part gyr—created by collecting sperm from the males and artificially inseminating females. “Gyrs are highly intelligent birds, much smarter than peregrines,” Howard says. “They can have diva personalities, but when you combine them with peregrines, you get a large, strong hunting bird that is easier to handle and more resistant to disease.”

In one of the rooms I spot a gyr the color of pure snow, without a speckle of brown or gray. It is the precious White One. For millennia, historians have expounded on the obsession with pure white gyrs. Ransoms for kidnapped nobles, overtures of international diplomacy, dowries for royal marriages have hinged on the special birds. During the Crusades, Sultan Saladin of Egypt and Syria refused the enormous sum of a thousand gold ducats from King Philip of France to return his pure white gyr, which had flown across the battle lines.

It’s not just the bird’s beauty that excites Howard and Sheikh Butti. The White One is proving to be a fearless, aggressive hunter. “She’s not just a show falcon,” Howard says. “It’s everything you dream about in a bird.”

I’ve seen news reports of wealthy sheikhs buying super falcons such as this for as much as \$250,000, and I ask Howard how much the White One could sell for. “The media reports crazy prices,” he says, but few are accurate. “Those stories help fuel the black market,” he adds, incentivizing people to trap wild falcons. You might find a wealthy Middle Eastern falconer willing to pay hundreds of thousands of dollars for the White One, he allows, but Sheikh Butti would never sell her. To him and to Howard, the White One represents much more than just a trophy. She was born from the line of gyrs that stretches back to one of the lost-cause, problem falcons Howard was given in the late 1990s. She offers living proof that wild falcons aren’t better than those bred in captivity. The sheikh’s consistent success over the years hunting with his captive-bred falcons has prompted other royal falconers to seek out captive-bred birds. Some have invested in their own breeding programs. This marks an important trend, reasons Howard, one that has helped dampen the market for smuggled wild falcons.

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HOWARD WALLER

Ultimately, Howard and the sheikh hope to release captive-bred gyrs into the wild to bolster their numbers in some parts of the Arctic that have seen a decline. It's a practice that actually saved peregrines. By 1970, because of the widespread use of the pesticide DDT, the peregrine falcon had all but disappeared in the United States. Tom Cade, an ornithologist and falconer, founded the Peregrine Fund and recruited falconers from across North America to help save the species. Their efforts included releasing 6,000 captive-bred falcons. Today the peregrine population is considered robust. "Eventually, we'd like to release into the wild most of the birds we breed," Howard says.

After the feeding, Howard takes me to a building that holds imprints, or falcons he's hatched from artificially inseminated eggs and is raising by hand. Over time, an imprint will recognize the person who feeds it as its parent. The room is filled with dozens of plastic crates holding imprints, some only days old, their pink flesh covered with wisps of down. Others are fat little fuzz balls insistently chirping at him to feed them. He takes a bowl of freshly ground pigeon and quail meat, hands me long steel tweezers, and shows me how to gently fill their gullets with the meat.

Once all the mouths are fed, we move to the incubator room. The walls are lined with elaborate charts tracking in punctilious detail the genetic lines and development of every falcon bred this season. Nearby, the season's last dozen brown speckled gyr eggs sit under the warmth of infrared heat bulbs. Every day Howard and his wife, Victoria, use a special light to illuminate each egg and measure the chick's development inside—a sort of falcon sonogram.

He picks up one egg that seems ready to hatch. There is a minuscule nick in the shell where the chick has tried to break through. "Sometimes they're too weak. Breaking the shell is part of nature's test for weeding out the weak ones," Howard says.

He lightly taps the egg and holds it to my ear. Faintly, I hear "Cheep, cheep." It is soft but unmistakable, like a feeble radio signal from another world. Howard, always a champion for the weak ones, gently begins peeling open the shell, and in seconds he's holding a baby falcon. He dabs away the sticky yolk. The bird is mostly wet pink flesh and matted silver down. It struggles to lift its head, which seems far too big for its tiny body. It's nearly impossible to imagine this helpless creature one day gliding across the sky like an overlord. Finally, the chick manages to open one globelike eye, and the newest gyrfalcon on the planet looks up at Howard Waller, its new father.

"Cheep," it says. □



A medieval painting depicts a woman with an arctic gyr, the largest falcon species. Revered by Vikings, gyrs were introduced to European falconers by Norse merchants and became Iceland's most precious export during the Middle Ages.

RMN-GRAND PALAIS/ART RESOURCE, NY

#### **NEXT PHOTO**

Falconer John Prucich positions raptors on a model for a photo shoot near Seattle. Falcons can be fussy, he says. "But when you connect with them and see nature in full splendor, it's perfection."

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Senior Editor **Peter Gwin** wrote about the Central African Republic for the May 2017 issue. Photographer **Brent Stirton** was named 2017 Wildlife Photographer of the Year for his photos depicting the rhino poaching crisis, published in the October 2016 issue of *National Geographic*.





# I AM



PAT COFFEY, NATIONAL ARCHIVES

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## **JUNZO JAKE OHARA, TAKESHI MOTOYASU & EDWARD TETSUJI KATO**

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| FAMILIES 05658, 09650,  
05653

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**INCARCERATED AT SANTA ANITA  
(CALIFORNIA) ASSEMBLY CENTER  
AND HEART MOUNTAIN (WYOMING)  
RELOCATION CENTER**

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At Heart Mountain Relocation Center in Wyoming in 1943, Boy Scouts Junzo Jake Ohara, 14, Takeshi Motoyasu, 14, and Edward Tetsuji Kato, 16, paid homage to the American flag. In 2013 photographer Paul Kitagaki, Jr., tracked down the men and had them pose, 70 years later, outside Kato's home in Monterey Park, California.



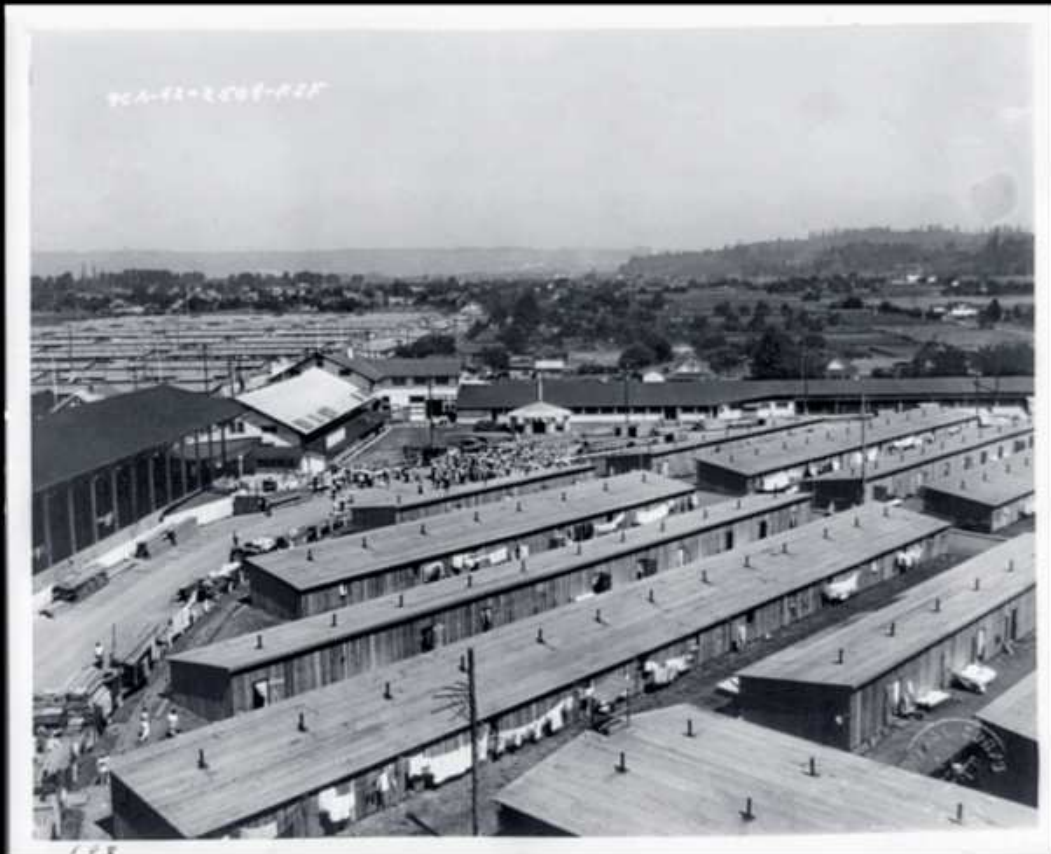


Scenes from the Japanese internment  
resonate today.

