

NGM.COM | AUGUST 2010

# NATIONAL GEOGRAPHIC

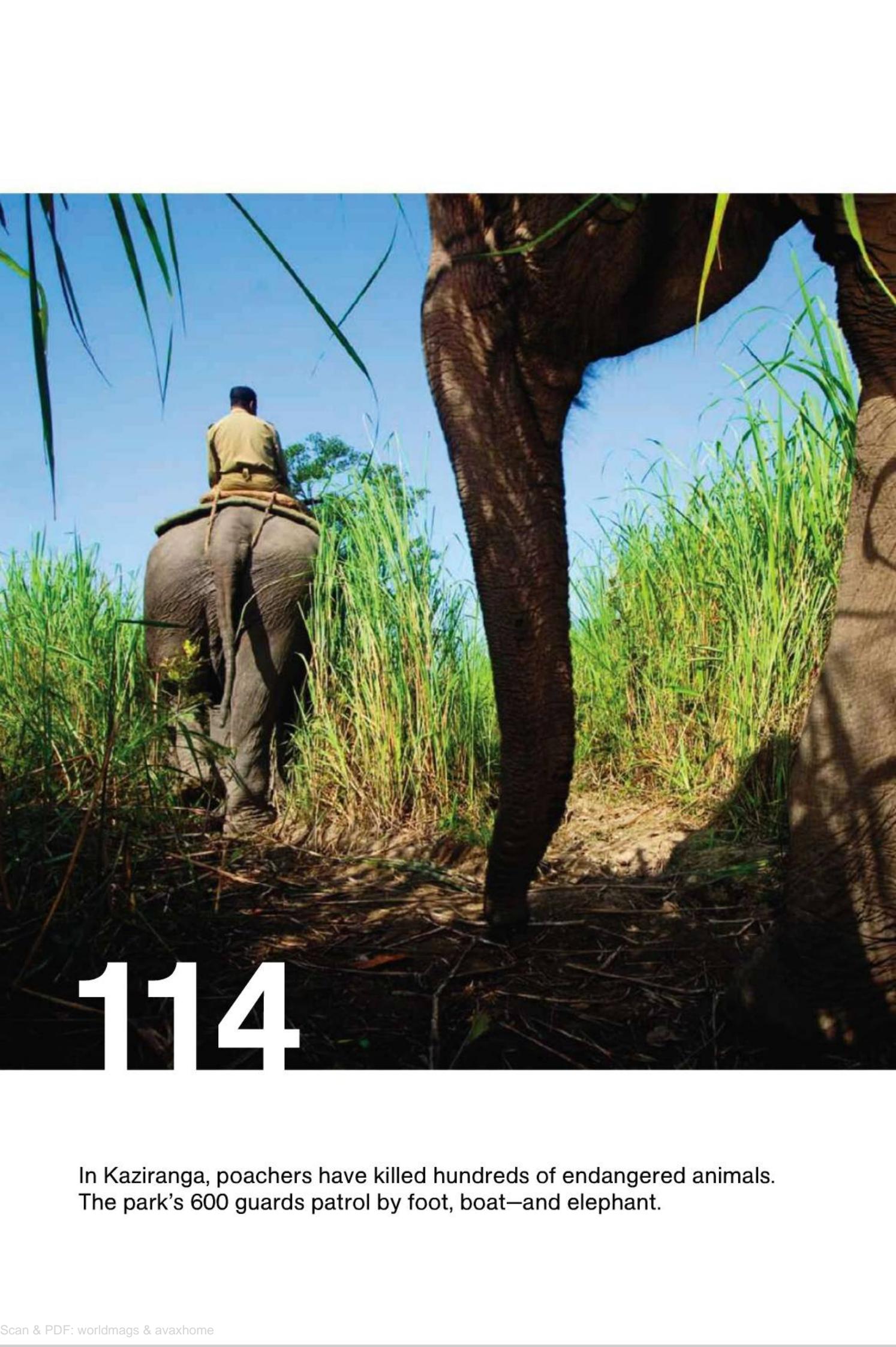
# Bahamas Blue Holes

DIVE INTO BEAUTY, DANGER, AND DISCOVERY

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# NATIONAL GEOGRAPHIC

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STEVE WINTER

OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY

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*Photo by Wes C. Skiles*

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PHOTO: WES C. SKILES

Wes Skiles took this photo of veteran diver Kenny Broad as they began their descent into the hydrogen sulfide zone of a Bahamas blue hole.

## Photographer Wes Skiles descends

through 30 feet of fresh water and encounters a pink, murky haze. The color indicates the presence of hydrogen sulfide gas—produced by decaying organic material in environments where oxygen is scarce—and it's dangerous. Skiles has little time to traverse this 20-foot-thick, toxic layer. The longer he lingers in this sulfurous hell, the more the risk. His head will begin to throb. He'll get a tingling sensation in his lips. He'll feel nauseous from oxygen deprivation. He must reach the saltwater layer below before he collapses. Skiles, writer Andrew Todhunter, and a team led by Kenny Broad, an anthropologist and veteran cave diver, are on a National Geographic–funded expedition to explore the flooded limestone caves of the Bahamas. These blue holes, the subject of this month's cover story, are an environment like no other. Their dangers are also like no other. Many caves produce violent whirlpools that can rip off a face mask and suddenly suck a diver down hundreds of feet. The risk is worth it.

To study blue holes is to deepen our understanding of the Earth's biology, chemistry, and geology. Some of the caves, Todhunter writes, are the scientific equivalent of Tut's tomb. "It's true exploration," Skiles says. Explorers, like Broad's team of scientists and divers, open doors. They lift the curtain on hidden, sometimes dangerous, worlds. That's their nature, and our world is richer for it.

A handwritten signature in black ink, appearing to read "Andrew Todhunter".

## LETTERS

### The Water Issue

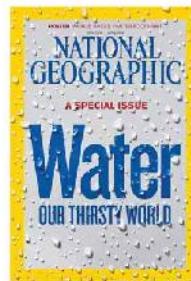
I wanted to share my thoughts on your water issue. Most articles talk of technology to improve what we have so it will continually support life on the planet. The one major issue that is always tap-danced around is our exponentially growing population. I believe the planet has sufficient resources to support humans, as long as population growth is managed in a way so that we don't eat, drink, burn, and trash our way into oblivion. We have to take steps to make sure we don't use up all the planet can provide.

**WES WHEADON**  
Los Angeles, California

I did not notice any mention of the big industrial water users. I wonder if they are paying their fair share of the value of water? I used to be in charge of the water required by a pulp mill on Vancouver Island in Canada. The daily usage was 60 million gallons. This was more than was required by the capital of British Columbia, also on Vancouver Island. I have recently studied the tar sands in northern Alberta. Industry there takes on average three barrels of fresh water for every barrel of oil extracted. And they want to extract oil from shale: more water requirements?

**J. G. HANS DUERICHEN**  
Smithers, British Columbia

*(Click Text button to read more.)*



April 2010

Some 70 percent of our planet's surface is water. How can we be running out? It irks me to hear the incessant whine of Californians lamenting shortages of water when an endless supply is at their doorstep.

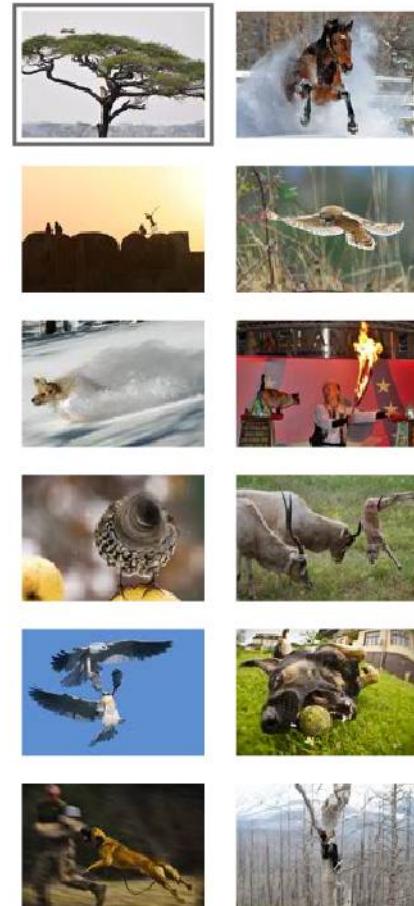
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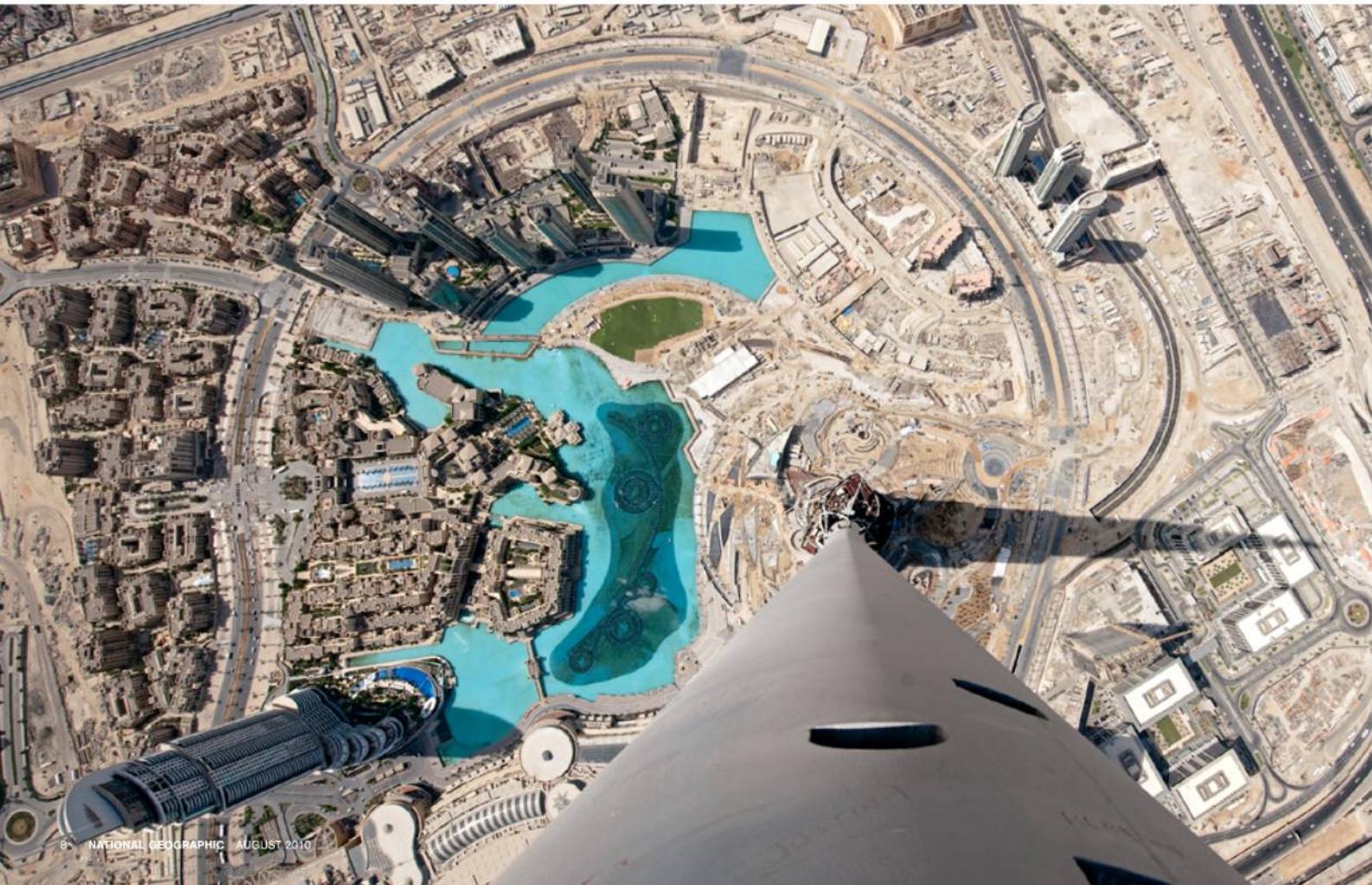
**EDITORS' CHOICE** Brenda Rusnak Toronto, Ontario

On safari in Tanzania's Serengeti National Park, Rusnak, 50, captured a scene her guide said he'd never seen in 25 years: a treebound leopard leaping far away from a lion. The bigger cat had climbed up to take away the smaller one's freshly killed prey.



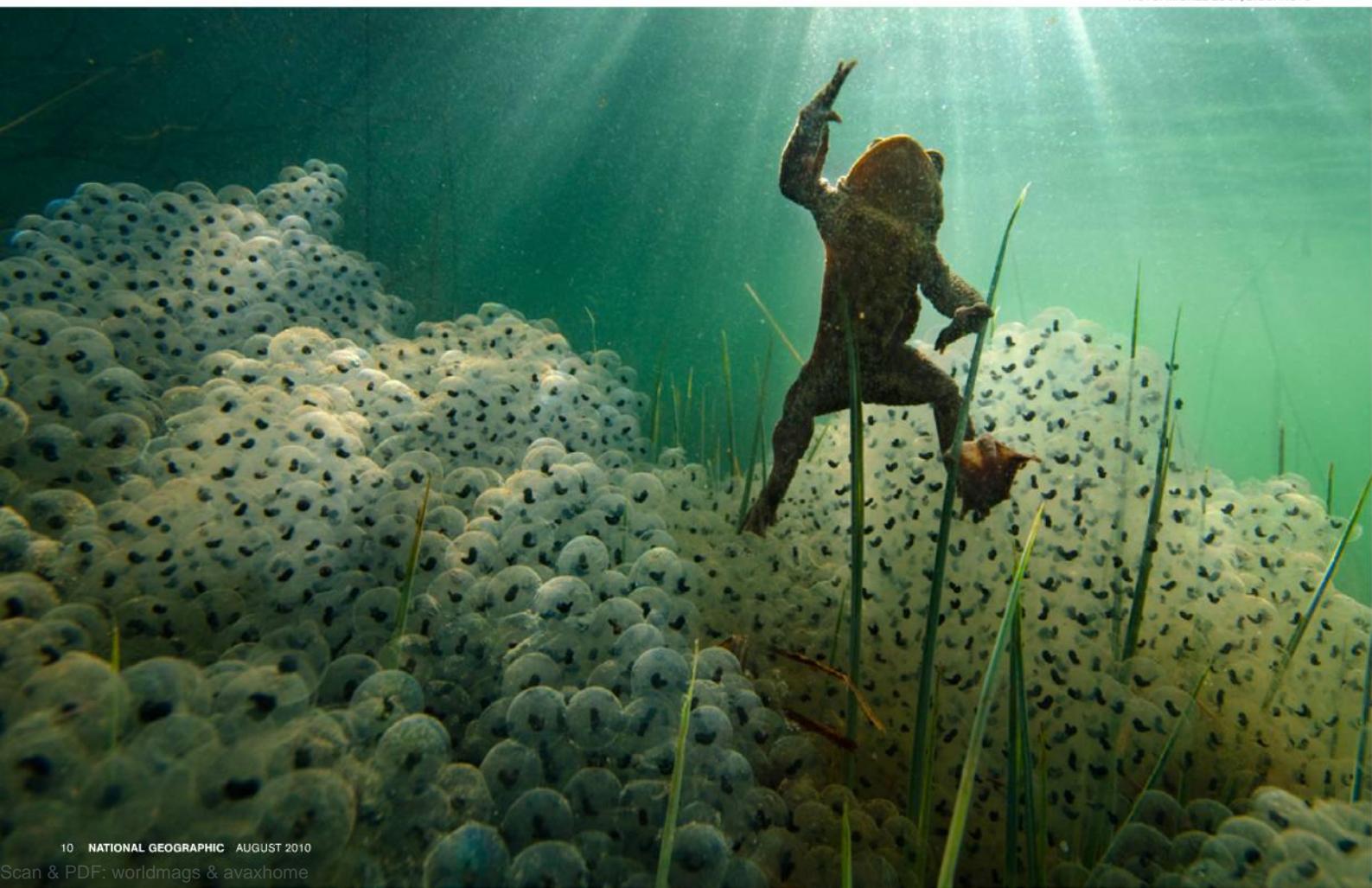
**United Arab Emirates** Atop the world's tallest building—the 164-story, 2,717-foot Burj Khalifa—an economic history of Dubai is visible. Development reflects the recent boom; open spaces are remnants of an earlier era.

