OCTOBER 2010

NATIONAL GEOGRAPHIC

INTERACTIVE EDITION

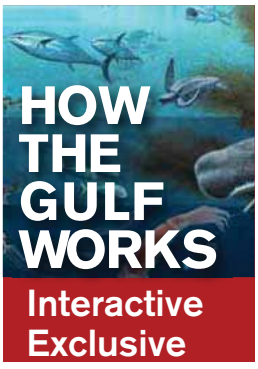
THE SPILL

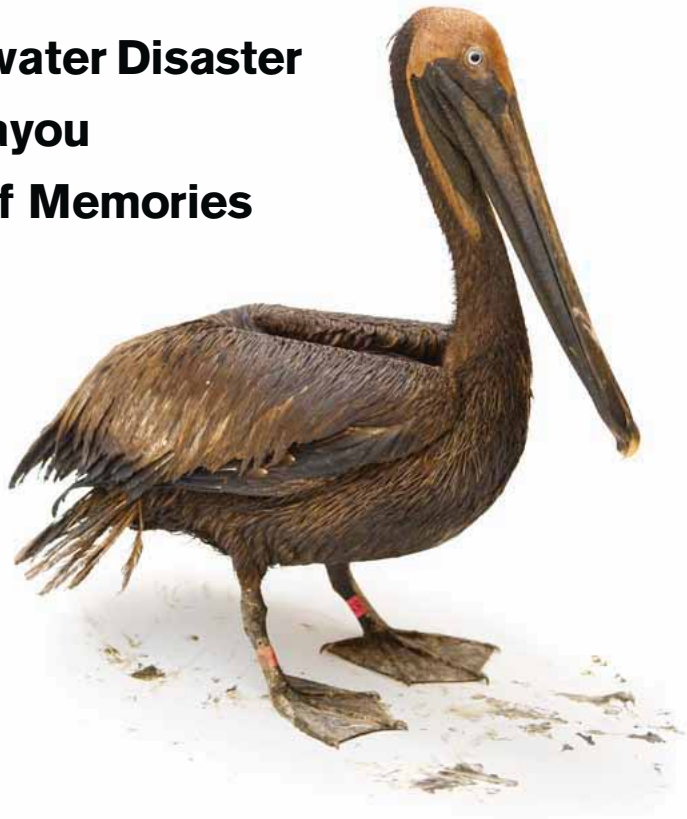
SPECIAL REPORT

Inside the Deepwater Disaster

The Toll in the Bayou

Sylvia Earle: Gulf Memories





Brown Pelican, Fort Jackson Bird Rehabilitation Center

PROTECTING MARINE LIFE

AUSTRALIA'S LOST GIANTS

NATIONAL GEOGRAPHIC

VOL. 218 · NO. 4

October 2010

Cover Story

The Spill

Is another deepwater disaster inevitable?

By Joel K. Bourne, Jr.

In the battle against oil, the wetlands aren't giving up

By Bruce Barcott

Special Section: Gulf of Mexico

The blue wilderness of my childhood

By Sylvia Earle

OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY


MORE

Seafood Print

The case for sardines, not tuna.

Australia's Lost Giants

Jumbo kangaroos once ruled the land.

MORE

Being Jane Goodall

Her work made us rethink chimps.

Allard's West

VIDEO

On the Cover
On June 14, the rehab center caught the oiled brown pelican. After a bath—the scared birds fight back—it was released July 1. *Photo by Joel Sartore*

▲

ENVIRONMENT

Everest Cleanup

The "death zone" holds 60 years' worth of dumped gear. Now the cleanup begins.

GEOGRAPHY

Record Hail

Hailstones aren't easy to make, but they fall with abandon in Kenya and are as big as eight inches across in the U.S.

OCEANS

Too Many Fish to See

A $650-million survey is creating a census of crabs, sea squirts, jellyfish, lampshells, and more.

▲

HEALTH

The Hydration Myth

Eight eight-ounce glasses a day? Experts think that the dictum doesn't hold water.

GEOGRAPHY

Crisis Cartography

Volunteers in post-quake Haiti quickly helped fill in the cartographic blanks.

THE BIG IDEA

Backing Up History

Laser devices are making detailed images of landmarks to aid in any future restoration.