BY ANN CURRY | PHOTOGRAPHS BY PAUL KITAGAKI, JR.



AN AMERICAN



After the Japanese attack on Pearl Harbor, President Franklin D. Roosevelt's Executive Order 9066 forced more than 120,000 people of Japanese descent to live for years in incarceration camps. At left, construction crews work at Puyallup Assembly Center, a detention facility in Washington State that the government euphemistically called Camp Harmony.

LIBRARY OF CONGRESS

## Diversity in America

A YEARLONG SERIES

Quite by chance, in the small-town public library of Ashland, Oregon, while searching for an engaging book to read, I was confronted by their faces: Asian children, in a black-and-white photograph, smiling incongruously from behind a barbed wire fence.

“Where could this have happened?” I wondered, thinking it was somewhere in Southeast Asia, maybe part of the Vietnam War, as I peered deeper into the pages. That was the moment I first learned, at 17, that civilians of Japanese ancestry had been rounded up and confined in America during World War II. It was even more surprising, as I am the daughter of a Japanese immigrant.

What caused America to lock up more than 120,000 civilians, two-thirds of them U.S. citizens, without due process during the war? Even now Junzo Jake Ohara struggles to answer the question. “I think it was probably because of prejudice; I don’t know,” says Ohara, 89, who was confined for three years. “They were afraid of us, I guess.”

The answer, according to the historical record, lies not just in fear and prejudice but in the power of politics to exacerbate both. And it reveals a great nation locked not just in a world war after a devastating attack but also in a painful struggle with itself over its own ideals—a

struggle still echoing nearly 80 years later. The incarceration is cited in today’s immigration debates, including over the detention of migrant children and families crossing the southern border in June and the current ban on people from several Muslim-majority countries from entering the United States.

The Commission on Wartime Relocation and Internment of Civilians was tasked by Congress in 1980 to investigate the U.S. government’s decision to confine people of Japanese ancestry during World War II. After an exhaustive review of government documents and gathering testimony from more than 750 witnesses, historians, and others, the commission concluded that forces had been moving against people of Japanese descent long before Japan attacked Pearl Harbor on December 7, 1941. Beginning in the late 1800s, a rising chorus of politicians and labor leaders was pointedly agitating against Japanese immigrants, accusing them of taking farming jobs away from Caucasian Americans.

On May 7, 1900, San Francisco Mayor James Duval Phelan had said, “Chinese and Japanese are not bona fide citizens. They are not the stuff of which American citizens can be made.”

The American Federation of Labor lobbied Congress to legally exclude all “Mongolian”

labor. An editorial in the *San Francisco Chronicle* agreed: “Our first duty is to preserve America for the Americans and the white races whom we can assimilate, and whose children will have the American standard of life.”

A pattern soon emerged, constraining the freedoms of people of Japanese ancestry. First, immigration from Japan was limited by an unwritten agreement. Japanese people were not allowed to own land in California. It became illegal for anyone with Japanese ancestry to marry a Caucasian. Then, in 1924, Congress approved an immigration ban on all Asians, including Japanese people, saying that they could not become citizens, no matter how long they lived in the United States. Only their children, if born in the U.S., could be citizens, as guaranteed by the Constitution. The nation’s leaders made it clear that Japanese people were not wanted in America.

**THE ANIMOSITY** intensified in the 1930s as Japan invaded Manchuria and then expanded into China.

By the time Japan staged its surprise attack on Pearl Harbor, shocking America into war by killing or wounding more than 3,500 people and crippling the U.S. fleet, it was like a match igniting layers of dry tinder for people of Japanese ancestry in the United States. Fury roared across America as Japan moved aggressively in the Pacific, capturing Guam, Wake Island, and Hong Kong and forcing the surrender of U.S. troops in the Philippines.

Fear that Japan could soon invade the U.S. West Coast gripped America, as did fast-spreading misinformation. Unfounded rumors circulated that people of Japanese ancestry in Hawaii had aided in the attack on Pearl Harbor.

U.S. Navy Secretary Frank Knox gave credence to the conspiracy theory as others demanded drastic action against people of Japanese ancestry. “Each of our little Japanese friends will know his part in the event of any possible attempted invasion or air raid,” Los Angeles Mayor Fletcher Bowron said. “We cannot run the risk of another Pearl Harbor episode in Southern California.”

Few, including the media, questioned whether action against people of Japanese heritage was justified or moral. Instead they joined the chorus. As the congressional commission would later put it, “The press amplified the unreflective emotional excitement of the hour.”

On February 14, 1942, the man in charge of

military security in the West, Army Gen. John L. DeWitt, recommended that people of Japanese ancestry be excluded from the West Coast as a military necessity: “In the war in which we are now engaged racial affinities are not severed by migration. The Japanese race is an enemy race and while many second and third generation Japanese born on United States soil, possessed of United States citizenship, have become ‘Americanized,’ the racial strains are undiluted.”

The Justice Department initially opposed the recommendation but ultimately went along with it, once it became clear that President Franklin D. Roosevelt would approve it. Ten weeks after the attack on Pearl Harbor, on February 19, 1942, Roosevelt signed Executive Order 9066, giving military leaders broad powers to round up and incarcerate “any or all persons.” It was well known this meant people of Japanese ancestry, including U.S. citizens. Congress moved quickly to support the order. Few politicians stood up against the tide, but one who did was Colorado Governor Ralph Carr, a Republican who considered Roosevelt’s order inhumane. At one point, faced with a large and hostile audience threatening violence, he said, “An American citizen of Japanese descent has the same rights as any other citizen,” adding, “If you harm them, you must first harm me.” It was a position that would doom a promising political career. A small group of churches also protested. Writer Pearl S. Buck and civil rights activist W.E.B. Du Bois joined in a petition against the order. But few listened.

**IN MARCH** U.S. Army soldiers started knocking on doors and posting evacuation orders in targeted neighborhoods in California, Oregon, Washington, and Arizona, using data quietly provided by the U.S. Census Bureau. People could bring only what they could carry and were forced to dispose of everything else they owned within weeks, sometimes days. Some sold all their assets to scavengers at incalculable financial losses. Others piled possessions into improvised warehouses in family garages, leased their homes, or found caretakers for their property. Many of these storehouses would be ransacked, many rents would go unpaid, and many caretakers would betray these families’ trust, selling off or abandoning their belongings. Each family was assigned a number, which was written on tags that hung from luggage and people alike and defined their new identity. The military moved so efficiently



*“We were American citizens, but the government says... ‘You are still Japanese.”*



NATIONAL ARCHIVES

"We could not trust you."

GEORGE HIRANO (LEFT, PICTURED IN 1942)

## GEORGE HIRANO

I FAMILY 12374

INCARCERATED AT SALINAS (CALIFORNIA) ASSEMBLY CENTER AND POSTON (ARIZONA) RELOCATION CENTER

**W**ith an American flag as a backdrop, a newly drafted George Hirano (left), 18, posed for a portrait with his mother, Hisa Hirano, and father, Yasubei Hirano. His mother holds a photo of her oldest son, Shigera Hirano, a U.S. Army sergeant who was serving with the 442nd Regimental Combat Team. The family was first held for three months at

the Salinas Assembly Center, a former California fairgrounds. They spent the rest of World War II incarcerated at the Poston Relocation Center. Built on an Indian reservation over the objections of tribal leaders, Poston held nearly 18,000 people at its peak. George Hirano finished Army basic training but came down with measles before he could be deployed with his company. When the war ended, he went back to Watsonville, California, where he eventually would own a farm. In 2012, at age 86, he posed again in Half Moon Bay, California, saying, "We were American citizens, but the government says, 'Regardless of nationality, you got citizenship, but you are still Japanese. We could not trust you.' It didn't make me feel good." Hirano died in 2013.