PHOTO: SAMAR JODHA



**France** Late afternoon finds the shallows of Lac de la Motte awash in amphibian life. As a mature common toad ascends to the sunlit surface, a clutch of frog eggs—set to hatch in a few days—piles the reed-lined bottom.

PHOTO: MICHEL LOUP, BIOSPHOTO



**Afghanistan** In a private shop in Kandahar, where images of modern beauty adorn the walls, a seated woman primpers for a Persian New Year party. In public she will honor custom and veil her makeup beneath a burka.

**Order prints of National Geographic photos at [PrintsNGS.com](http://PrintsNGS.com).**

PHOTO: PAULA LERNER, AURORA PHOTOS



## New Beasts in the East

Hiking in a Nova Scotia park last fall, a young woman was killed by two canids. They were bigger than coyotes and smaller than wolves, with skulls and jaws unlike either species'. Some eastern Canadians and Americans had glimpsed "coywolves" before, but the grisly incident conjured



fresh questions. What exactly are they? And should we be worried?

Roland Kays of New York State Museum can answer the first one. In the 1920s,

he says, coyotes from the west pushed into the Great Lakes region and mated with wolves from the east. The result wasn't a new species but, according to recent DNA analysis, a hybrid that's more coyote than wolf, with the street smarts of the former and the hunting capabilities of the latter. No one knows their current numbers, but eastern coyotes (the favored term) form families, seek food at night, and can prey on pets and livestock—the main reason for their recent run-ins with humans.

As for worrying, Cape Cod wildlife specialist Peter Trull says there's no need to; the Nova Scotia case was an anomaly. "Coyotes are wild animals, and people have been bitten by them," he says. "But generally they avoid humans." —*Jeremy Berlin*



Western coyote



Eastern coyote (hybrid)

Wolf genes give eastern coyotes bigger skulls and wider jaws—capable of taking down prey like deer—than their western predecessors. Adult eastern coyotes, like this one snapped by a camera trap in upstate New York (far left), weigh 32 to 44 pounds.

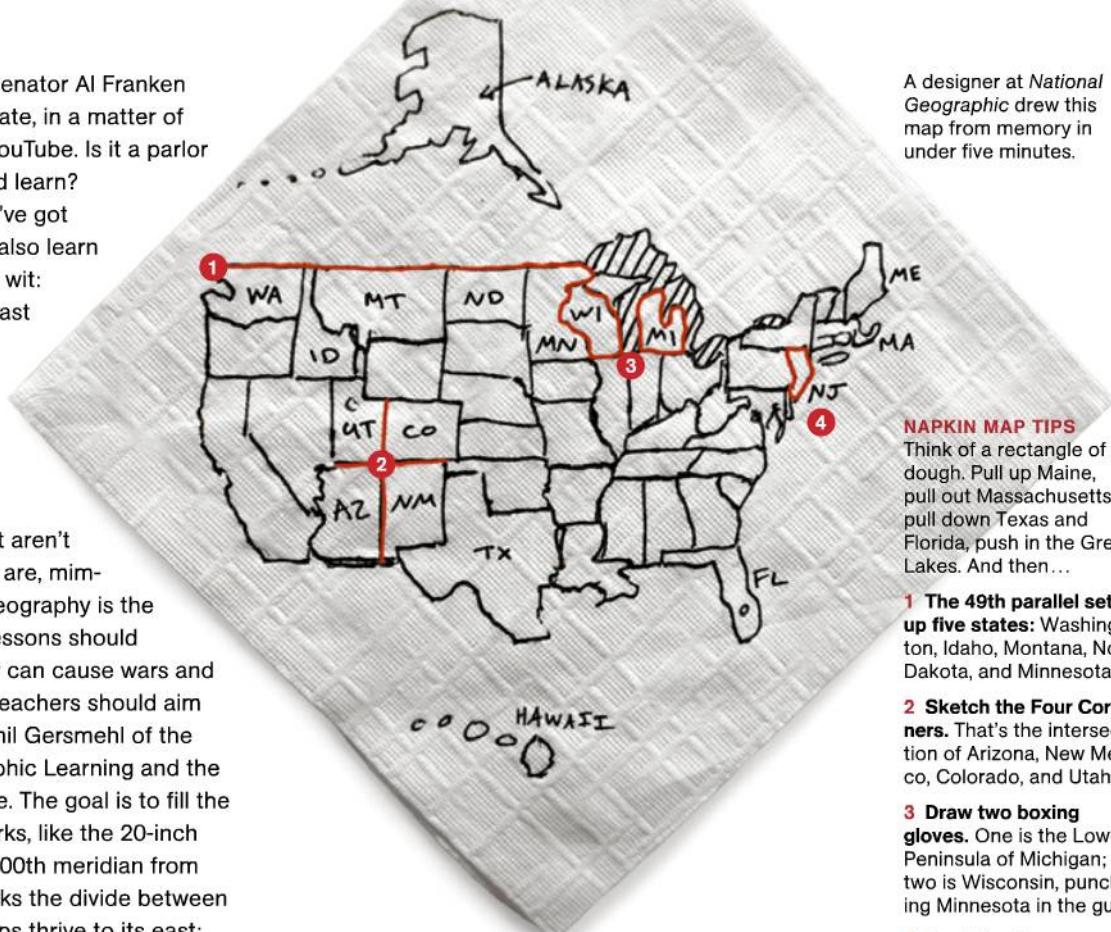
PHOTOS: NEW YORK STATE MUSEUM, ALBANY. NGM MAPS. SOURCES: ROLAND KAYS, NEW YORK STATE MUSEUM; BRADLEY N. WHITE, TRENT UNIVERSITY, ONTARIO

## GEOGRAPHY

**Ready, Set...Map** Senator Al Franken can draw the U.S., state by state, in a matter of minutes—check him out on YouTube. Is it a parlor trick or a skill students should learn?

It's a bit of both. Sure, you've got to memorize trivia. But you'll also learn a lot of useful information. To wit: "Texas has Louisiana to the east and goes all the way to New Mexico and is huge," says Paul Blank, chair of the geography department at California's Humboldt State University.

Then again, some kids just aren't good at drawing. Even if they are, mimicking maps isn't enough. "Geography is the why of where," says Blank. Lessons should help kids see how geography can cause wars and shape cultures. To that end, teachers should aim to build mental maps, says Phil Gersmehl of the New York Center for Geographic Learning and the Michigan Geographic Alliance. The goal is to fill the brain with instructive landmarks, like the 20-inch rainfall line. Heading up the 100th meridian from Texas to North Dakota, it marks the divide between wet and semiarid climates. Crops thrive to its east; people grow scarce to its west. —Marc Silver



A designer at *National Geographic* drew this map from memory in under five minutes.

### NAPKIN MAP TIPS

Think of a rectangle of dough. Pull up Maine, pull out Massachusetts, pull down Texas and Florida, push in the Great Lakes. And then...

**1 The 49th parallel sets up five states:** Washington, Idaho, Montana, North Dakota, and Minnesota.

**2 Sketch the Four Corners.** That's the intersection of Arizona, New Mexico, Colorado, and Utah.

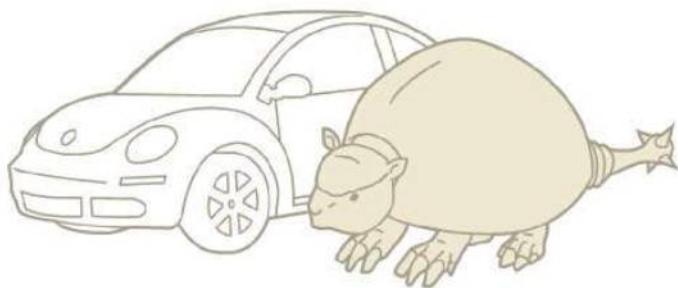
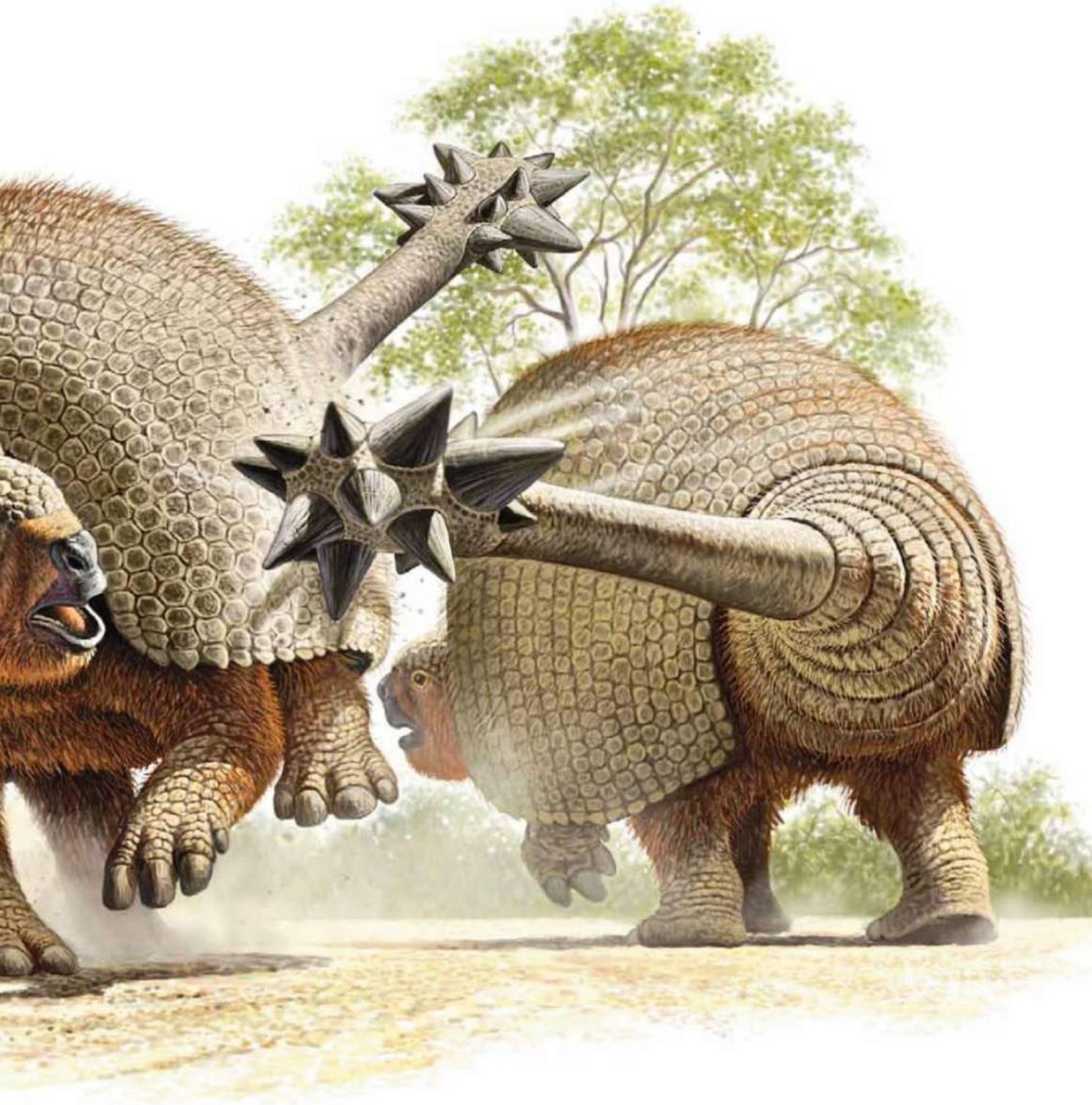
**3 Draw two boxing gloves.** One is the Lower Peninsula of Michigan; two is Wisconsin, punching Minnesota in the gut.

**4 Look for shapes.** New Jersey? A peanut.

**Hard Hit** Every batter and tennis pro knows the best *thwack* comes when the ball hits the equipment's sweet spot. Turns out glyptodonts, giant armored mammals that lived from about 30 million to 10,000 years ago, were using that center of percussion, as the spot is known, to strike hard blows with their battle-ready tails.

Fossil evidence tells us that some of the largest of these armadillo kin wielded spiked clubs weighing up to 140 pounds, joined to the body by a series of bony rings. Now biomechanical studies by Uruguayan scientist R. Ernesto Blanco and colleagues suggest that glyptodont fights didn't involve random swinging of arms. While smaller species had mobile tails for quick swipes at predators like carnivorous birds, the largest ones had stiffer tails with a sweet spot at or near their prime spike. This morphology allowed the beasts to nail foes while minimizing harmful vibrations to the body joint from the force of impact. The big guys could afford this adaptation, which limited the tail's speed and range of motion but, Blanco theorizes, offered a particular advantage during slow, ritualized courtship battles over favored females. How sweet is that? —Jennifer S. Holland



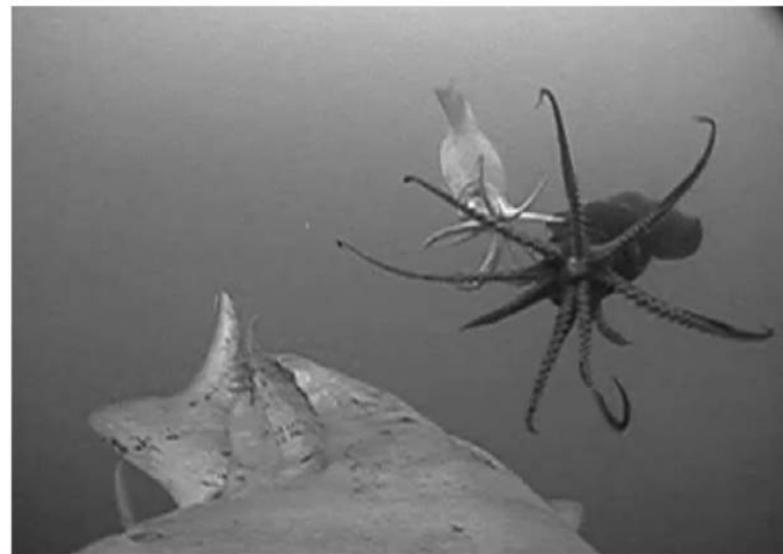


The tail's sweet spot minimized joint injuries from the impact of blows. At up to two tons, the largest glyptodonts weighed more than a Volkswagen Beetle.