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NATIONAL GEOGRAPHIC TRAVELER

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EDITOR'S NOTE

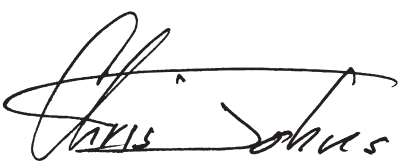
An oily wave breaks on the beach at Gulf Shores, Alabama.

PHOTO: TYRONE TURNER

It is 151 years, three months, and 24 days from the day, August 27, 1859, when Edwin Drake drilled the first successful oil well near Titusville, Pennsylvania, to the blowout of the *Deepwater Horizon* oil rig, 48 miles off the coast of Louisiana, this past spring.

Drake's well, which struck oil at a depth of 69.5 feet, launched the modern oil industry. We have been dealing with the consequences of our petroleum-fueled lifestyle ever since. There's been much finger-pointing and debate over who is to blame for the stain of oil in the Gulf of Mexico, but the fault can be said to lie in no small part within ourselves and our appetite for oil. It is an appetite that Drake, with his 20-barrel-a-day well, could not have imagined. The oil from that well, and others of that era, went mostly into kerosene, which was replacing whale oil for lighting. Henry Ford's company, which would ultimately put car keys in millions of hands, was nearly half a century away. Petroleum-based polymers, plastic bottles and bags, fertilizers, jet planes, the Age of Hydrocarbon Man, as Daniel Yergin calls it in *The Prize*, his history of oil, had not yet arrived.

The words that follow in this month's issue, and the photographs—an oil-soaked pelican, a tarry shoreline, the despair on fishermen's faces—remind us that there is more to the cost of oil than the ticking numbers at the fuel pump.



LETTERS

Greenland

Your article showed the challenges of agriculture in Greenland. However, it's a bit unfair to knock Greenland's farms for importing fodder from Europe. The European Union is highly dependent on imports for feeding its livestock. Over 50 percent of the EU's protein feed is imported; it is largely soybeans from the Americas. Better that Greenlanders develop their agriculture than become dependent on drilling for oil off the coast.

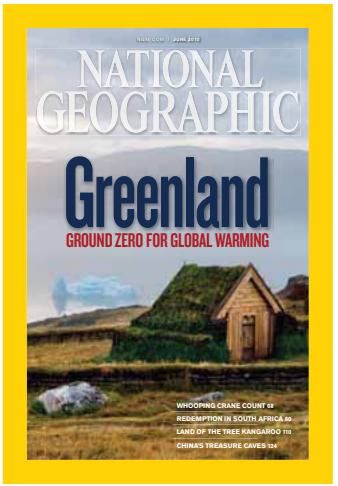
HERB S. ALDWINCKLE
Professor of Plant Pathology
Cornell University
Geneva, New York

While Greenland citizens' optimistic view of oil and rare earth profits is understandable, it should be tempered by recent realities. The deaths of miners in China and West Virginia and the disaster in the Gulf of Mexico should warn of the possible price. The thousand-year tradition of fishing and farming could end tragically, with the newly wealthy populace sopping up oil or digging out buried friends and relatives.

DALE BARTOLETTI
Salinas, California

China's Caves of Faith

To the foreign curators who contend that "their museums have saved treasures that might otherwise have been lost forever— destroyed *(Touch* Text *button to read more.)*



June 2010

The European Union is highly dependent on imports for feeding its livestock. Over 50 percent of the EU's protein feed is imported; it is largely soybeans from the Americas.

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D I N G

EDITORS' CHOICE **Andrew Davison** Arvayheer, Mongolia
An Australian living in Mongolia, Davison, 32, braved -22ºF temperatures to witness an annual ice festival held on Lake Hovsgol. One of the events was this game, called *musnii shagai.* It involves two teams skimming animal bones toward red targets.

Selections from our editors

D I N G

United States Lunar light in California's Joshua Tree

bursts into view beneath Arch Rock, a 12-foot-tall, 30-foot-wide granite formation
National Park. Naturally beige, the rock is illuminated here by a red LED.