## DOROTHY HIURA

| FAMILY 0311

INCARCERATED AT SANTA ANITA (CALIFORNIA) ASSEMBLY CENTER AND JEROME (ARKANSAS) RELOCATION CENTER

In 1942, then college freshman Dorothy Takii beamed as she hung from the family car, entering the Santa Anita racetrack, a temporary detention center in California. She soon realized life there would not be the adventure she'd hoped for. Her family was sent to an incarceration camp in Jerome, Arkansas. Released from the camp in 1943, she moved to Chicago, where

she met her husband. The couple moved to San Jose, California, in the 1950s. In 2017, at 93, Dorothy Hiura posed outside her San Jose home. She never discussed the incarceration with her son and daughter. "I never felt like it was something that they needed to know," said Dorothy, who assumed they would figure it out. But they didn't. Her daughter, Barbara Hiura, would sometimes hear Dorothy talk about camp with friends. "I was like, 'Girl Scout camp? Boy Scout camp?' I had no clue," Barbara recalled. "But they wanted us to become Americans. They didn't want us to face racism or hatred of any kind." Dorothy is still pained by her parents' experience. "They lost everything—everything that they had worked hard to build and buy."



"I felt like something exciting was happening. I didn't understand."

DOROTHY HIURA





ANITA - TADANO ARRIVES FROM SAN PEDRO

that temporary “assembly centers” were set up at fairgrounds and racetracks while “relocation centers” were being built. The Santa Anita racetrack in Los Angeles was the largest assembly center, with more than 18,000 people, and one of several where people were forced to live in horse stables. Confined as a boy at Tanforan racetrack in San Bruno, Kiyoshi Katsumoto remembers walking around the stables with friends when they heard a cry. “It was muddy; it stank to high heaven,” Katsumoto recalls. “We peeked inside, and there was a woman sitting on a cot, wailing her head off. They had whitewashed the walls, but you could see the horse manure and horsehair stuck on the walls. That memory has never left my mind.”

People stayed in the assembly centers for months before they were moved, most by train, to 10 camps in remote mountains, deserts, and other inland areas. A government film produced at the time called it a “mass migration” to “pioneer communities” on desert lands “full of opportunity,” adding, “We are protecting ourselves without violating the principles of Christian decency.” The congressional commission that investigated the incarcerations later described it much differently, documenting “harsh” conditions, including “hard winters” and “unbearably hot and humid” summers in which people were forced to live in uninsulated and hastily built “tar paper barracks” that were “bleak” and “spartan,” with one room per family, in camps surrounded by “barbed-wire fences.” Military police manned watchtowers with machine guns and searchlights, and people perceived to be violating the boundaries were shot.

Though America’s decisive victory in the Battle of Midway in June 1942 diminished fears of a Japanese attack on the U.S. mainland, the camps did not close. Eventually some Japanese Americans designated as loyal were allowed to leave, but most had to stay against their will, the months turning into years. More than 5,000 babies were born in detention. Close to 2,000 people died, including Torazo Sakawye in Manzanar camp, at age 67. “He passed away, I think, more or less, of a broken heart,” his grandson Walter Yoshiharu Sakawye says, adding, “He hadn’t done anything wrong.”

Some resisted. A young man named Fred Korematsu refused to comply with the order, remaining in San Leandro, California, after the Army declared it a “military area” that was off-limits to all people of Japanese ancestry.

Korematsu was convicted of ignoring an exclusion order. He appealed his conviction all the way to the U.S. Supreme Court. Justice Frank Murphy wrote that treating those of Japanese descent differently from people of Italian or German descent whose ancestral nations also were at war with the U.S. was the “legalization of racism.” But the court voted six to three to uphold the conviction, agreeing with the government that the actions were a military necessity.

The justices didn’t know that a Navy intelligence report had found that Japanese Americans posed no military threat and showed no evidence of being disloyal, of being spies, or of signaling submarines, as the government had argued. They didn’t know, the government acknowledged in 2011, because the U.S. solicitor general during World War II had deliberately hidden the intelligence report from them.

The high court finally repudiated its 1944 decision this past June. Chief Justice John G. Roberts, Jr., wrote that forcing U.S. citizens into “concentration camps, solely and explicitly on the basis of race, is objectively unlawful and outside the scope of Presidential authority,” 13 years after Fred Korematsu had passed away. Roberts’s condemnation of the U.S. Supreme Court’s earlier decision allowing the government to imprison Japanese Americans came as the court upheld President Donald Trump’s ban.

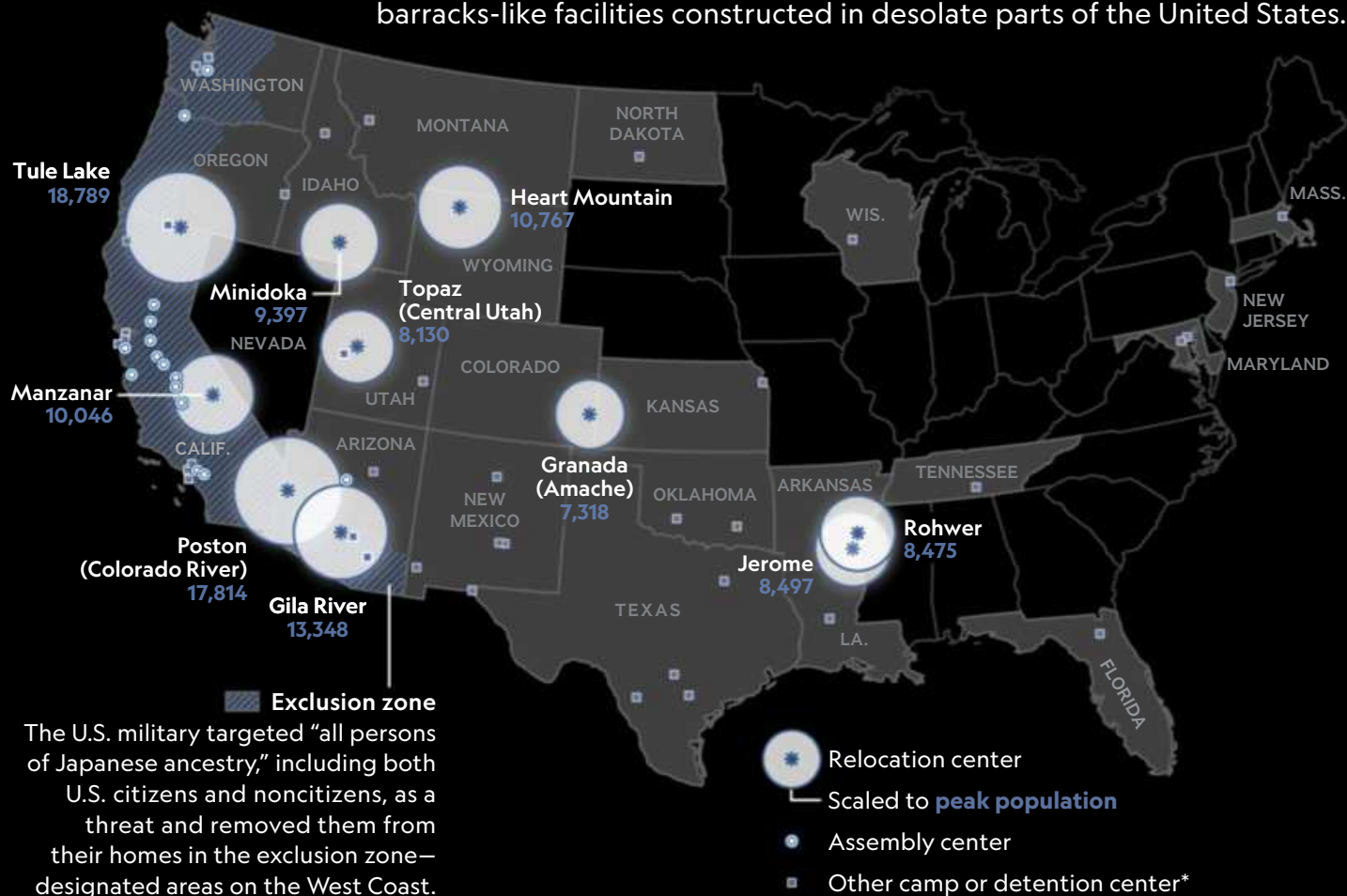
**AS AMERICA** was fighting World War II, the military realized it needed more soldiers to fight. A unit made up almost entirely of Japanese Americans, the 100th Infantry Battalion, was sent to Europe. Roosevelt asked for volunteers for a second mostly Japanese-American unit: the 442nd Regimental Combat Team. More than 10,000 Japanese Americans in Hawaii answered the call for 1,500 volunteers. In the camps, where Japanese Americans chafed at the loss of their fundamental rights as citizens, several hundred would take a stand against serving until their families were set free.