ART: RAÚL MARTÍN

**Squid on the Fly** The millions of Humboldt squid, aka jumbo flying squid, live "fast and furious" lives, says NOAA Fisheries oceanographer Ken Baltz. "They hunt and eat and hunt and eat" for a year or two, then expire. Their diet is mainly fish, an occasional floating seabird—and sometimes each other. Once in a great while they "fly" by ejecting themselves from the water. Given that a squid's body plus tentacles can run six feet and top the scales at 80 pounds, that's quite a feat. Flight might be a way to evade predators, although scientists don't know exactly why squids soar. Nor do they understand why the squid can quickly change from red to pink to maroon: maybe to confuse prey, maybe to signal each other.

Now this warm-water denizen is in the news because of an unexpected incursion into the northern Pacific. Its big appetite will surely affect the ecosystem. If salmon are also on the menu, adds William Gilly, a biologist at Hopkins Marine Station of Stanford University, Northwest fisheries will suffer. But he doesn't buy reports of summer 2009 attacks on San Diego scuba divers. A squid might nudge with a toothed appendage to assess edibility, he says. "They're smart and curious and really tactile." Anyone in a wet suit would be deemed unfit for cephalopod consumption. —Marc Silver



Wearing a Crittercam that later detached, a Humboldt squid, 140 feet down in the Gulf of California, films its cohorts. Warming oceans could be causing this ace predator, which thrives in tropical waters, to head as far north as Alaska.

**Hark the Round Ark** “Make thee an ark,” the Lord told Noah in the Book of Genesis, and forever after the ark has been pictured as an animal-filled boat with a conventional prow and stern. Now a recently translated Babylonian tablet (above), related to the *Epic of Gilgamesh*, floats an intriguing alternative in which the archetypal ark was round and made of pitch-covered reeds, much like a coracle, a craft still used today on the Euphrates and Tigris Rivers.

“The ark wasn’t going anywhere,” explains Irving Finkel, assistant keeper of cuneiform at the British Museum, who did the translation. “It simply had to bob along the surface until the waters went down.” The author of the 4,000-year-old clay tablet might have glanced out his window at the vessels on the river and adapted the detail to his story.

Flood myths appear in many cultures, and this one had circulated for eons before it was incorporated into the Bible. Finkel thinks the Babylonian version may have been a precursor to the familiar Hebraic one. While the shape of the ark may vary according to the teller, a basic narrative thread holds: Man was flawed. Revision was required. Best to wipe the slate clean and start again. —Cathy Newman

**"Atram-Hasis, pay  
heed to my advice, that  
you may live forever!"**

**... Draw out the boat  
that you will build  
with a circular design;  
let its length and  
breadth be the same."**

—ENKI, A BABYLONIAN GOD

A Babylonian text  
has specs for a  
round ark meant to  
ride out the Flood.



PHOTO: ROLF MARRIOTT

# Scrubbing the Skies

Pulling CO<sub>2</sub> back out of the air might be easier than building jets and cars that don't emit it.

Every time you drive to work, or worse yet, fly on a plane, the vehicle emits carbon dioxide that will stay in the atmosphere, warming the planet for thousands of years. Does it have to? Trees can take CO<sub>2</sub> back out again—but even covering the planet with forests wouldn't solve our problem, and there would be an awful lot of wood to preserve. (If allowed to rot or burn, trees release their carbon again.) Physicist Klaus Lackner thinks he has a better idea: Suck CO<sub>2</sub> out of the air with “artificial trees” that operate a thousand times faster than real ones.

They don't exist yet, and when they do, they probably won't look like real trees. But in Lackner's lab at Columbia University he and colleague Allen Wright are experimenting with bits of whitish-beige plastic that you might call artificial leaves. The plastic is a resin of the kind used to pull calcium out of water in a water softener. When Lackner and Wright impregnate that resin with sodium carbonate, it pulls carbon dioxide out of the air. The extra carbon converts the sodium carbonate to bicarbonate, or baking soda. *(Click Text button to read more.)*

## THE CO<sub>2</sub> SITUATION

Roughly a third of carbon dioxide emissions come from cars, planes, and other vehicles. Scientists are developing scrubbers to capture colorless CO<sub>2</sub> from the outside air.

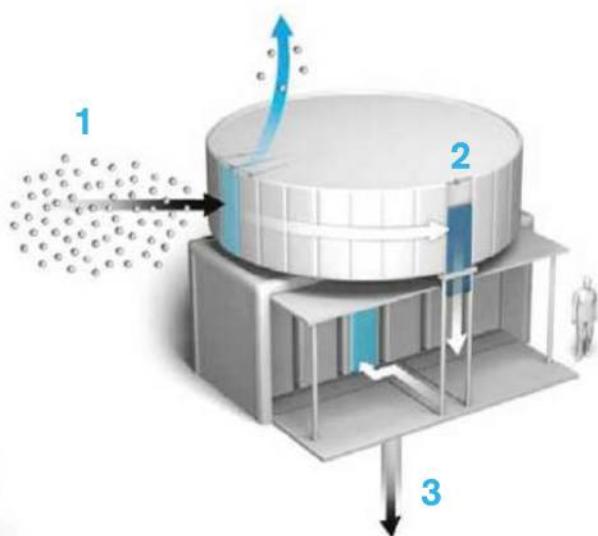
## THE SOLUTION

In physicist Klaus Lackner's plan, a single scrubber, small enough to fit in a shipping container, could capture a ton of CO<sub>2</sub> a day—the output of 75 average U.S. cars. CO<sub>2</sub> spreads quickly, so scrubbing it out anywhere benefits everyone.



Text

## THE BIG IDEA | CONTINUED

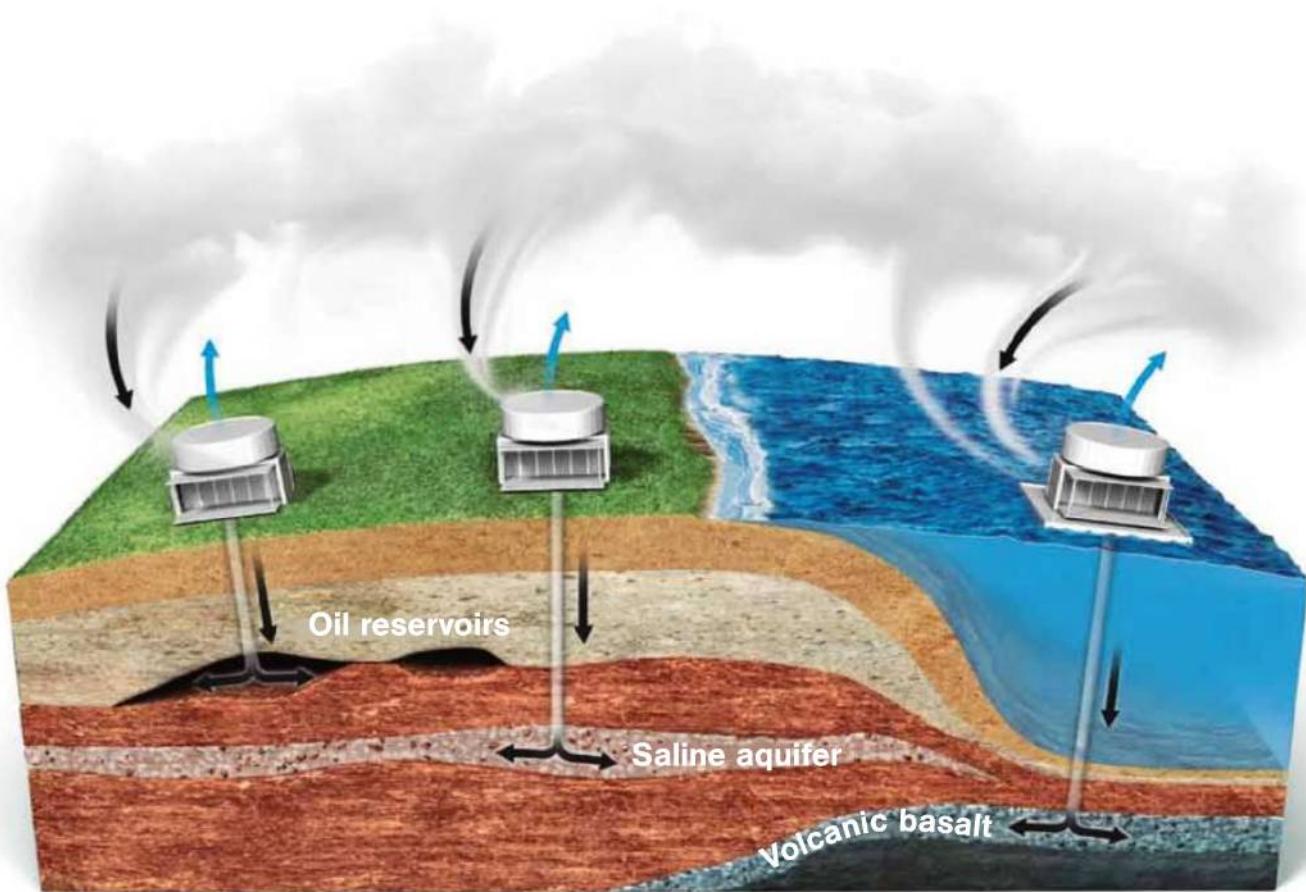


### HOW IT WORKS

**1** Wind blows air through a carousel's plastic filters, which are laced with an absorbing agent that extracts CO<sub>2</sub>. When the air reemerges, it contains less CO<sub>2</sub>.

**2** As filters become saturated, they are lowered into vacuum chambers and rinsed with water vapor, which removes the lightly bound CO<sub>2</sub> from the filters.

**3** The filters return to the carousel. The CO<sub>2</sub> is separated from the water, compressed to a liquid, and pumped underground (top right).



**Where the Carbon Goes** Government studies suggest there is room underground for many decades' worth of CO<sub>2</sub>—though the idea has not been tested on the massive scale required.

#### OIL RESERVOIRS

Captured CO<sub>2</sub> could be used to flush oil out of old reservoirs; oil companies today buy CO<sub>2</sub> for that. But such cavities could store only a small fraction of our CO<sub>2</sub> emissions.

#### SALINE AQUIFERS

Briny aquifers a half mile down or more, widely distributed on all continents, might store vast amounts of CO<sub>2</sub>. The pressure at those depths would keep it liquid and unlikely to escape.

#### DEEP OCEAN BASALT

Injecting liquefied CO<sub>2</sub> into volcanic basalt, which under-lies all oceans and some areas on land, might secure it permanently as an inert carbonate mineral. The idea is being tested in Iceland.

ART (ABOVE): JOE ZEFF DESIGN. SOURCE: DAVID GOLDBERG, LAMONT-DOHERTY EARTH OBSERVATORY, COLUMBIA UNIVERSITY

# Deep Dark Secrets

The blue holes of the Bahamas yield a scientific trove that may even shed light on life beyond Earth. If only they weren't so dangerous to explore.

PANORAMA COMPOSED OF THREE IMAGES.  
TO SEE FULL PICTURE, SCROLL OVER TO THE NEXT PAGE.



The Cascade Room, some 80 feet beneath the surface, leads divers deeper into Dan's Cave on Abaco Island. Nearly seven miles of the cave have been explored since the mid-1990s.





Bacteria color the water at a depth of 30 to 36 feet in Sawmill Sink on Abaco. Here and in a colorless layer below, poisonous hydrogen sulfide gas is present. Divers move through it with all deliberate speed.



In Sawmill Sink, expedition leader and anthropologist Kenny Broad descends through the bacterial layer on an exploratory dive.





Veteran cave diver Brian Kakuk lifts a more than 3,000-year-old Cuban crocodile skull—an animal no longer found in the Bahamas—from sediment in Sawmill Sink. Nearly oxygen free, blue holes preserve bones intact.

BY ANDREW TODHUNTER

PHOTOGRAPHS BY WES C. SKILES

**W**E SINK INTO STARGATE, sweeping the void with our dive lights. Fifty feet from the surface looms a pale haze, less smoky than fibrous, like a silvery net of faint, swirling cobwebs hovering motionless in the darkness. It's a layer of hydrogen sulfide, a toxic gas created by bacterial colonies and decaying organic matter. Divers entering the gas may experience itching skin, tingling, or dizziness; some smell rotten eggs as it penetrates their skin and metabolizes through their lungs. The gas density in Stargate is relatively low, but I'm struck by a wave of nausea as we descend. I glance at my guide, Brian Kakuk—one of the world's foremost cave divers. He appears unfazed. My head begins to throb; clearly, I'm unusually sensitive to the toxin. In the epic poem *Beowulf*, "dim serpent shapes" in the depths guard the lake of Grendel and his mother, shielding their lair. The otherworldly mist in Stargate appears to serve a similar role—a poisonous curtain that *(Click Text button to read more.)*

In Stargate, a blue hole on Andros Island, divers illuminate North Passage.



Andrew Todhunter's latest book is the award-winning *A Meal Observed*. Explorer Wes Skiles is a pioneer in underwater cave photography.

Text

# Blue Holes of the Bahamas





"All of a sudden, it's got you," says photographer Wes Skiles of the "insanely dangerous" vortex in Chimney Blue Hole (left) off Grand Bahama. Like a giant bathtub drain, it sucks down millions of gallons when the tide comes in. "It's like going over a waterfall—there's no escape." Keeping his distance, a diver sets up equipment to measure the whirlpool's flow rate. From a protected cove on Long Island, Dean's Blue Hole (above)—Earth's deepest known underwater cave—plunges more than 600 feet into darkness.

# As living laboratories, blue holes are tomb. From a diver's perspective, t



In lightless blue holes, animals like this inch-long *Agostocaris* cave shrimp don't need surface pigmentation. Only part of the shrimp's digestive system has color.

e the scientific equivalent of Tut's  
hey're on par with Everest or K2.



The remipede is a “living fossil” nearly unchanged for 300 million years. It kills its prey, primarily other crustaceans such as cave shrimps, with venom-injecting fangs.



Archaeologist Michael Pateman lifts a centuries-old Lucayan Indian skull from a gridded site 110 feet down in Sanctuary Blue Hole on Andros Island.





Brian Kakuk has an arsenal of offbeat tools for gathering samples. His turkey baster (above) collects red dust blown from the Sahara in ancient times, and the inflatable lift bag brings a stalagmite to the surface to be studied for evidence of abrupt climate changes in the past.

■ **Society Grant** This project was funded in part by your National Geographic Society membership.



Following the guideline her life depends on, a diver threads the needle through a stalagmite forest in Dan's Cave on Abaco Island. A single, misplaced fin kick can shatter mineral formations tens of thousands of years old.