PHOTO: JIM PATTERSON PHOTOGRAPHY

United States Nearly camouflaged on the debris-strewn bottom of Florida's
male jawfish holds hundreds of eggs in its mouth—a five-day incubation pro

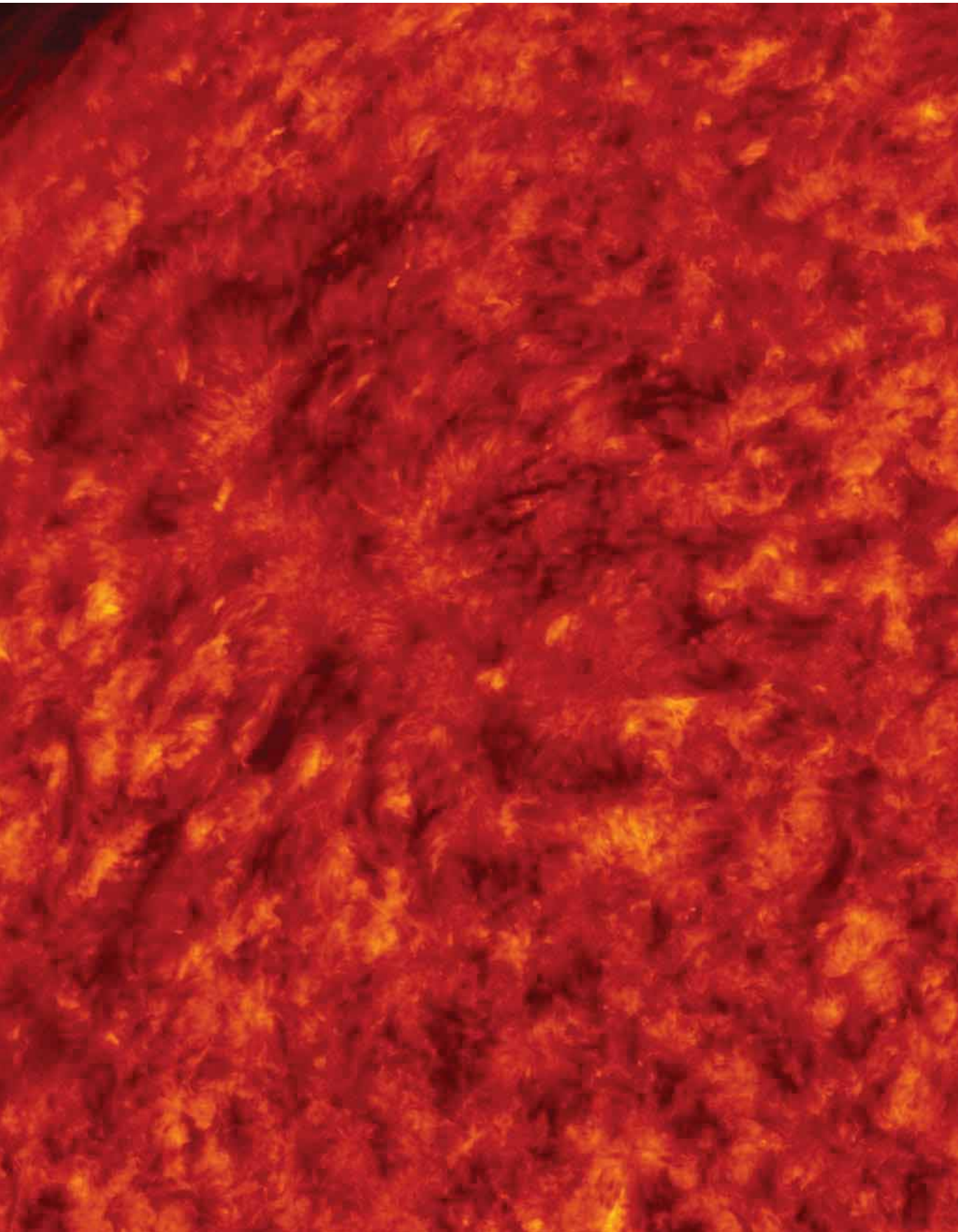
Lake Worth Lagoon, a six-inch-long
cess called paternal mouth brooding.

PHOTO: MICHAEL PATRICK O'NEILL

The Sun NASA's new Solar Dynamics Laboratory reveals an erupting plasma looping into the atmosphere along a magnetic field line. Ten Earths could be

plume—aka a solar prominence—
stacked inside the twisting ring.