Others saw enlisting as a chance to prove their loyalty, and some 1,000 young men in the camps volunteered. As U.S. Senator Daniel Inouye, who volunteered for the 442nd from Hawaii, would recall years later in a History Channel documentary, “All of us, in addition to fighting the enemy, had a goal...to redeem our name, to uphold our honor. Failure was almost impossible. You had to succeed.”



# CIVILIANS INCARCERATED

More than 120,000 civilians of Japanese ancestry, two-thirds of whom were U.S. citizens, were forced to live in incarceration camps between 1942 and 1946. First families were uprooted and moved to temporary sites called assembly centers, where they were detained for months until being transferred to so-called relocation centers. These were more permanent, barracks-like facilities constructed in desolate parts of the United States.



Succeed they did. In seven major campaigns the 442nd suffered 9,486 casualties, including 600 killed. The unit received seven Distinguished Unit Citations and 18,143 individual decorations, including more than 3,600 Purple Hearts, becoming the most decorated combat unit for its size in U.S. history. The 100th, which became known as the Purple Heart Battalion, merged with the 442nd on June 15, 1944. The combined unit fought in key battles: first across Italy at Mount Belvedere, Luciana, and Livorno, enduring heavy casualties to cross the Arno River, and then even heavier losses while rescuing a lost battalion of 200 Texans caught behind enemy lines in the Vosges Mountains in France.

After the war, President Harry Truman greeted the 442nd in Washington, D.C. “You fought not only the enemy, but you fought prejudice—and you’ve won,” he said. But prejudice would take longer to defeat: Japanese Americans endured anger, racial slurs, and discrimination in the years to come, though no evidence was ever found of disloyalty or wrongdoing by any American of Japanese ancestry during World War II.

**AFTER THE CAMPS** began to close in 1945, the *Los Angeles Herald* ran a front-page photo of Mary Masuda and her parents, who were among the first to return home. The photo, taken on December 8, four years—to the day—after the United States declared war on Japan, shows Army Gen. Joseph Stilwell saluting Mary and her family. He also pinned a Distinguished Service Cross on Mary in honor of her brother, Staff Sgt. Kazuo Masuda, who died fighting in the 442nd Regimental Combat Team. Mary’s two other brothers, who also had served in the Army, witnessed the moment along with others, including a young actor named Ronald Reagan.

As president in 1988, Reagan would recount that ceremony before signing H.R. 442, a bill named in honor of the 442nd. It provided \$20,000 in restitution to each of the 60,000 people still alive who had been incarcerated. “No payment can make up for those lost years,” Reagan said, adding that people had been put into the camps “based solely on race,” which was “a mistake” and “a grave wrong.”

Junzo Jake Ohara, now 89, says that his father

“They would say,  
‘Oh, yeah, they’re camp friends.’  
There were never any open  
conversations about camp life.”

—TED TANISAWA (PICTURED AT FAR RIGHT)



**COUSINS  
GERRY NARUO,  
KAREN HASHIMOTO  
& TED TANISAWA**

| FAMILIES 40492, 40493,  
40419

NARUO BORN AFTER CAMPS CLOSED,  
PARENTS INCARCERATED AT GILA RIVER  
(ARIZONA); HASHIMOTO INCARCERATED  
WITH PARENTS AT GILA RIVER; TANISAWA  
BORN AFTER CAMPS CLOSED, MOTHER  
INCARCERATED AT GILA RIVER

**A** sign in front of the Masuda family grocery store in Oakland, California, photographed in 1942, proclaimed loyalty to America. But anti-Japanese sentiment was sweeping the country. Karen Hashimoto (center), whose grandfather founded the store, was three months old when she was taken to the Gila River Relocation Center. Her cousins Gerry Naruo and Ted Tanisawa were born after the camps closed. It was important for Japanese Americans to remind the world that they were Americans, even as the U.S. was incarcerating people of Japanese ancestry, including U.S. citizens. The grocery store site was redeveloped in the 1980s. In 2016 Naruo, 67, Hashimoto, 73, and Tanisawa, 70, were photographed where the store used to be. Naruo, a retired engineer, said the number of people who were held at the camps is “mind-boggling.”



never fully recovered from the struggle to rebuild his life and the shame of having been considered disloyal. “He had a mental breakdown,” Ohara says, and “would walk the long way around, so he didn’t have to see anyone he knew.”

The emotional cost of what would be called the “Japanese internment” has been underestimated, says Satsuki Ina, who was born in captivity and is now a trauma therapist specializing in the Japanese-American experience. “The public sees it as relocation. The language has been modified to look like the government took care of us. But it was an arrest. I am seeing people who were young adults when they were incarcerated who now in old age are trying to make sense of what happened,” she says.

The language used to describe the U.S. government’s forced removal of people of Japanese ancestry from their homes and into camps is still debated. “Assembly centers” were temporary detention centers where families were processed and sometimes remained for months before being sent to “relocation centers,” the incarceration camps where many families were forced to live for years.

“We gave the fancy name of ‘relocation centers’ to these dust bowls, but they were concentration camps nonetheless,” U.S. Secretary of the Interior Harold Ickes said in 1946.

The numbers placed on tags to identify detained families in the U.S. were so humiliating that many who were incarcerated are still wrestling with their emotions about it, Ina says, adding, “To become a number means to no longer be known. Many felt this loss of identity and meaning as America turned its back on us.”

Ina, who still has the tag used to identify her family, says that “significant memories are often reported of having to place the tags on their outerwear on the day they were removed from their homes.”

Ina says she had an emotional reaction recently when she learned that the U.S. government was separating children from their parents as part of Trump’s immigration crackdown. Knowing the children’s anguish, she says, “I felt I was looking at myself.” During the national debates over border policy and the Supreme Court’s recent decision to uphold the president’s travel policy, many Japanese Americans who were incarcerated and their children, including the children of Fred Korematsu, have taken a stand against the administration’s policies.

“It could happen again,” says Kiyoshi Katsunoto, who as a boy saw the woman wailing in the horse stall. Now 82, he wants future generations to know what happened.

“We, as citizens, really need to understand what this country means,” he says. “It was founded on a belief that it would welcome all people, founded on freedom and law, and that we could succeed on the merits of our hard work. You have to become knowledgeable to have a country like this. You can easily be led by demagogues.”

Among the archival black-and-white photos included in this article is one taken by Dorothea Lange, whom the government hired to document the “relocation.” She took hundreds of largely empathetic images, only to have them impounded by the military until after the war. Paul Kitagaki, Jr., whose photos also are in this article, discovered Lange’s images of his father, aunt, and grandparents in the National Archives. He then set out to track down others who had been incarcerated and now rephotographs survivors to document their resilience and courage.