A dramatic photograph of a diver in a dark, turbulent underwater environment. The diver, wearing a black wetsuit and a yellow buoyancy compensator (BC) vest, is positioned in the lower right foreground. They are holding a large, light-colored stalagmite under their arm. A stream of bubbles is rising from their mouthpiece, illuminated by a bright light source, creating a stark contrast against the deep blue and black surroundings. The water is filled with numerous small, glowing particles, likely bioluminescent organisms. In the background, a large, circular opening leads to a bright, sunlit area, possibly a surface or another part of the cave system.

His air bubbles forced down by the current in a blue hole on Abaco, Kenny Broad fights to the surface, a stalagmite under his arm. Divers must bring extra breathing gas when they'll have to struggle against a siphoning tide.





Tires and other debris have piled up in Garbage Hole on Grand Bahama (above). "You're swimming through people's drinking water and junk piles at the same time," says Kenny Broad. "It really drives home why we need to protect these places." He and Brian Kakuk surface at dusk after multiple dives in Sawmill Sink (right), where they collected bacteria samples and fossils. "It's an alien world down there," says Broad, "that keeps pushing us beyond our dreams."



# New Worlds to Explore

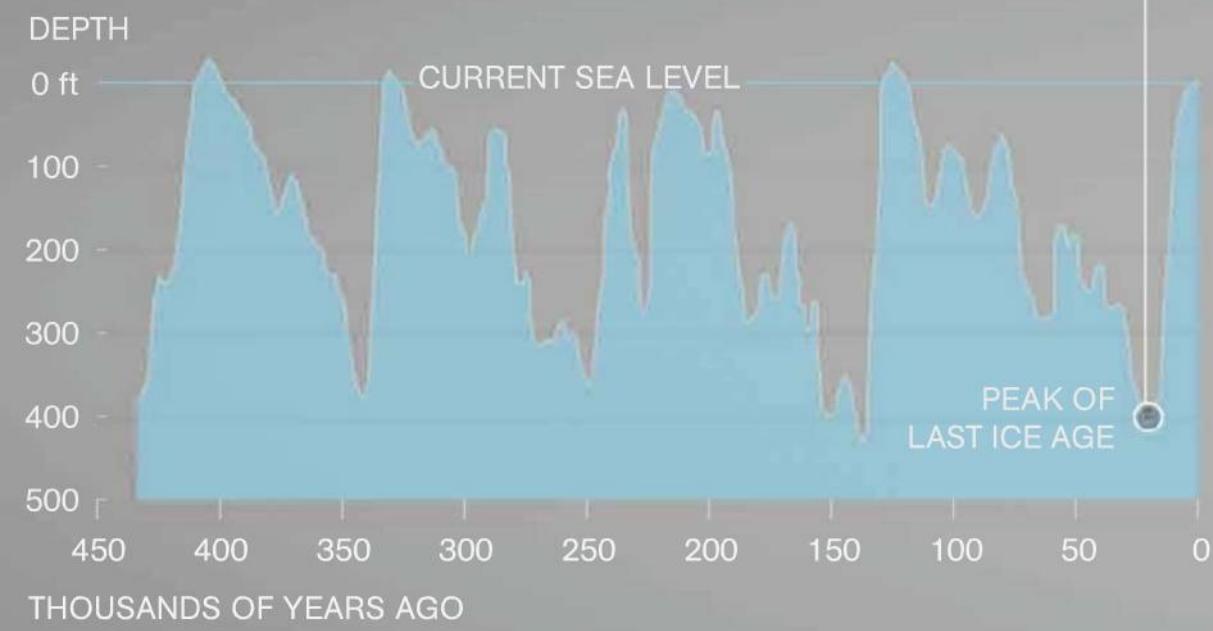
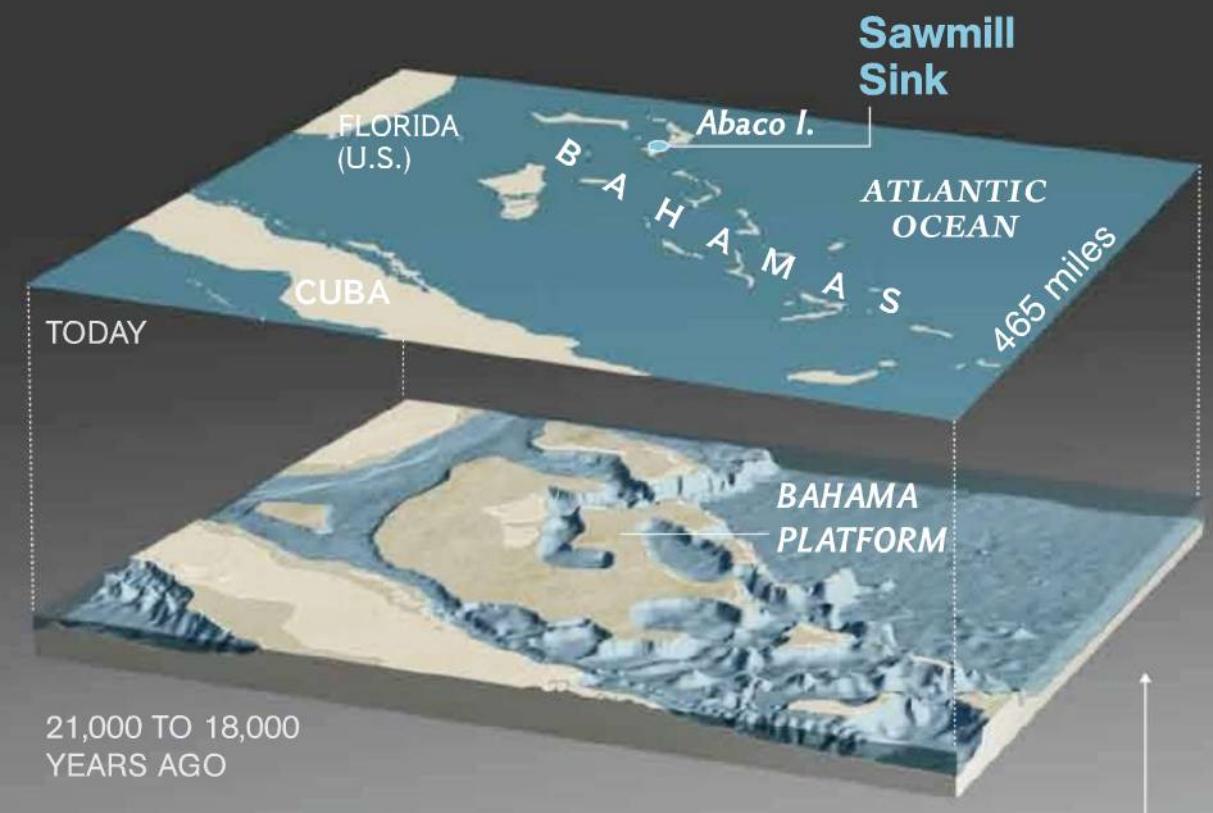
A blue hole is a flooded cavern with an eye to the sky, a sinkhole with a twist. Its opening, created by a cave-in, leads to a deep void and side passages filled with seawater. The Bahamas may hold more than a thousand blue holes, on land and offshore. About 200 have been explored.

## What lies beneath

The Bahamas are visible slivers of a great limestone platform. It was most fully exposed when seas were some 400 feet lower, 21,000 to 18,000 years ago.

## Sea-level changes sculpt caverns

Sea levels fell when Pleistocene ice sheets far to the north expanded, then rose as the ice melted. When the Bahamas limestone was exposed, rain seeped into the rock and carved passages. When rising seawater penetrated the limestone, a chemical reaction between fresh and salt water further dissolved the rock.



## Climate Clues

Sawed lengthwise to reveal its core, a blue hole stalagmite, 14.5 inches tall, holds 36,000 years of climate history. Growing drop by drop as rainwater leaches calcite from limestone, a stalagmite becomes a climate time line.

Chemical analysis shows high levels of iron at five intervals, evidence of dust blown from the Sahara. Their dates match episodes of rapid climate change (from drier to wetter in the Bahamas) previously detected in ice cores and ocean-floor sediments.

Colors may reflect the rate of formation.

○ HIGH LEVEL OF IRON

Scientists have only begun to study blue hole stalagmites, including one dating back 350,000 years. These rare records from the tropics help build a global picture of when and why climate changes.

STALAGMITE HEIGHT: 14.5 IN  
FROM DAN'S CAVE, ABACO



# Sawmill Sink

Conditions in this inland blue hole on Abaco Island make it ideal for reconstructing the ancient natural history of the Bahamas and can even mirror life on the planet billions of years ago. The cave-in that opened Sawmill Sink as early as 120,000 years ago filled it with a cone of limestone debris.

## Water chemistry

An inland blue hole's water is very still and highly stratified. A lens of fresh water, from rainfall, floats on the denser salt water and isolates it from oxygen in the atmosphere. Brightly colored bacteria thrive where the layers meet (right). They need light but can't tolerate oxygen. Other bacteria here produce hydrogen sulfide, which the colored bacteria consume.

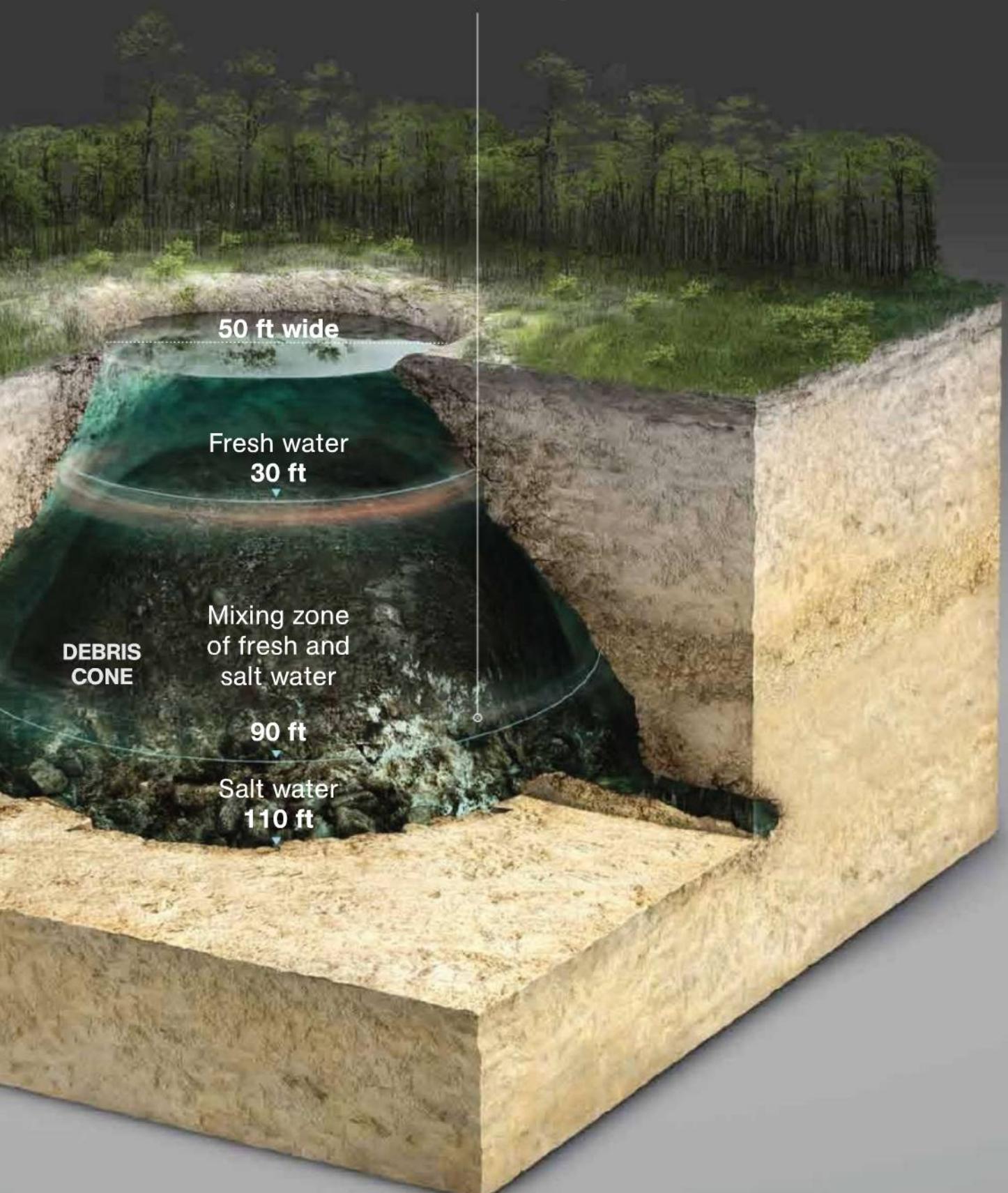
## Cave formations

Stalagmites and stalactites grow only when sea level is too low to flood the caves. Some formations merge into massive columns.



Sawmill's two side passages, each about 2,000 feet long, descend as deep as 180 feet.

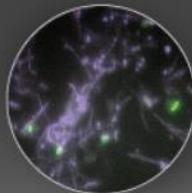
Indigestible bones from birds, bats, lizards, and snakes littered a ledge where owls roosted 10,000 or more years ago, when seas were lower.



# Emergence of Oxygen

## Oxygen-free Earth

Bacteria like those that ruled the seas when Earth had scant oxygen flourish in blue holes (right, in purple), helping scientists envision early Earth and how life might exist on other planets.

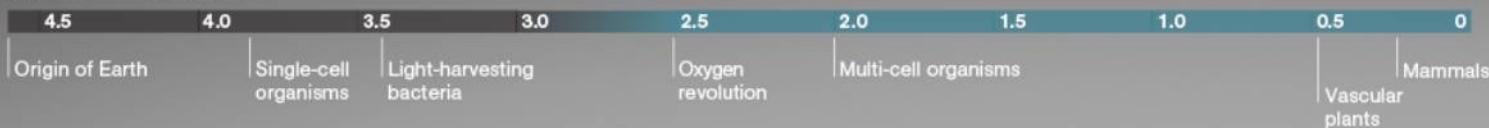


FALSE COLOR, MAGNIFIED 1,000 TIMES  
COLLECTED IN SAWMILL SINK AT 33 FT

## Oxygen-rich Earth

Oxygen entered the atmosphere after the rise of now common cyanobacteria (left, in green), which give off oxygen as a waste product.

BILLIONS OF YEARS AGO



# Remains of a Lost World

The best preserved fossils in the Bahamas lie in the low-oxygen depths of blue holes. Sawmill Sink is a natural trap, where prey and their predators tumbled in. Peat from decaying vegetation covered the bones.



7 ft long

**Crocodylus rhombifer**  
4,000-3,000 years old



The Cuban crocodile, a freshwater species, now survives only in Cuba; the most recent bones in the Bahamas are 2,800 years old. Human predation and environmental change may have killed it off.