IMAGE: NASA



Left on Everest For 60 years climbers have dumped gear and trash en route to the top of Mount Everest, often in the low-oxygen "death zone" above 26,000 feet, where shedding a few pounds can preserve precious energy.

In recent years melting ice has begun to reveal the scope of the high-altitude imprint, exposing oxygen tanks and other long-frozen jetsam. Though tons of refuse are removed annually from base camps, last spring two Nepali groups, Extreme Everest Expedition and Eco Everest Expedition, targeted the peak's upper reaches and hauled down seven tons of waste, including debris from a 1973 helicopter crash.

Nepalis are also concerned about corpses collecting on the mountain they consider holy. Since 1996 some 80 climbers have perished above base camp; most remain near the spot they died. In May two bodies, a Swiss and a Russian, were removed along with a pair of unidentified arms, one wearing a watch. Bringing back corpses was long considered logistically unfeasible, says Linda McMillan of the International Mountaineering and Climbing Federation. But as traffic on Everest has risen, she notes, so too has the desire to clean it. *—Peter Gwin*

Melting ice exposed an unidentified hand and a watch.

A Sherpa on Mount Everest sorts trash into plastics, metals, and biodegradables.

PHOTOS: CORY RICHARDS

Where's the Hail? It's not easy to make a hailstone—conditions have to be just right. First come cumulonimbus clouds. What's needed next are powerful updrafts and downdrafts. These winds carry forming precipitation up to the frigid top of the clouds to freeze solid and then down toward the warmer bottom again to collect more moisture, before repeating the cycle. The more times the cycle repeats, the bigger the hailstones can grow—and the more severe the damage down below.

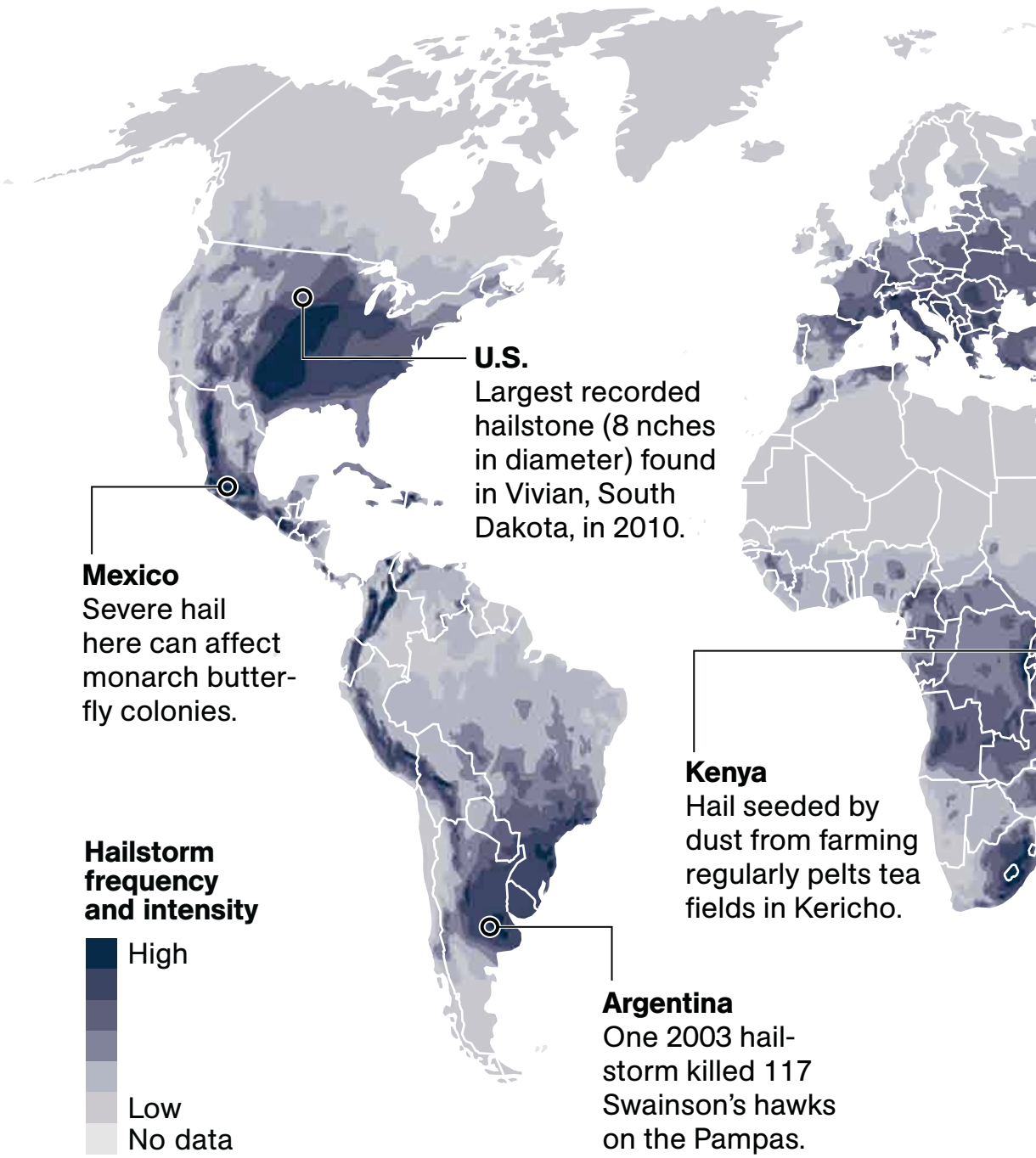
Most hail hits in the midlatitudes, on plains downwind of major mountain chains. But intense hail conditions can exist wherever warm, moist air is pushed to great heights, even near the Equator. The high-altitude tea-growing region of Kericho, Kenya, is more than 7,000 feet above sea level and may have more days with hail than any other place in the world.