“This is an American story,” he says. “What Americans did to Americans.”

**KNOWING THIS STORY**, I can better understand my own Japanese-American mother, even though she didn’t immigrate to the U.S. until after the war.

I see why she was so painfully shy about speaking English in public, why she insisted on flying the American flag in front of our house when she passed the test and became a U.S. citizen, why she rarely missed a Fourth of July parade and, unlike me, never forgot to wear red, white, and blue. She admired the ideals of America and would tell me, in her thick accent, “Anna, you, American girl. No speak Japanese. Speak English like other people.”

My mother wanted what other immigrants want: to be accepted by the people in this nation she had embraced. She rose above the periodic racial epithets she endured, believing it would get better for her and her children. I think she would wish these photos could be a reminder that Americans can look like any one of us. □

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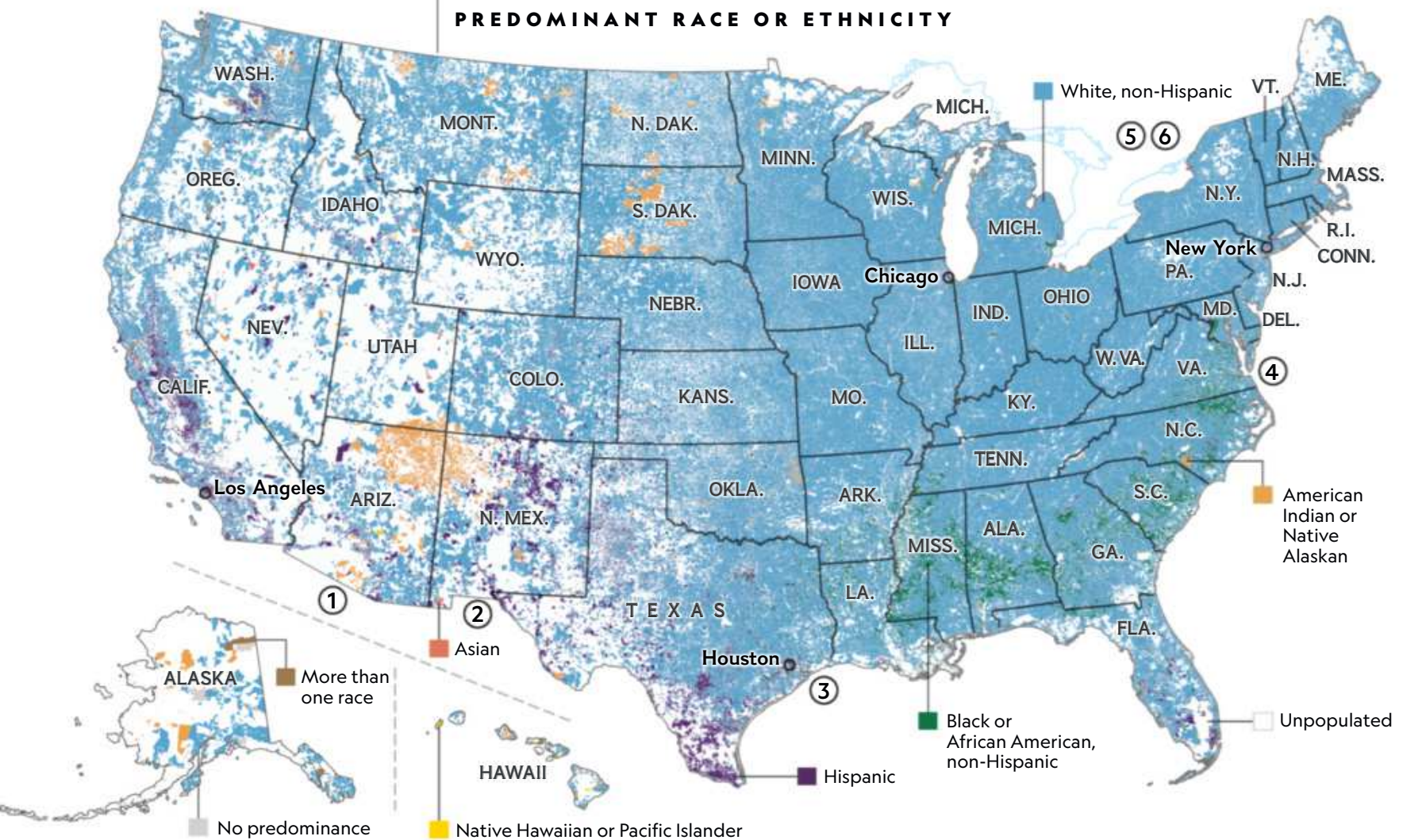
Journalist **Ann Curry** has reported from all over the world for nearly 40 years, interviewing global leaders and covering humanitarian disasters, war, and genocide. Her awards include a Simon Wiesenthal Center Medal of Valor. Since 2005, photographer **Paul Kitagaki, Jr.**, has photographed people of Japanese ancestry who were incarcerated in American internment camps.

# American Tapestry

BY  
MATTHEW W.  
CHWASTYK

**E PLURIBUS UNUM—OUT OF MANY, ONE.** The traditional motto of the United States encompasses the hope that different peoples can unite as one nation. Every 10 years, mandated by the Constitution, the U.S. Census Bureau conducts a tally to keep track of the populace. It parcels the country into some 11 million units, many as small as a city block, and endeavors to record the ethnic or racial character of the people within. Mapping this diversity reveals not just a snapshot of today but the imprint of two and a half centuries of migration, conflict, and prosperity.

## PREDOMINANT RACE OR ETHNICITY



**1 RESERVATIONS**  
About 56.2 million acres, including remnants of ancestral lands, are reserved for Native American tribes forced to move by waves of new arrivals over four centuries.

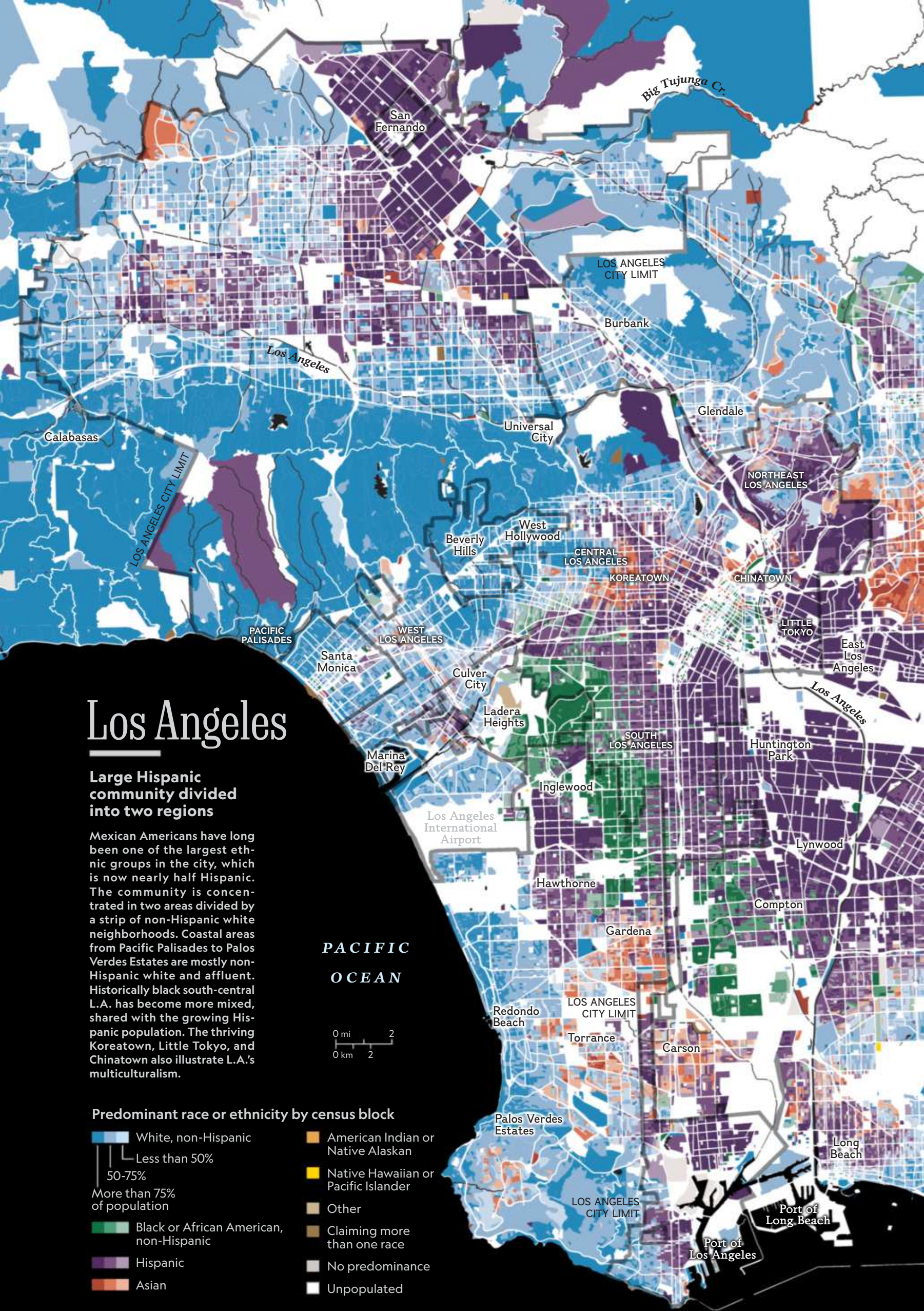
**2 OLD NEW SPAIN**  
Settled by Spain long before the U.S. was founded, New Mexico is the only part of the nation where many Hispanics report their ancestry as Spanish, not Mexican.