PAGES 56-65: ALEJANDRO TUMAS; AMANDA HOBBS, NGM STAFF. ART: HERNÁN CAÑELLAS. MAPS: VICKIE TAYLOR, INTERNATIONAL MAPPING. TEXT: JANE VESSELS, NGM STAFF  
SOURCES: NANCY ALBURY AND MICHAEL PATEMAN, NATIONAL MUSEUM OF THE BAHAMAS; KENNETH BROAD, PETER SWART, AND MONICA ARIENZO, UNIVERSITY OF MIAMI; BRIAN KAKUK, BAHAMAS CAVES RESEARCH FOUNDATION; THOMAS ILIFFE, TEXAS A&M UNIVERSITY; JENNIFER MACALADY, PENNSYLVANIA STATE UNIVERSITY; JOHN MYLROIE, MISSISSIPPI STATE UNIVERSITY; DAVID STEADMAN, FLORIDA MUSEUM OF NATURAL HISTORY. PHOTOS: NANCY ALBURY



***Caracara creightoni***  
Undated



23 in tall

Known only from a few fossils in the Bahamas and Cuba, this extinct short-winged caracara was likely a poor flier. It's among 35 bird species found in Sawmill Sink, some new to science.



**Human sacrum**  
ca 1,040 years old



Lucayan Indians, whom Columbus met on his first New World landing in 1492, vanished from the islands soon afterward. This sacrum, a bone near the base of the spine, belonged to a juvenile about age 13.

# THE NEW SILK ROAD

A railroad through the southern Caucasus will soon connect Europe and Asia, fueling dreams and discord in the region.



**GEORGIA** A bustling trackside market in Tbilisi offers a taste of what Georgians hope soon to gain: an economic boost as trains pass through their country en route from oil-rich Azerbaijan to trade partner Turkey and beyond.



**TURKEY** A ten-foot concrete hand stands above the eastern Turkish town of Kars, part of a monument of goodwill toward nearby Armenia that may never be completed. Construction stopped partly because of protests by residents opposed to improved relations with Armenia.





**AZERBAIJAN** A promenade along the Caspian Sea attracts residents of Baku, capital of Azerbaijan, for an afternoon stroll. Increased oil production has enriched the nation; Azerbaijan hopes the completion of the new railroad will spur energy exports.

BY BRETT FORREST

PHOTOGRAPHS BY ALEX WEBB

**T**HE DYNAMITE COMES from Ankara. Ten tons, and it takes two days. The truck climbs carefully, screwing 2,500 feet up the mountains of northeastern Turkey, where the clouded sun makes faraway ice fields roll like a distant sea. This is beautiful, forbidding country, through which a new railroad will soon run.

Arslan Ustael awaits the dynamite in the snow, with night temperatures reaching 40 below. Standing before the rail tunnel, Ustael says that in this weather your spit freezes before it hits the ground. He is a young man still, 30, and free with Turkish good humor, even up here in the cold clouds waiting for the dynamite that will make the volcanic mountain agreeable to his demand to bore a tunnel through it. Free with good humor because he knows this is an undertaking that could make a young engineer's career: building the Baku-Tbilisi-Kars (BTK) railway, an "Iron Silk Road" that will connect the oil-rich Caspian Sea region to Turkey—and beyond to Europe. (*Click Text button to read more.*)



**TURKEY** Crossing cultures and connecting faiths, the newest section of the planned rail route stitches Christian Georgia to Muslim Turkey. Gönülalan is one of the Turkish villages on the train's path; nomadic Kurds like this man and boy find temporary housing in tents while they tend livestock.

*Brett Forrest reports frequently from the former Soviet Union. Photographer Alex Webb's most recent book is Istanbul: City of a Hundred Names.*

Text



## CONTINENTAL CROSSROADS

The Iron Silk Road, as promoters call the Baku-Tbilisi-Kars railroad, will make the southern Caucasus a greater corridor for East-West trade. Financed largely by Azerbaijan, whose oil dominates the area's economy, the railroad breaks a long dependence on transporting goods through Russia—and reflects the region's hostility toward Armenia, which it pointedly bypasses.

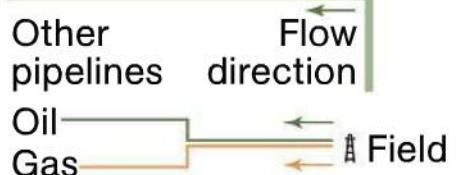


### Baku-Tbilisi-Kars (BTK)

Open Closed

Scheduled to open by 2012, the BTK will carry goods, including some oil, as well as passengers. Linked with other rail systems, the new track will give the region direct rail access to Europe through Turkey.

### Baku-Tbilisi-Ceyhan (BTC) oil pipeline



The Baku-Tbilisi-Ceyhan pipeline brings Azerbaijan's Caspian Sea oil to Turkey's Mediterranean port of Ceyhan. It's the world's second longest pipeline (1,100 miles), after the Druzhba pipeline in Russia.

VIRGINIA W. MASON,  
NGM STAFF  
SOURCE: IHS ENERGY  
(PIPELINES)

The Caucasus region is a 750-mile stretch of land between the Black Sea and the Caspian Sea, a strategically important corridor between Europe and Asia. Once the BTK railroad is complete and the Marmaray tunnel opens in 2013 beneath the Bosphorus in Istanbul, trains from Baku will reach all the way to London. For NATO, the southern Caucasus is viewed as a needed route for supplying the war in Afghanistan.



**WHEN THE RAILWAY** *plans were announced, Georgia's Armenians*



*opposed its construction, citing the unfairness of bypassing Armenia.*



**GEORGIA** The railway provides work for many, including these men digging a drainage ditch along a freshly cleared railbed between Akhalkalaki and the Turkish border. Georgians (left) make the morning commute from the capital, Tbilisi, to jobs in nearby Rustavi in the existing railway's faded cars.

A photograph showing a group of young men at a lake. In the foreground, a man in a red cap sits on a wooden bench, facing away from the camera. Behind him, several other young men are standing or wading in the water. One man in a black cap and striped shorts stands on the left, looking down. Another man in a white cap and dark pants stands on the right, adjusting his shirt. In the center, two men are in the water; one is holding the other by the arms, and they appear to be performing a dip or a similar maneuver. The background features a large, calm lake with hills and mountains under a blue sky with scattered clouds.

**GEORGIA** Spring warmth draws a crowd to a lake on the outskirts of Tbilisi. Georgia seeks greater ties with western Europe—and security in the shadow of Russia, the giant to its north. In 2008 Russia routed Georgian forces from South Ossetia and Abkhazia in a short-lived war.





**AZERBAIJAN** Makeshift slaughterhouses line the road to the mosque in Şüvälän during the Kurban Bayram holiday, when sheep are killed to commemorate Abraham's willingness to sacrifice his son to God. The meat is shared with the poor.

**BAKU NO LONGER SUPPLIES** *half the world's petroleum, as it did at the opening of the 20th century. But it feels like it does.*



**AZERBAIJAN** In the capital of Baku modern construction dwarfs a figure from the past—the father of Azerbaijani communism, Nariman Narimanov. Rusting oil pumps (left) from the Soviet era fill the horizon outside the city, where obsolete equipment and poor extraction techniques pollute the landscape.

## AZERBAIJAN An

Azerbaijani refugee from Nagorno-Karabakh huddles in his Baku home beneath a picture of his wife, now dead. When ethnic Armenians won control of the enclave in the early 1990s, some 800,000 Azerbaijanis fled the region.





**ARMENIA** A couple waits to be married in a hilltop church above Lake Sevan. Isolated and landlocked, Armenia has been left out of the regional railroad plan because of political tensions with Turkey and Azerbaijan.



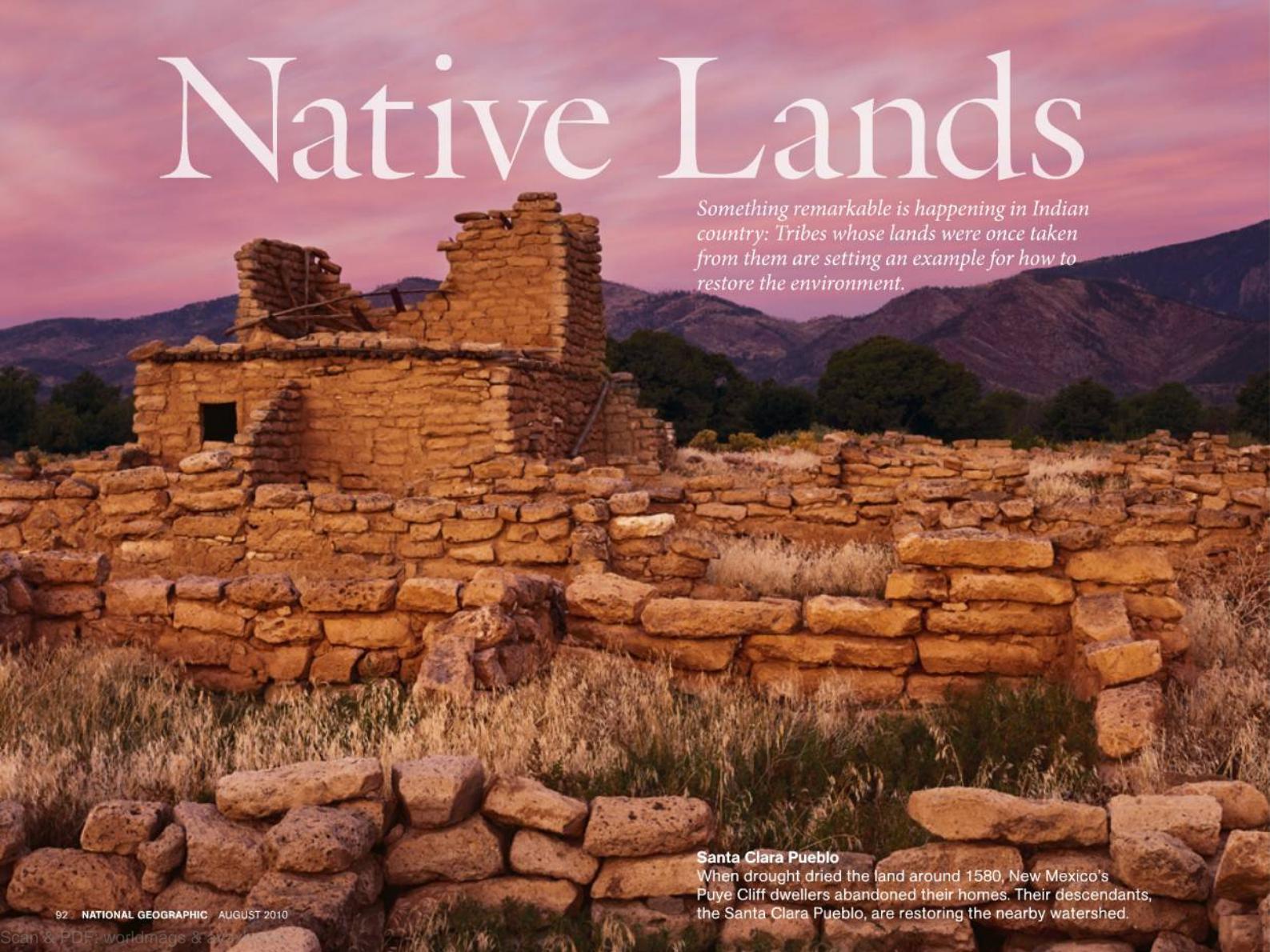


**NAGORNO-KARABAKH** The license plates were taken from cars abandoned by Azerbaijanis fleeing their homes as Armenia and Azerbaijan fought over control of the region in the early 1990s. Now they line roadside walls in the town of Vank and are seen as trophies of victory.



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# Native Lands



*Something remarkable is happening in Indian country: Tribes whose lands were once taken from them are setting an example for how to restore the environment.*

## Santa Clara Pueblo

When drought dried the land around 1580, New Mexico's Puye Cliff dwellers abandoned their homes. Their descendants, the Santa Clara Pueblo, are restoring the nearby watershed.





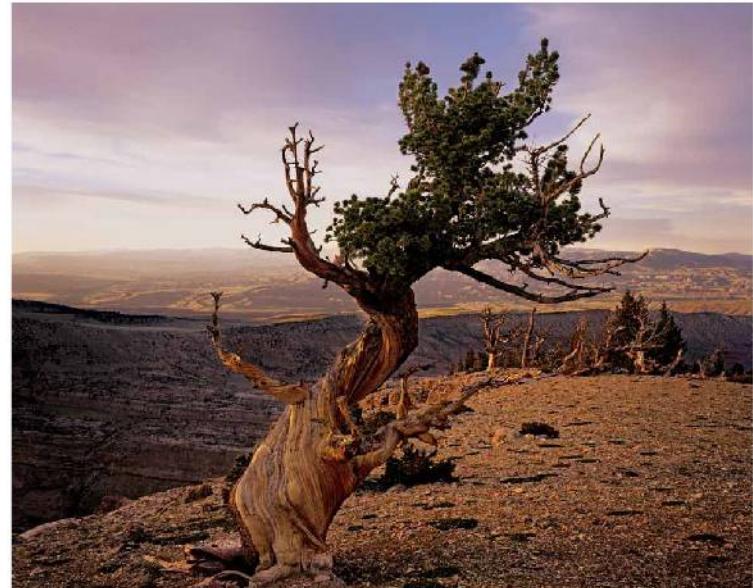
### **Big Cypress Reservation**

In the green firmament of a slough, galaxies of duckweed are stirred by slow moving waters. Florida's Seminole call this section of swamp the Jurassic.

BY CHARLES BOWDEN

PHOTOGRAPHS BY JACK DYKINGA

**B**etween the city that gave birth to the atomic bomb and a Rio Grande Valley now studded with Indian casinos, something new is appearing under the sun: the way things were. Here in New Mexico's Santa Clara Canyon, a Native American tribe is restoring its ancestral land. On a volcanic bluff 200 feet above Santa Clara Creek sit the Puye Cliff Dwellings, with hundreds of rooms in buildings fashioned from cut stone and at least 700 more homes incised into the soft tuff of the cliffs below. No one has been home for five centuries. The settlement was probably created during a time of good rain. Then deep drought emptied out this pueblo around 1580. The descendants of its former inhabitants are the current residents of Santa Clara Pueblo, an Indian reservation eight miles downstream on the Rio Grande. The tribe is working to restore the entire watershed along Santa Clara Creek to its natural state after decades of neglect. Eventually thousands of acres will once again be thick with native (Click Text button to read more.)



#### Wind River Roadless Area

No signs point the way here, only the arthritic limbs of a pine gesturing to an endless sky. It is the wildest of the wild, a glacier-scoured terrain unmarred by roads, tugged at by wind, on the shoulder of the Continental Divide. This preserve of the Eastern Shoshone and Northern Arapaho dates back to 1937, decades before the United States passed the Wilderness Act, in 1964.

WIND RIVER  
ROADLESS  
AREA  
WYOMING  
Cheyenne



U.S.

NGM MAPS

Text

Charles Bowden wrote about Libya's Fezzan region in the October 2009 issue. Jack Dykinga photographed the Big Bend of Texas and Mexico in 2007.



### InterTribal Sinkyone Wilderness

The ten tribes of the wilderness council are careful custodians of a temperate rain forest rich in moss-covered tan oak (above) and redwood and closed to commercial logging. The “sacred ecosystem,” as executive director Hawk Rosales calls it, is threaded by waters like Wolf Creek (right), focus of a project to restore salmon habitat.