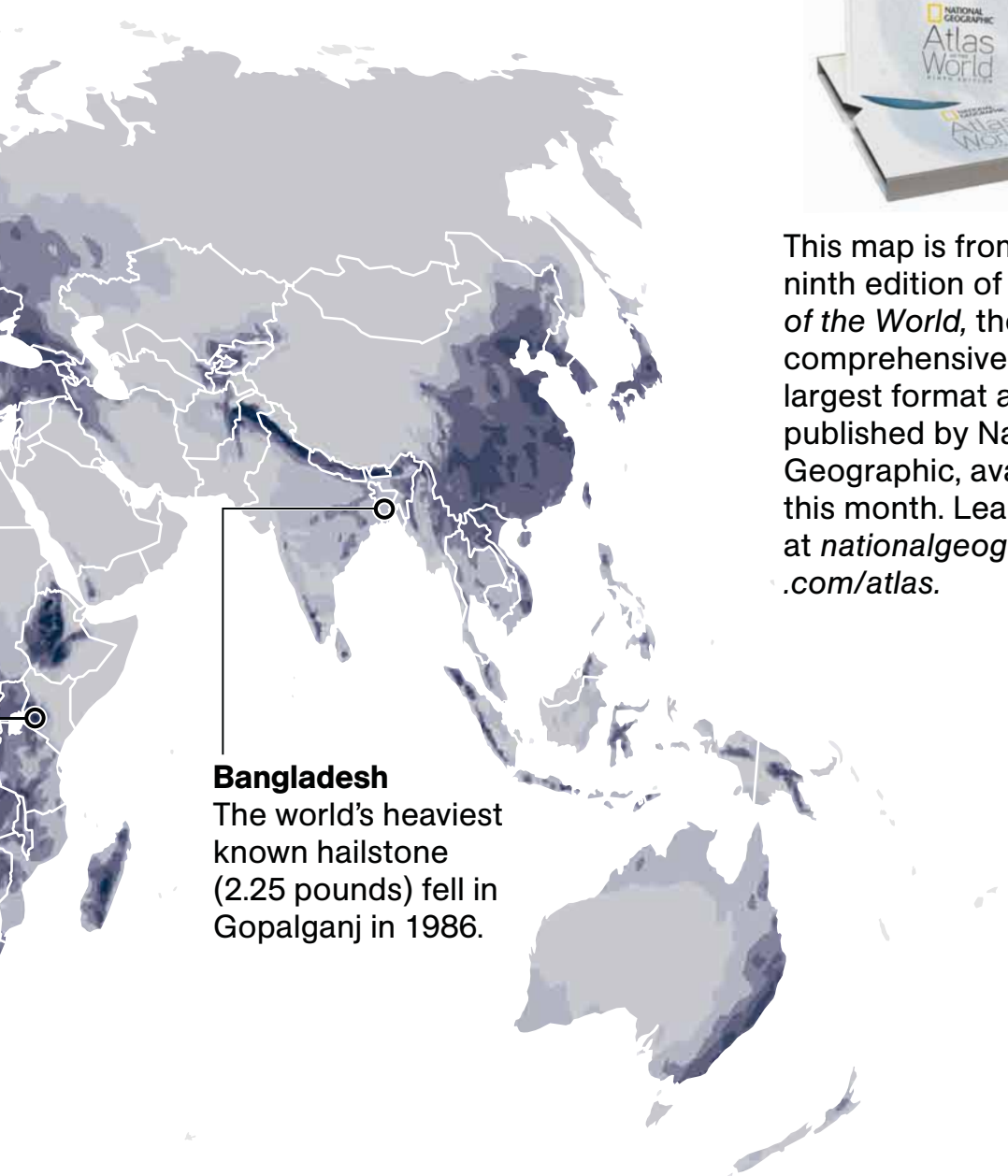
In 2009, 306 destructive hailstorms in 16 states caused more than $500 million in damage to crops and property in the United States. With warmer, wetter summers predicted for the Great Plains, experts fear that number is sure to rise. *—Thomas Hayden*