**3 REVOLUTIONS**  
Large numbers of immigrants fleeing the Mexican Revolution went to South Texas in the early 20th century. Florida took in Cubans after the Cuban Revolution in the 1950s.

**4 SHARECROPPING**  
Virginia had the most slaves of any state. After the Civil War, ex-slaves became sharecroppers growing cotton, sugar, and tobacco on land rented mostly from white owners.

**5 GREAT MIGRATION**  
Concentrated black populations in many cities came from the great migration that brought some 28 million blacks and whites from the South between 1910 and 1940.

**6 EUROPEANS**  
Many Europeans settled in the North or Midwest, avoiding the South, where demand for labor was low because of slavery and a weak economy after the Civil War.



# Los Angeles

## Large Hispanic community divided into two regions

Mexican Americans have long been one of the largest ethnic groups in the city, which is now nearly half Hispanic. The community is concentrated in two areas divided by a strip of non-Hispanic white neighborhoods. Coastal areas from Pacific Palisades to Palos Verdes Estates are mostly non-Hispanic white and affluent. Historically black south-central L.A. has become more mixed, shared with the growing Hispanic population. The thriving Koreatown, Little Tokyo, and Chinatown also illustrate L.A.'s multiculturalism.

### PACIFIC OCEAN

0 mi 2  
0 km 2

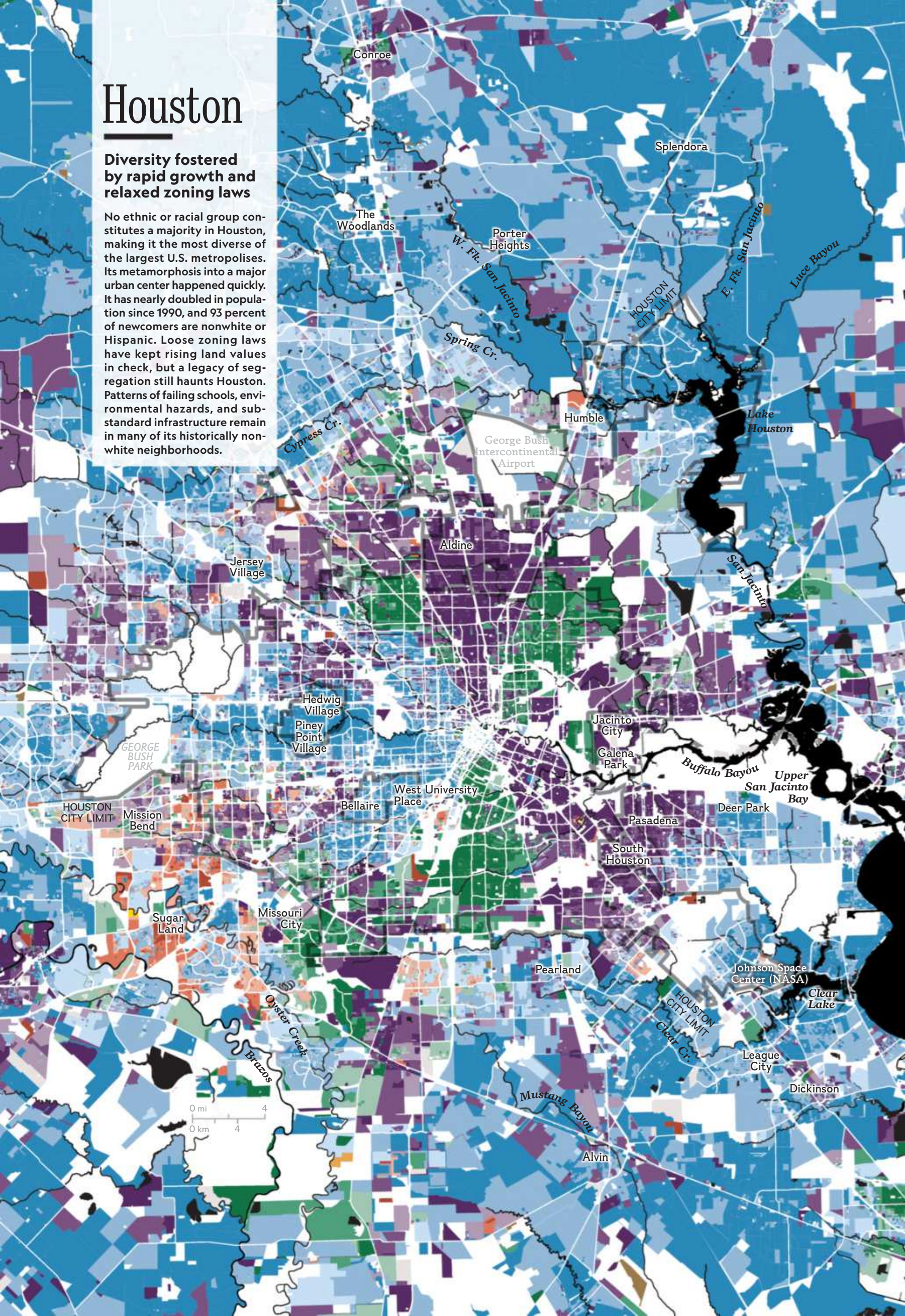
#### Predominant race or ethnicity by census block

- |   |                                     |
|---|-------------------------------------|
| White, non-Hispanic                     | American Indian or Native Alaskan   |
| Less than 50%                           | Native Hawaiian or Pacific Islander |
| 50-75%                                  | Other                               |
| More than 75% of population             | Claiming more than one race         |
| Black or African American, non-Hispanic | No predominance                     |
| Hispanic                                | Unpopulated                         |
| Asian                                   |                                     |