### **Fort Peck Reservation**

At home on the range, bison graze the slopes of their refuge on the Fort Peck Reservation. Support from the Defenders of Wildlife helped add more than 4,000 acres to the original 5,000 the Assiniboine and Sioux set aside in 2000. The reserve sustains 200 buffalo and could support more if the tribal council can buy or lease additional acreage.

FORT PECK  
RESERVATION  
Helena  
MONTANA







Fifteen years ago the last beaver left Santa Clara Canyon. Now the tribe hopes that with the restoration of streamside growth, the beaver will return and start a new cycle of dams and ponds.



Goat Rock, Santa Clara Pueblo



**Mission Mountains  
Tribal Wilderness**  
Post Creek staircases down through the Grizzly Bear Management Zone, an 11,000-acre section of the Mission Mountains Tribal Wilderness closed to humans in summer so bears can feed on army cutworm moths. The Confederated Salish and Kootenai Tribes designated 92,000 acres as wilderness in 1979, but the way had been paved earlier. In 1974 a pending timber sale threatened old-growth trees. Three grandmother elders, or *yayas*, appeared at a tribal council meeting. "They straightened their scarves, spoke of their concern for generations to come, and refused to leave until the council banned logging," said a witness. It did.



## Fort Apache Reservation

Flowering spikes of sotol, or desert spoon, frame the Salt River Canyon on the Fort Apache Reservation in Arizona's White Mountains. The tribe monitors fish populations in the Salt River drainage area, gauging the consequences of stream runoff in the aftermath of the Rodeo-Chediski wildfire, which consumed 280,992 acres of reservation forest in the summer of 2002.





The Big Cypress Swamp is a rare relic of the very earth that once saved tribal members from genocide. After the Seminole Wars, those not exiled remained hiding in the swamp.



Saw palmetto, Big Cypress Reservation







## Nez Perce Precious Lands

“For a short time we lived quietly. But this could not last,” Chief Joseph of the Nez Perce said. In 1877 the federal government forced the Nez Perce from the fir-clad mountains of Oregon’s Wallowa Valley. Joseph spent his last days in exile, dying, his doctor said, of heartbreak. With assistance from the Trust for Public Land, the tribe has regained 16,286 acres of its Precious Lands, as they are rightly called. Native grasses are being replanted. The graceful flight of a white-throated swift has been noted. The green-banded mariposa lily unfurls its lavender petals. Renewal is in the air; it is not just restoration of land but of spirit.

WASHINGTON  
★Olympia

NEZ PERCE  
PRECIOUS LANDS<sup>®</sup>  
★ Salem

OREGON

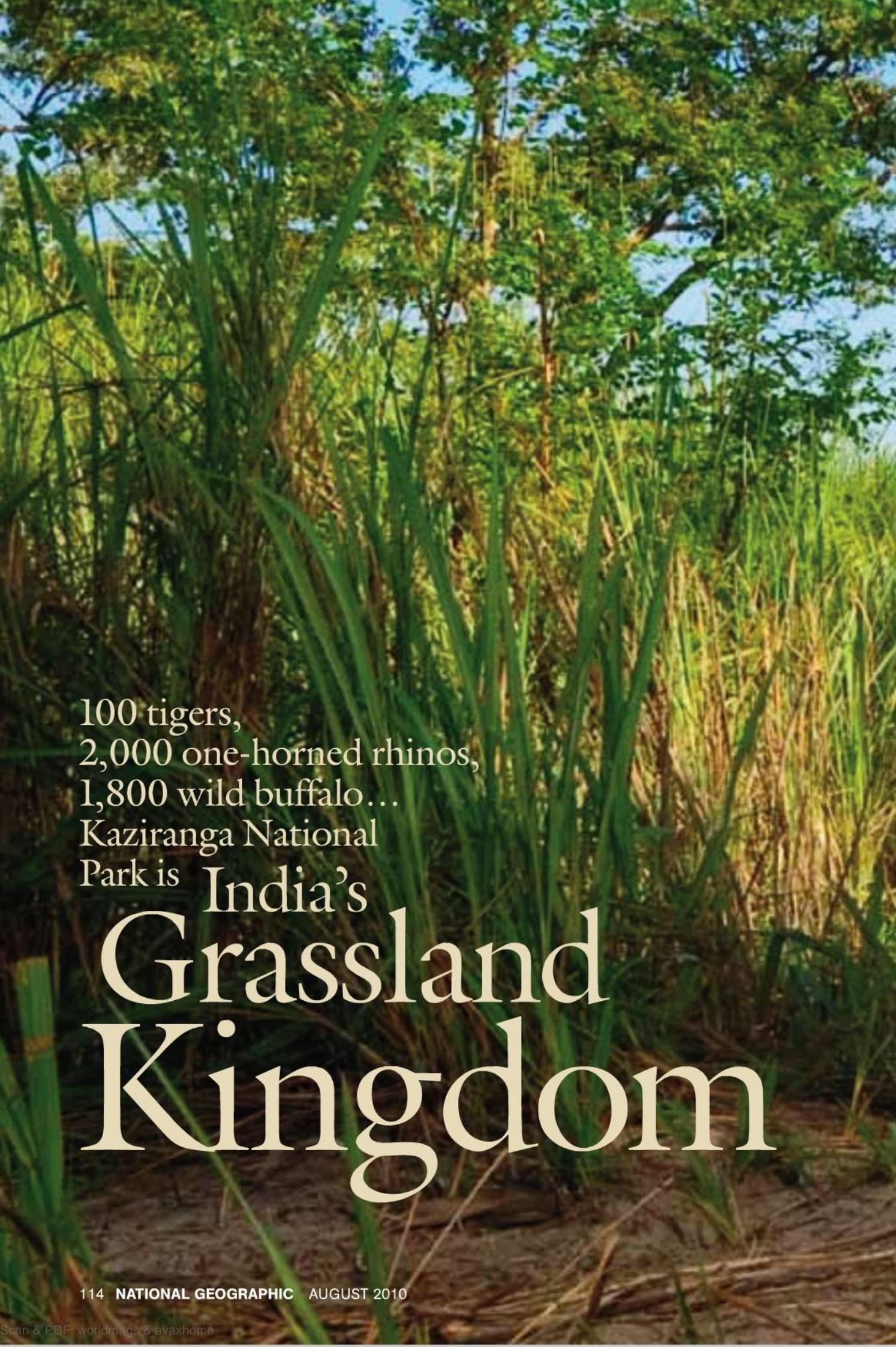




### Red Lake Reservation

Sunset flares over Thunder Lake, one of 14 small lakes on the Red Lake Reservation managed by the tribal fisheries department. It feeds Red Lake, sacred to the Chippewa and once again thick with walleyes—fish with a glassy stare revered for their sweet, snowy flesh. By 1996 decades of overfishing had decimated the Red Lake fishery. Tribal, state, and federal agencies, along with the University of Minnesota, cooperated to set up a management plan. Fishing was suspended. Walleye fry were stocked. In less than ten years the fish population exploded from 200,000 to eight million, and tribal members were allowed to resume commercial fishing.





100 tigers,  
2,000 one-horned rhinos,  
1,800 wild buffalo...

Kaziranga National  
Park is

India's  
**Grassland  
Kingdom**



Hunted to death in much of India, tigers survive in Kaziranga.



Each of Kaziranga's 1,300 elephants downs an average 300 pounds of forage and 50 gallons of water a day—more than the park can provide at times. Upland forest reserves are vital for these and other species, but expanding human settlement could sever access.





The rhino charged. A park guard, riding with the *Geographic* team, tried a warning shot, but his rifle jammed. A rhino can run 25 miles an hour, and cars can get rammed—or worse. The driver of this one managed to speed away.

BY DOUGLAS H. CHADWICK  
PHOTOGRAPHS BY STEVE WINTER

Douglas Chadwick and Steve Winter last worked as a team tracking snow leopards in Central Asia for the June 2008 issue. Both are regular contributors.

# An Indian one-horned rhino

—*Rhinoceros unicornis*, the kind that looks like it has shields bolted to its butt—weighs as much as an SUV. Only Africa's white rhino is larger. Only the Sumatran rhino (population 350 or fewer) and Javan rhino (50 or fewer) are more imperiled. Once common from Pakistan to Myanmar, *R. unicornis* is represented today by fewer than 2,700 animals. A quarter are confined to ten little reserves in northern India and neighboring Nepal. Virtually all the rest—about 2,000 at the latest count—live in Kaziranga National Park, a 332-square-mile reserve that takes in 50 miles of the Brahmaputra River with its sand islands, a few areas to the north, and a much



Meet a Kaziranga rhino—  
up close and personal.



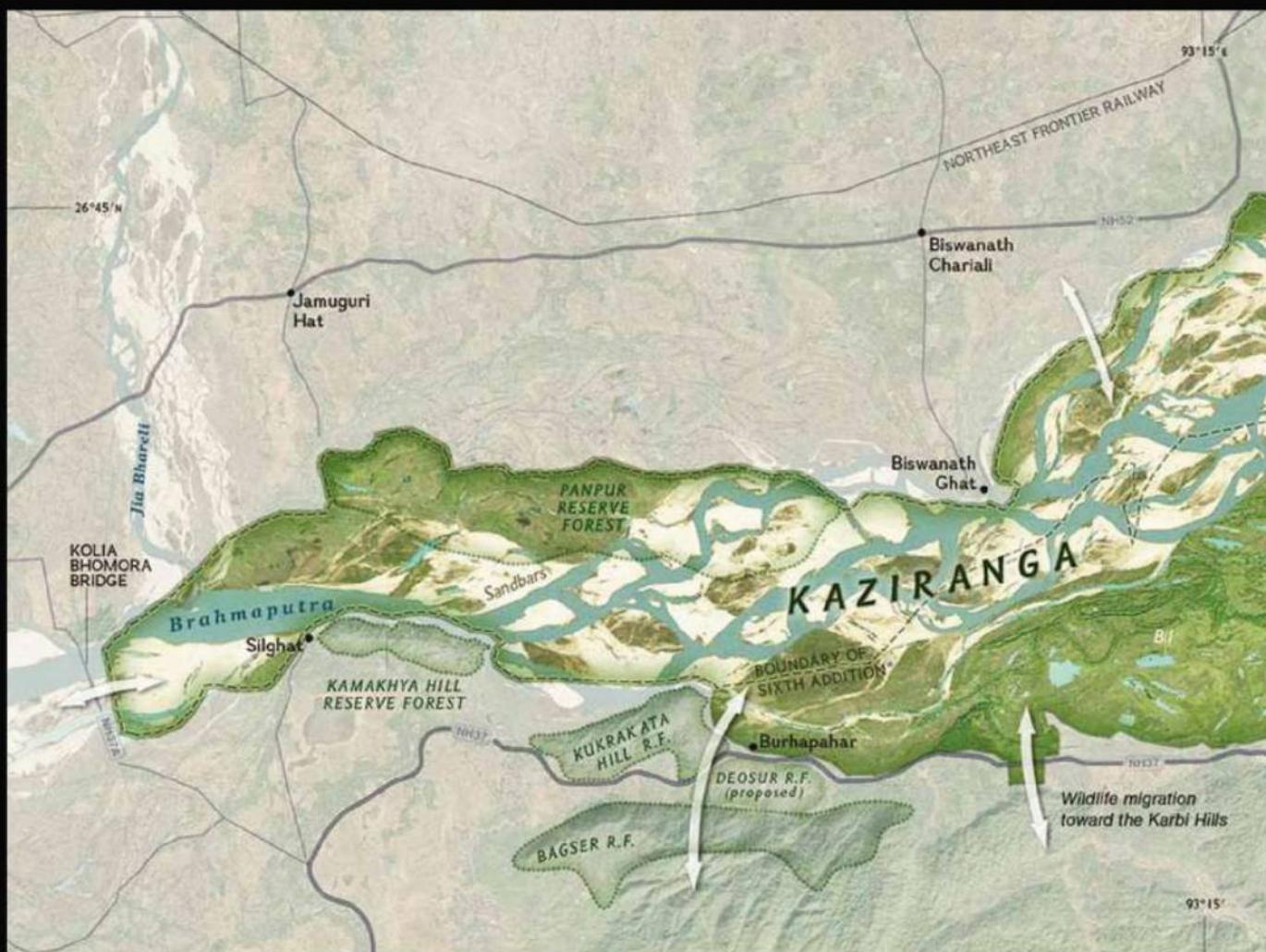
larger portion of the floodplain to the south. Excluding the river, that's an average of 11 ancient, armored, irritable unicorns for every square mile of the park.

Fewer than 200 were left in the north Indian state of Assam a century ago. Agriculture had taken over most of the fertile river valleys that the species depends on, and the survivors were under relentless assault by trophy hunters and poachers. Kaziranga was set aside in 1908 primarily to save the rhinos. It held maybe a dozen. But the reserve was expanded over the years, given national park status in 1974, and named a World Heritage site in 1985. During the late 1990s it grew again, doubling (Click Text button to read more.)