# Houston

## Diversity fostered by rapid growth and relaxed zoning laws

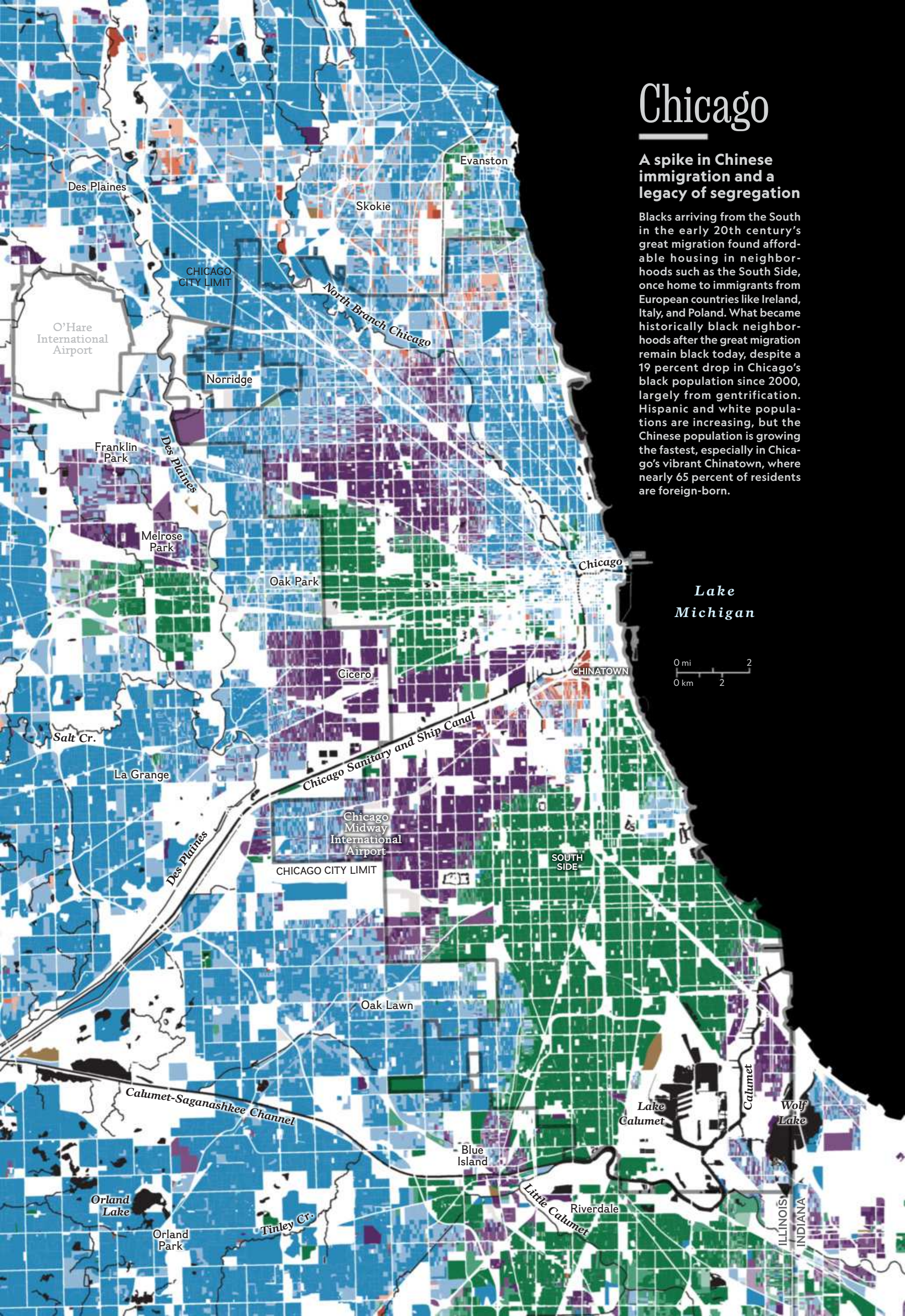
No ethnic or racial group constitutes a majority in Houston, making it the most diverse of the largest U.S. metropolises. Its metamorphosis into a major urban center happened quickly. It has nearly doubled in population since 1990, and 93 percent of newcomers are nonwhite or Hispanic. Loose zoning laws have kept rising land values in check, but a legacy of segregation still haunts Houston. Patterns of failing schools, environmental hazards, and substandard infrastructure remain in many of its historically non-white neighborhoods.



# Chicago

## A spike in Chinese immigration and a legacy of segregation

Blacks arriving from the South in the early 20th century's great migration found affordable housing in neighborhoods such as the South Side, once home to immigrants from European countries like Ireland, Italy, and Poland. What became historically black neighborhoods after the great migration remain black today, despite a 19 percent drop in Chicago's black population since 2000, largely from gentrification. Hispanic and white populations are increasing, but the Chinese population is growing the fastest, especially in Chicago's vibrant Chinatown, where nearly 65 percent of residents are foreign-born.



Lake Michigan

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0 km 2

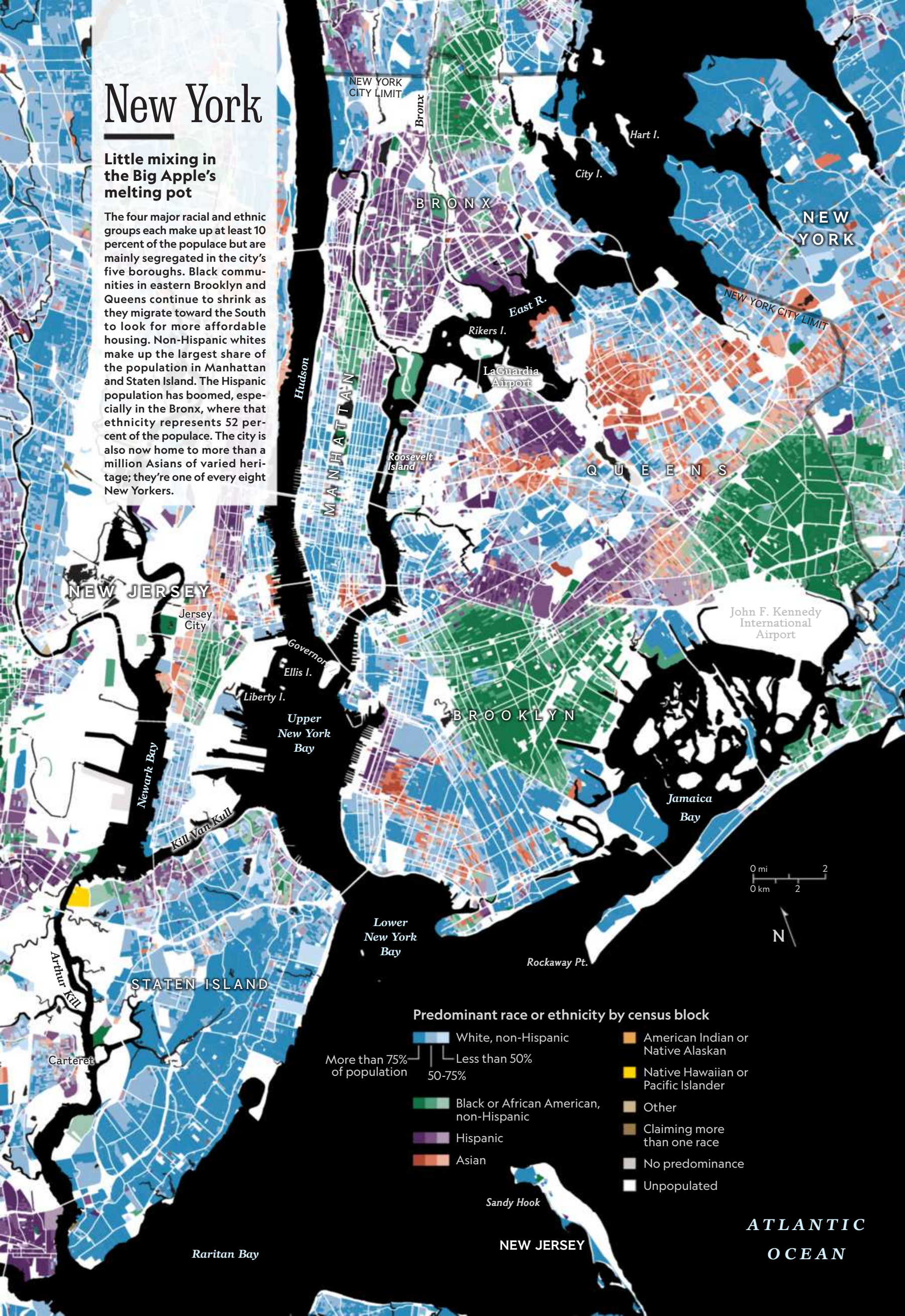
ILLINOIS  
INDIANA



# New York

## Little mixing in the Big Apple's melting pot

The four major racial and ethnic groups each make up at least 10 percent of the populace but are mainly segregated in the city's five boroughs. Black communities in eastern Brooklyn and Queens continue to shrink as they migrate toward the South to look for more affordable housing. Non-Hispanic whites make up the largest share of the population in Manhattan and Staten Island. The Hispanic population has boomed, especially in the Bronx, where that ethnicity represents 52 percent of the populace. The city is also now home to more than a million Asians of varied heritage; they're one of every eight New Yorkers.