Text

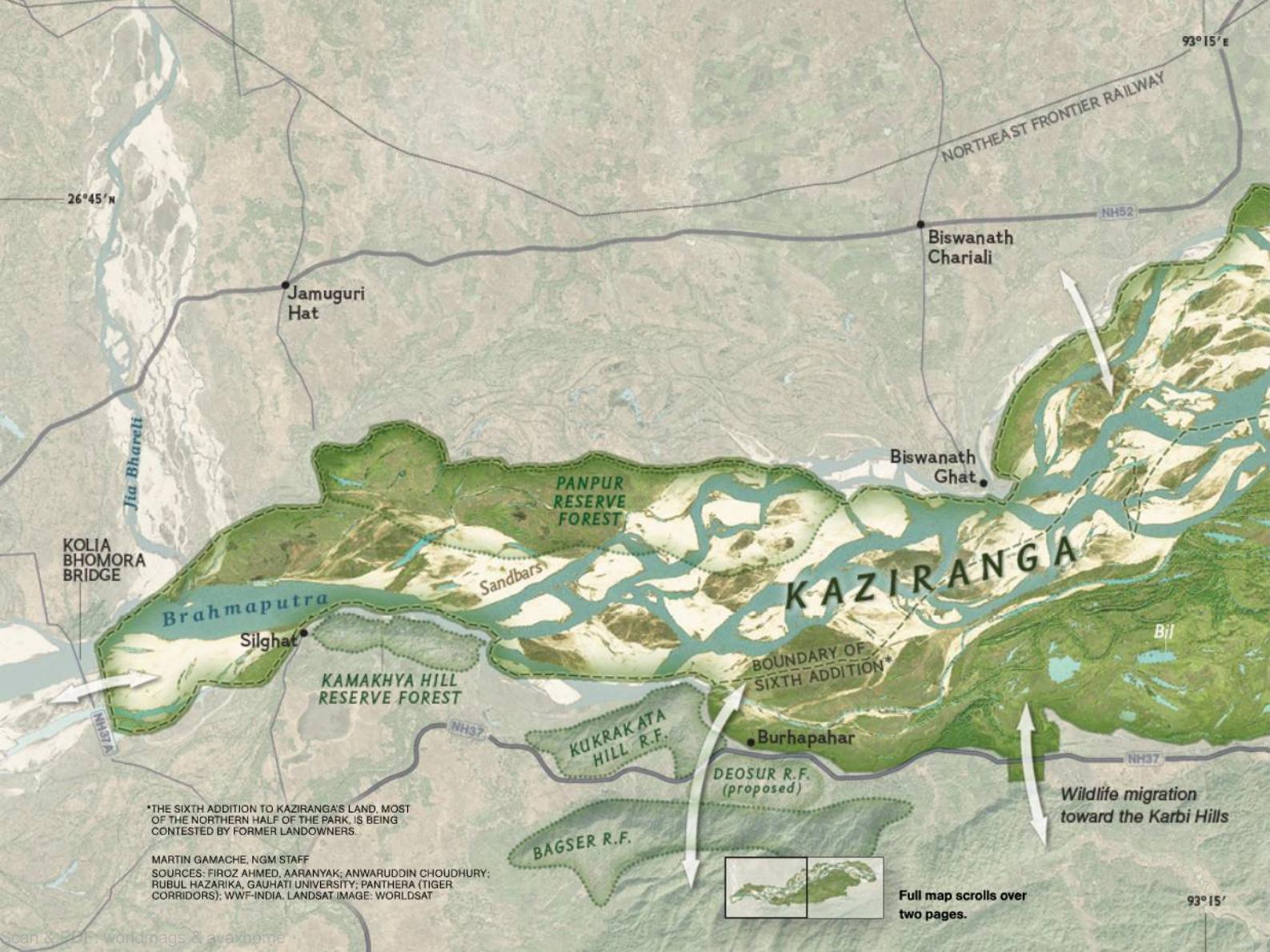
# A river's riches

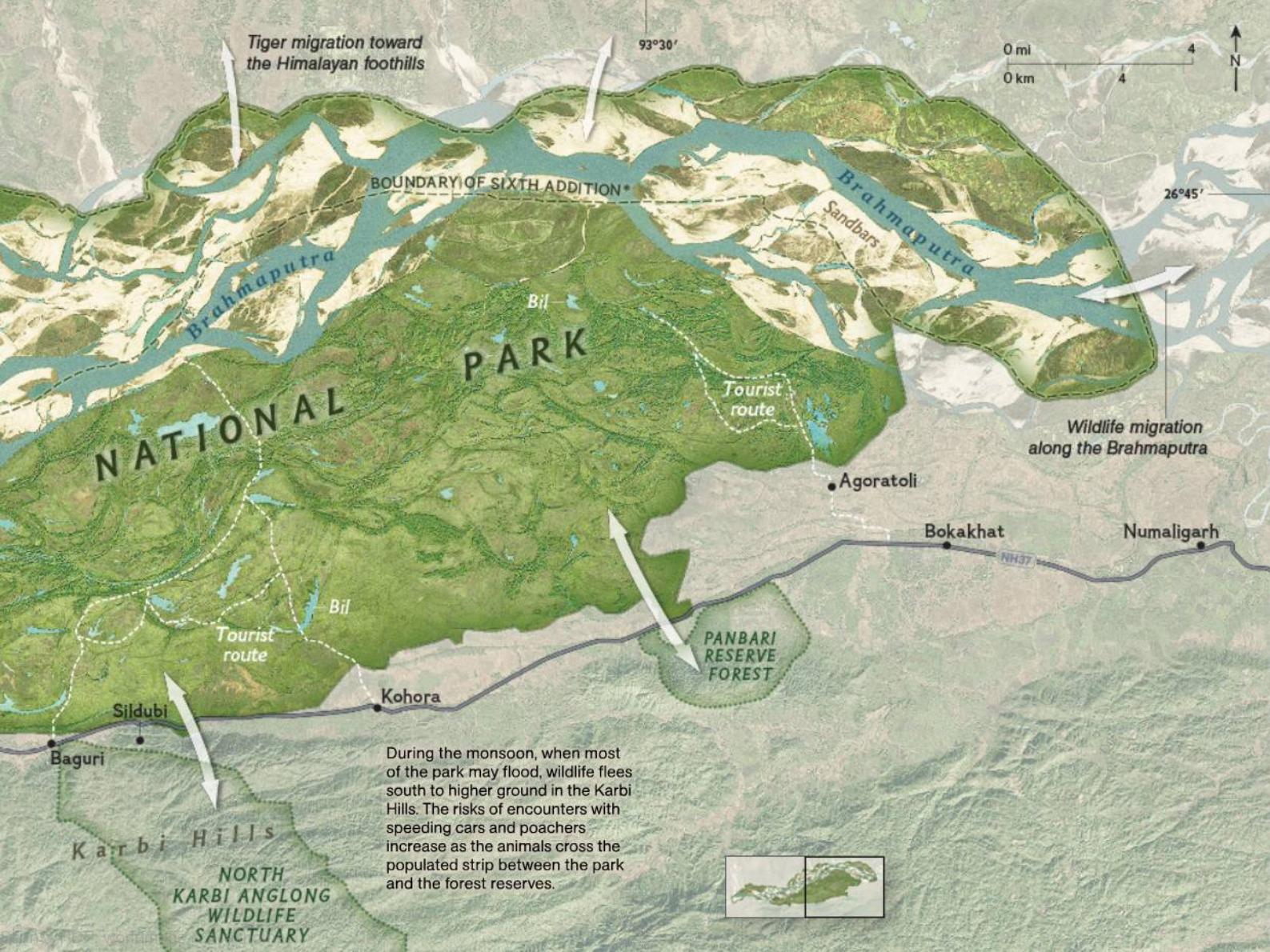
Pouring from the Himalaya, the Brahmaputra leaps its banks yearly, depositing nutrient-laden silt that grows towering grasses, which support megatons of wild grazers. But such fertility is a magnet for agriculture, making natural floodplain habitats like Kaziranga's extremely rare today.



To see enlarged map, scroll over the next two pages.







During the monsoon, when most of the park may flood, wildlife flees south to higher ground in the Karbi Hills. The risks of encounters with speeding cars and poachers increase as the animals cross the populated strip between the park and the forest reserves.



What bloodied this rhino? Maybe a clash with a male rival, maybe a courting session with the departing female in the background. The park harbors three-quarters of the world's Indian one-horned rhinos—11 per square mile. The crowding could lead to more battles and more wounds, which are a frequent sight.



My guide had made a rule: “No allowed for scared.” I was breaking it as the rhino butted our rig up onto two wheels.



Tourists atop elephants are safe from rhinos—and well positioned for a trek through Kaziranga. Swamp deer graze in an area of new growth stimulated by a fire set by park staff (right). Burns keep the grassland fertile and prevent woody plants from encroaching on the savanna.



Shouting villagers chase elephants from private land near the park border. The elephants were bound for Kaziranga's rich natural pastures from forested range outside the park. Keeping babies in the middle to protect them, the herd evaded mobs all day, escaping into the reserve after dark.





Villagers honor a fallen elephant with incense and prayers, reflecting the Hindu belief that these pachyderms are sacred. This animal was shot—an illegal act—while it was raiding a rice field near the park. It died of its wounds a few days later.



Suspects in a rhino-poaching deal are blindfolded for interrogation at the Baguri ranger station; they were later released. At right, a female rhino was killed by a pair of tigers while she was having difficulty birthing a calf. Park staff removed her horn after she died to prevent poachers from taking it.

Kaziranga has nearly 600 guards in the field, stationed between the unruly big animals and the poachers.



Amid tallgrass the coat of a tiger becomes a cloak of invisibility, the camouflage raising the odds for a successful kill. Tigers in the park hunt, with no competition, millions of pounds of deer, buffalo, and wild hog.



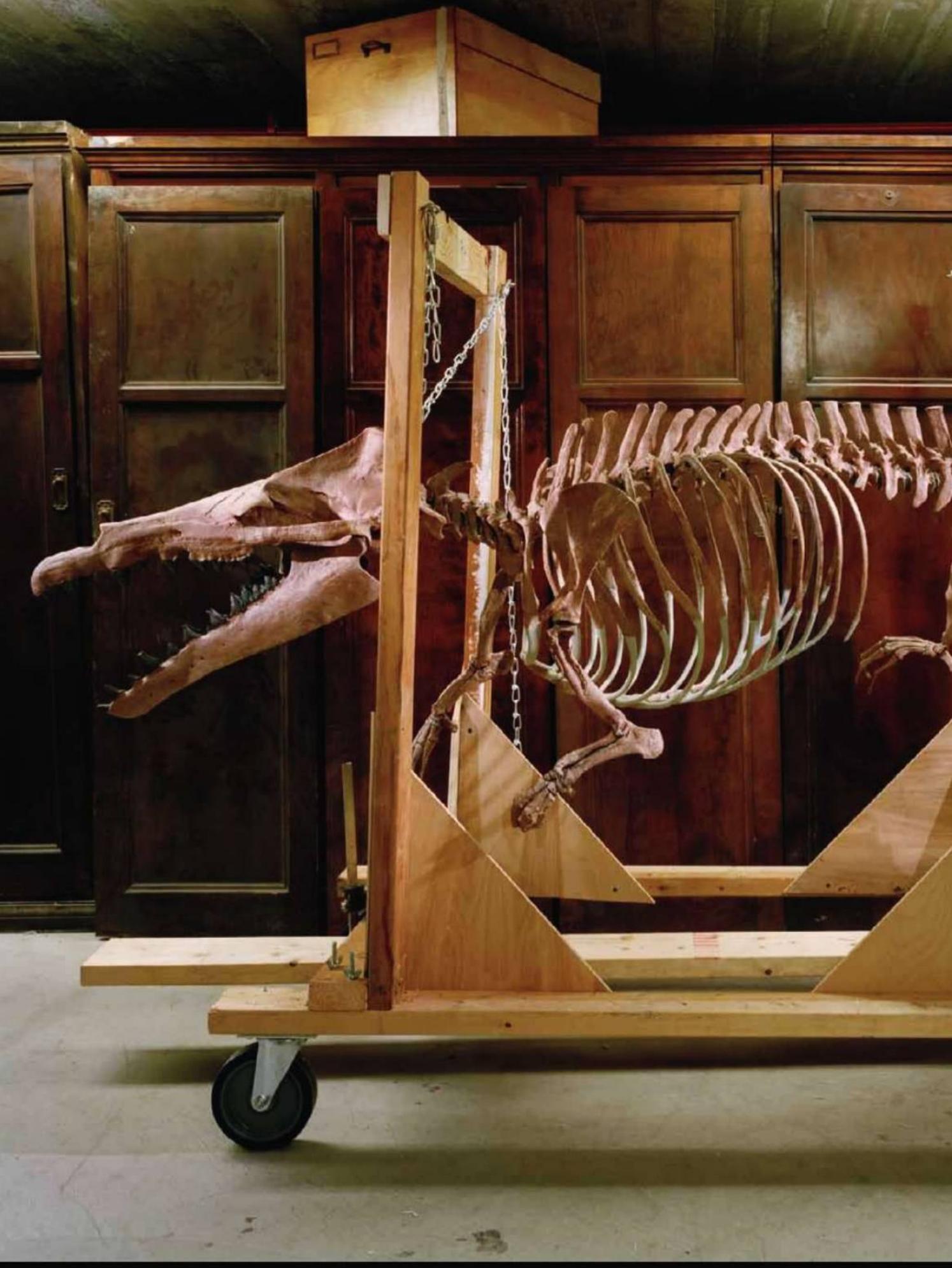
■ **Society Grant** This project was funded in part by your National Geographic Society membership.

# VALLEY OF THE WHALES

*An Egyptian desert,* ONCE AN OCEAN, HOLDS THE SECRET TO ONE OF EVOLUTION'S MOST REMARKABLE TRANSFORMATIONS.



Imagine this dry expanse underwater, with whales hunting and diving. Today visitors to Wadi Hitan walk a stone-lined path to see rocks that hold the fossils of the long-gone sea creatures.





Egypt isn't the only country with traces of early whales. Found in Pakistan, this 47-million-year-old *Maiacetus* now stands in the basement of the University of Michigan Museum of Paleontology. With robust legs and webbed feet, it propelled itself on land like a sea lion. The limbs also provided thrust for swimming; its tail served mainly as a rudder. Later whales swam more efficiently with tail power; their hind legs dwindled, and their front legs morphed into flippers.



A whale's jaws (at left) protrude from a cliff in Wadi Hitan, less than a hundred miles from the Pyramids at Giza. "An Egyptian folktale in hieroglyphics mentions a sea serpent," says paleontologist Philip Gingerich (above). "It could have been inspired by these animals."

*Thirty-seven million years ago,  
IN THE WATERS OF THE  
PREHISTORIC TETHYS OCEAN,  
A SINUOUS, 50-FOOT-LONG BEAST  
WITH GAPING JAWS AND  
JAGGED TEETH DIED AND SANK  
TO THE SEAFLOOR.*

Over thousands of millennia a mantle of sediment built up over its bones. The sea receded, and as the former seabed became a desert, the wind began to plane away the sandstone and shale above the bones. Slowly the world changed. Shifts in the Earth's crust pushed India into Asia, heaving up the Himalaya. In Africa, the first human ancestors stood up on their hind legs to walk. The pharaohs built their pyramids. Rome rose, Rome fell. And all the while the wind continued its patient excavation. Then one day Philip Gingerich showed up to finish the (*Click Text button to read more.*)



CT scans of *Basilosaurus* bones, including this long, slender jaw, will be used for a digital model showing how the whale moved, swam—and chewed.

*Tom Mueller wrote about mammoths in the May 2009 issue of National Geographic. More of Richard Barnes's photos can be seen in his book Animal Logic.*

# Semiterrestrial Whales

ART CONTINUES ON NEXT PAGE.

50 MILLION  
YEARS AGO

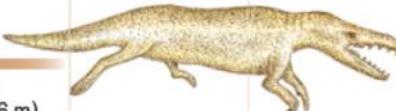
SELECTED WHALES SHOWN

*Pakicetus*  
6 feet (1.8 m)



*Maiacetus*  
8.5 feet (2.6 m)

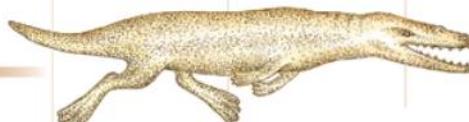
45



*Ambulocetus*  
11.1 feet (3.4 m)

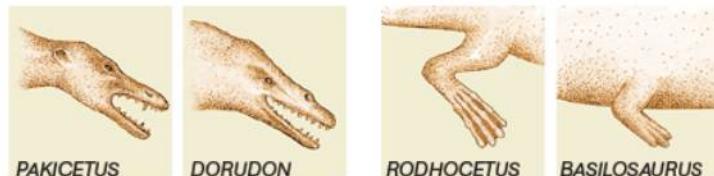


*Rodhocetus*  
9.8 feet (3 m)



## WHALES: FROM LAND TO SEA

Early whales plied the shallows but still hauled themselves onto shore, probably to rest and to give birth. The fossil record tracks anatomical changes (right) as whales adapted to conditions that favored a fully marine mammal. Modern whales appeared about 34 million years ago.



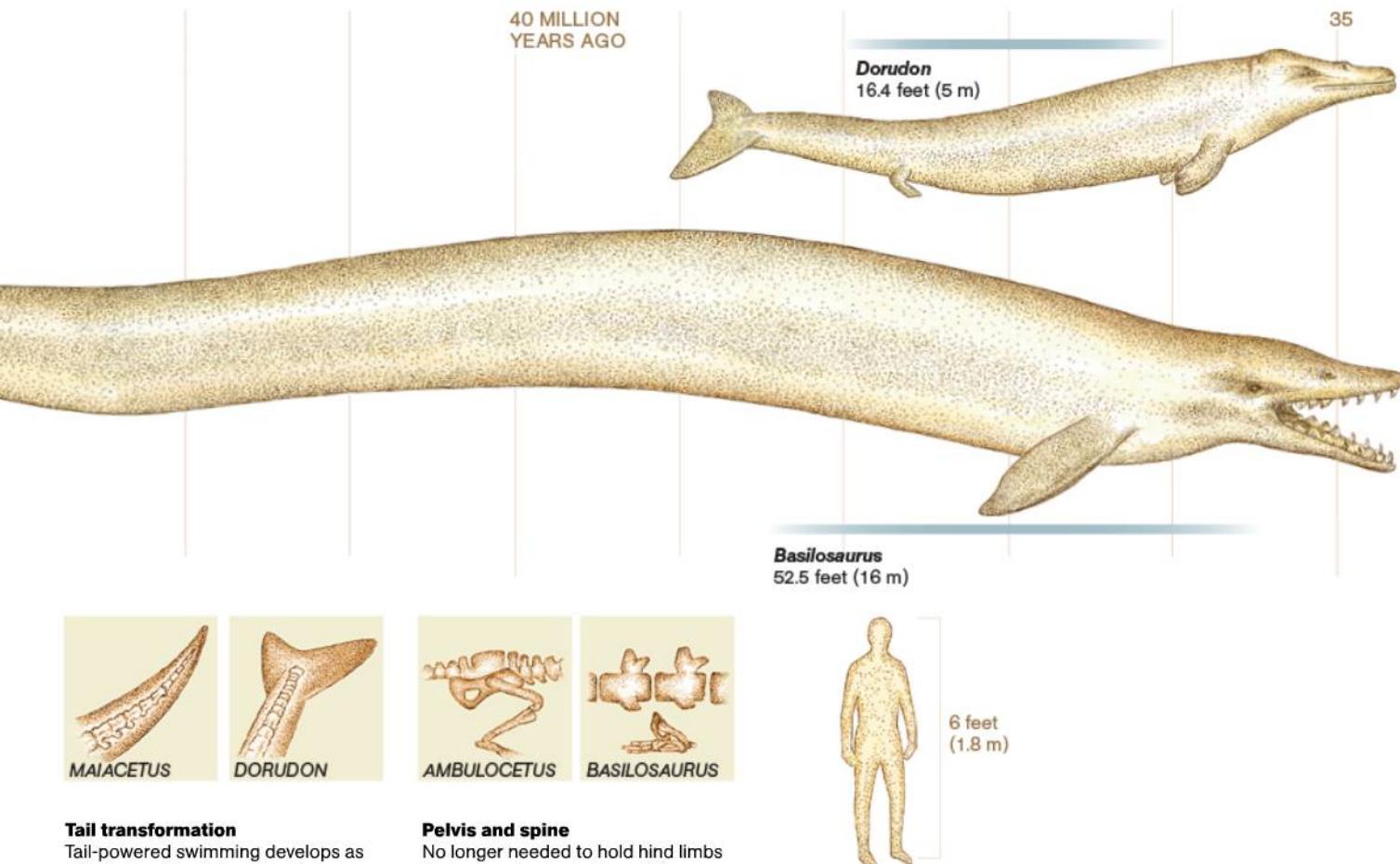
### Nose, eyes, and ears

Nostrils move farther up the skull for easier breathing at the ocean surface. Eyes migrate toward the sides of the head; ears adapt to underwater hearing.

### Feet to flippers

For foot-powered swimming, toes lengthen and grow webbing. As tail-powered swimming evolves, foot bones become encased in flippers.

# Fully Aquatic Whales



## Tail transformation

Tail-powered swimming develops as tails flatten into flukes. Backbones adapt to support the more powerful muscles that tail propulsion requires.

## Pelvis and spine

No longer needed to hold hind limbs that support a body, the pelvis becomes detached from the spine, enhancing the whale's range of motion.

MARIEL FURLONG AND AMANDA HOBBS, NGM STAFF.  
ART: JOHN BURGOYNE  
SOURCE: PHILIP D. GINGERICH, UNIVERSITY OF MICHIGAN

## CRADLE OF WHALES

Fifty million years ago the Tethys Ocean stretched from modern Gibraltar to what is now India. Land-living whale ancestors entered shallow water on the western edge of modern Pakistan and flourished throughout the Tethys until a sharp cooling of the climate 34 million years ago.



JEROME N. COOKSON, NGM STAFF. SOURCE: C. R. SCOTESE, PALEOMAP PROJECT



"Fossil whales are one of God's miracles," says Mohammed Sameh (at left), Wadi Hitan's head ranger, reassembling a *Dorudon* skeleton with University of Michigan postdoc Iyad Zalmout. The site's rare prehistoric whales helped earn it UNESCO World Heritage status.



"Molding, casting, and assembling a 50-foot whale is a puzzler's dream—or nightmare," says head restorer William Sanders of the University of Michigan Museum of Paleontology. His team spent a year making casts of a *Basilosaurus*'s fossil bones, shown here with ribs in the foreground, vertebrae behind. The white casts will be painted to match the rust-hued originals.





Sand-laden winds sculpt Wadi Hitan's stone outcroppings into exotic shapes that Egyptians call mud lions and sitting sphinxes.



Ornate struts of bone on *Basilosaurus* vertebrae secured huge muscles used to lift and lower the whale's tail and back as it swam.





Found in Wadi Hitan with its nose protruding from one side of a hill and its tail from the other, this 37-million-year-old *Basilosaurus* was perfectly preserved by the rock that entombed it. This year it will return to Egypt to become the centerpiece of a new museum on whale evolution.



Shiny as a mudflat, dry as the Sahara, nummulite basins (left) are named for the coin-shaped fossils that litter their soil (above). Nummulites and other tiny desert relics provide vital clues to how early whales lived and died.

ON ASSIGNMENT

## Kaziranga Recap

Taking pictures of Indian wildlife can be dangerous work. "It's an intense challenge," recalls photographer Steve Winter. During the 14 weeks he spent in Assam, India, in Kaziranga National Park, he was never without armed guards, who would occasionally fire shots to chase away (not injure) charging rhinos. He captured this story's lead photo with a camera trap; other shots were closer encounters. Still, Winter didn't get hurt, a fate he credits largely to the guards. "Jeng-jeng means 'trouble' in Assamese," he explains. "I learned that phrase pretty quickly."



Park guard Siba Sakia watches as Steve Winter sets up a camera trap.



PHOTO: SHARON GUYNUP

## Society Updates

### NG FILMS

Why climb Everest? "Because it's there," is what English mountaineer George Mallory said before setting out in 1924 to be the first to reach its summit. Mallory disappeared somewhere near the top, and his body was lost for years—until 1999, when Conrad Anker discovered it. What befell Mallory? Anker embarks on his own treacherous climb to find out in *The Wildest Dream*, a new film by National Geographic Entertainment featuring recently found Mallory footage. For theater listings, go to [nationalgeographic.com/movies](http://nationalgeographic.com/movies).

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### NAT GEO CHANNEL

On August 22 at 9 p.m. tune in to the National Geographic Channel's *Dawn of the Oceans*, a two-hour journey that explores the history and future of our mighty seas.

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### NG BOOKS

Set in Renaissance Italy, *The Professor of Secrets* tells the little-known story of a brilliant, unconventional doctor named Leonardo Fioravanti. Find it in bookstores now (\$26).

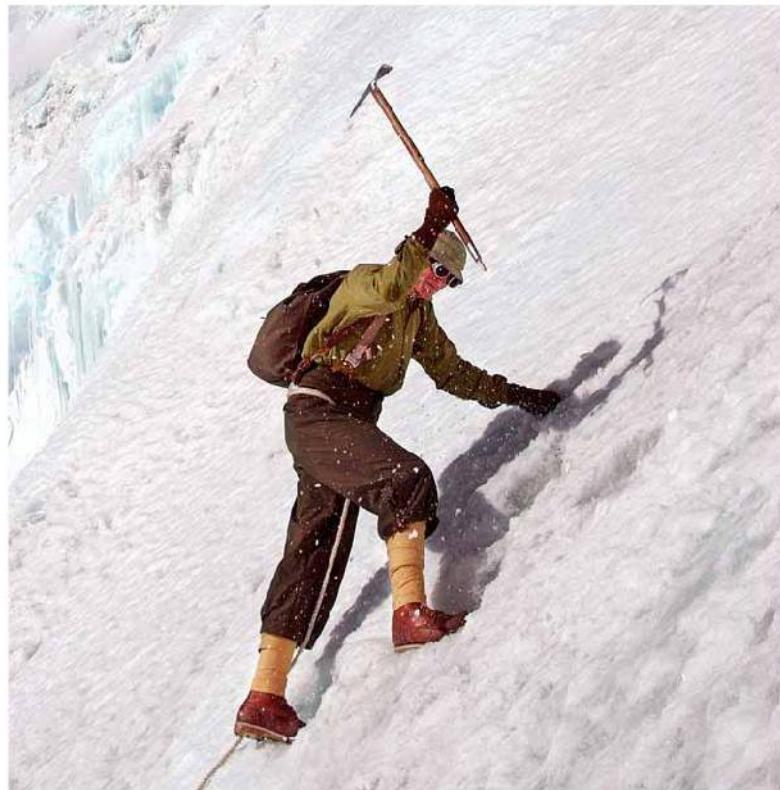


PHOTO: JIMMY CHIN

## FLASHBACK

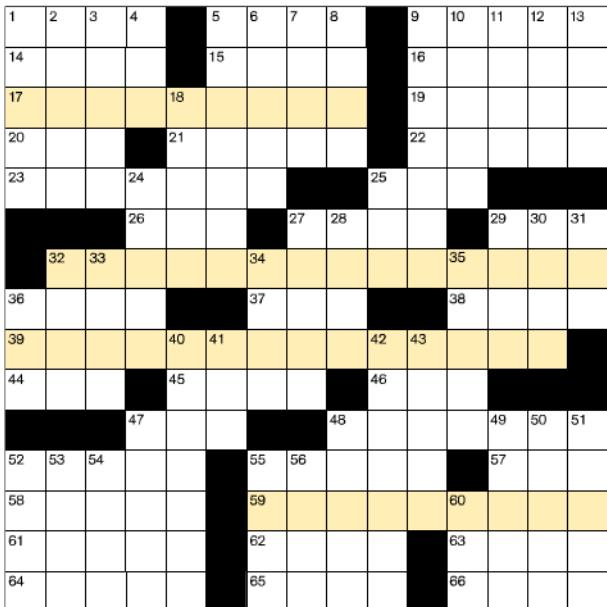




PHOTO: ROY WALDO MINER,  
NATIONAL GEOGRAPHIC STOCK

**Deep Cover** Peering through a 55-pound brass helmet, marine biologist Roy Waldo Miner “prepares to make movie actors of the rainbow-hued residents of a coral reef” off Andros Island, Bahamas. Miner’s expedition, which he wrote about in the June 1934 issue of *National Geographic*, also harvested some 40 tons of coral from the site. Specimens were hoisted from the sea bottom, bleached and dried, then shipped to New York City’s American Museum of Natural History, where they were coated with beeswax and painted to resemble a colorful living reef. That coral is still on display, part of a two-story-tall diorama in that museum.

—Margaret G. Zackowitz

**ACROSS**

- 1** Cabbage-family member
- 5** Weak, as excuses go
- 9** Brig digs
- 14** "Now \_ me down to sleep"
- 15** Gen. Bradley, George S. Patton colleague
- 16** Along the line of rotation
- 17** Stride of an *Ambulocetus*?
- 19** Margaret Sanger was one
- 20** "That's gross!"
- 21** Parenthetical remark
- 22** Like a kitty cornered, maybe
- 23** Kadiddlehopper portrayer Red
- 25** Designated driver alternative
- 26** Columbus sch.
- 27** Dirty reading
- 29** Avail oneself of Vail
- 32** What happened when a police-man caught a beluga jaywalking?

**36** Float ingredient**37** Court**38** Its use is decreasing?**39** What hiking humpbacks might leave behind?**44** Tiny toiler**45** "Three Little Pigs" baddie**46** Prefix with lateral**47** What a tetrapod's leg evolved from**48** Aesthetically appropriate**52** Buffoons**55** Cascades and such**57** Parseghian of Notre Dame fame**58** Dizzying gallery pieces**59** Shamu's showing-off step?**61** Cheshire change**62** Bottom-heavy fruit**63** Holey material**64** Express scorn**65** A piece of cake**66** Moonstruck star**DOWN**

- 1** Nickname for New Zealanders
- 2** Shakespearean "Shucks!"
- 3** Potato pancake
- 4** Kind of candy or tooth
- 5** Closes a computer system
- 6** At full throttle
- 7** Hotel staffer
- 8** One-named *Harper's Bazaar* illustrator
- 9** Many a Bach work
- 10** Bedroom community
- 11** Pisa dough of yore
- 12** Use beams surgically
- 13** Malamute's tow
- 18** Dustin, in *Midnight Cowboy*
- 24** New England hub
- 25** Piece of the pie
- 27** Express scorn
- 28** Siamese "please"
- 29** Dried and withered
- 30** The enemy organization in *Get Smart*
- 31** Wayside stopover
- 32** \_ in (intrude)
- 33** Menu-bar word
- 34** Truant GI
- 35** Lashes
- 36** Curative locale
- 40** Tornado
- 41** Ishmael, to Abraham
- 42** Rubik's Cube birthplace
- 43** Starting stakes
- 47** Coerce
- 48** Pizarro's victims
- 49** Fergie, formally
- 50** Cease-fire
- 51** One digging in
- 52** Conks
- 53** Candid
- 54** Westerns writer Grey
- 55** Dogie catcher
- 56** Neighborhood
- 60** Patient's pampering, briefly

## NEXT MONTH



King Tut's gold mask draws crowds daily to Cairo's Egyptian Museum.

PHOTO: KENNETH GARRETT

## September 2010

### Tut's Family Secrets

DNA evidence sheds new light on the boy king's life and death.

### Sands of Time

Aboriginal gods get credit for the creation of Australia's Fraser Island.

### Madagascar's Pierced Heart

Forces of greed are pillaging the island's rosewood, minerals, and gems.

### Tricky Insect Eggs

They are crazy looking, colorful—and utterly practical.

### Mystery Travelers

Eels writhe in rivers, cross oceans, and spawn in secret.