### Predominant race or ethnicity by census block

- |   |                             |   |                                     |
|---|-----------------------------|---|-------------------------------------|
|  | White, non-Hispanic         |  | American Indian or Native Alaskan   |
|  | More than 75% of population |  | Native Hawaiian or Pacific Islander |
|  | Less than 50%               |  | Other                               |
|  | 50-75%                      |  | Claiming more than one race         |
|  |                             |  | No predominance                     |
|  |                             |  | Unpopulated                         |

ATLANTIC  
OCEAN



YOUR SHOT

## BUI QUOC KY KYNHONG

PHOTOS FROM OUR COMMUNITY

**WHO**

Bui Quoc Ky Kynhong, 41, an artist and photographer in Vietnam

**WHERE**

Vietnam's Moc Chau tea-growing region

**WHAT**

A Phantom 4 Pro drone with focal length 8.8mm

In the famous tea-growing region of northwestern Vietnam, workers harvest green tea in the spring and summer. Bui, who was visiting the area, flew a drone overhead to capture the pickers at work. The leaves they gathered would be shipped to markets around the world. He arrived early each morning in search of the best compositions. But he often had to wait until afternoon—and work around the pickers' rest breaks—to catch the light just as he wanted it.

Join National Geographic's Your Shot community and share your photos at [YourShot.ngm.com](https://YourShot.ngm.com).



**TODAY SHE GOT HER FIRST PAIR OF GLASSES.  
AND A GLIMPSE AT A BRIGHTER FUTURE.**

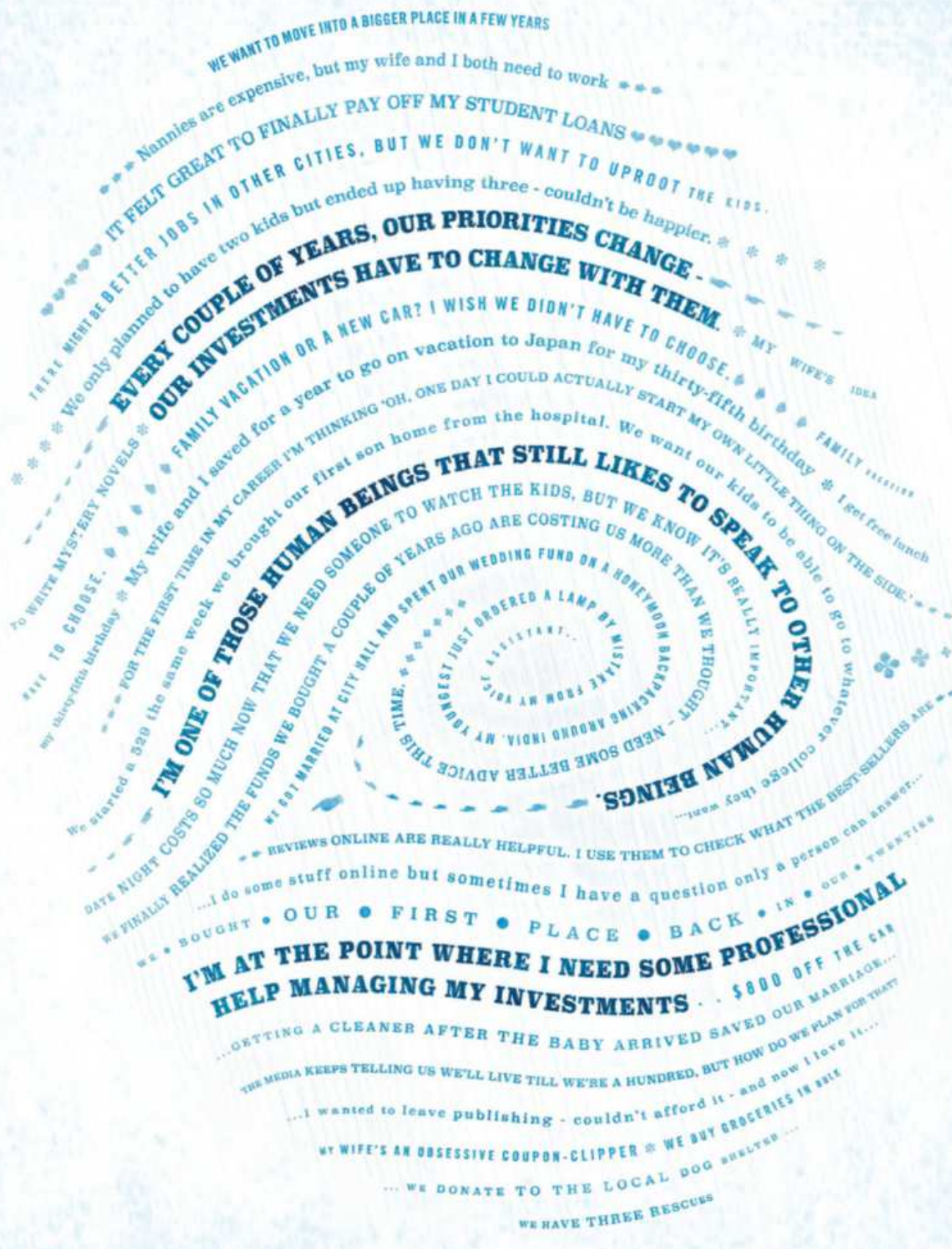
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Photo by Alexandra Reynolds



**OneSight**



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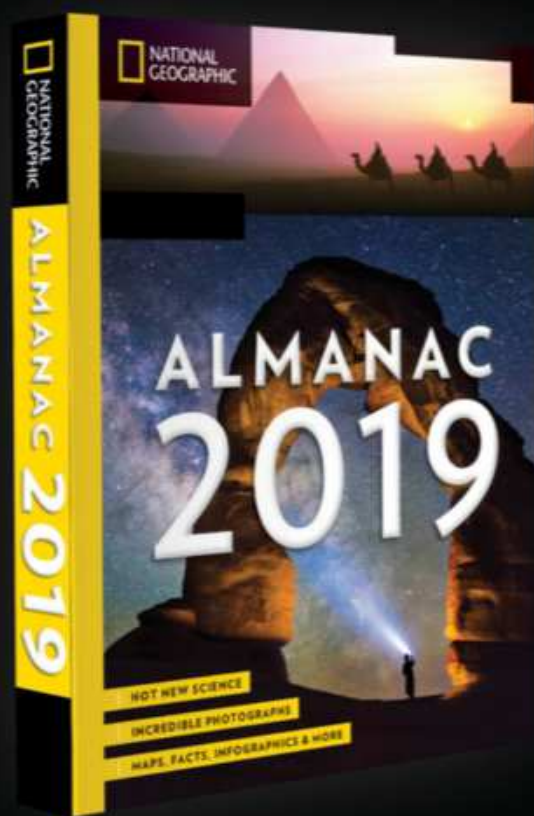
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DISCOVER OUR  
NEW ANNUAL!



## YOUR ULTIMATE GUIDE TO OUR MAGNIFICENT PLANET

Combining the latest trending topics with evergreen information, *National Geographic Almanac 2019* is the ultimate guide to our planet, bursting with facts and illustrations that will awe, inform, and inspire.



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