This baseball-size hailstone fell in Kansas in May 2007.

PHOTO: JIM REED, CORBIS

The United States has had some of the largest hailstones, but Kericho, Kenya, may hold the record for most frequent hail.





Bangladesh
The world's heaviest known hailstone (2.25 pounds) fell in Gopalganj in 1986.

This map is from the ninth edition of the *Atlas of the World,* the most comprehensive and largest format atlas ever published by National Geographic, available this month. Learn more at *nationalgeographic .com/atlas.*

MAP SOURCE: MUNICH RE, 2009

One Fish Two Fish

Dr. Seuss had the right idea but the wrong tools. To begin a tally of all sea life, he'd have had to swap rhymes for research—say, 538 expeditions and 30 million records cataloged over ten years by 2,700 scientists from more than 80 nations.

That's what went into the landmark Census of Marine Life, which unveils its full findings this month. Conceived by scientists Frederick Grassle and Jesse Ausubel, the $650-million survey—whose biggest funder was the Alfred P. Sloan Foundation—used everything from cutting-edge technologies to centuries-old fishing logs to find and ID species, map ecosystems, and assess data down to 16,000 feet.

"It's an astonishing start," says National Geographic Explorer-in-Residence Sylvia Earle. Yet with 95 percent of the ocean depths still unexplored, she says, a second census is warranted. "Don't we want to know who shares the planet with us?" *—Jeremy Berlin*

OCEAN CENSUS

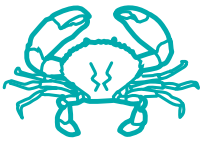
These figures hint at the scope of the seminal Census of Marine Life.

At least **one million** species* in the oceans

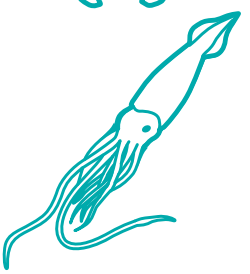
230,000 previously discovered

1,203 new species cataloged by the census

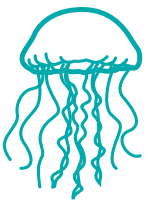
5,000 more awaiting description



562 crustaceans & kin



191 mollusks

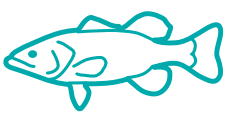


92 cnidarians

70 sponges

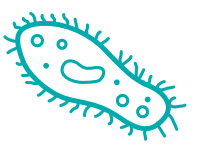
67 bristle worms

60 roundworms

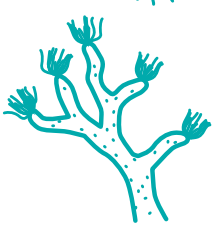


50 chordates

48 echinoderms



26 microbes



37 other

The yeti crab (left), a six-inch-long South Pacific native, is just one exotic find.

*EXCLUDING MOST MICROBES; NEW SPECIES AS OF JULY 2010
PHOTO: A. FIFIS, IFREMER 2006.
ART: JASON LEE

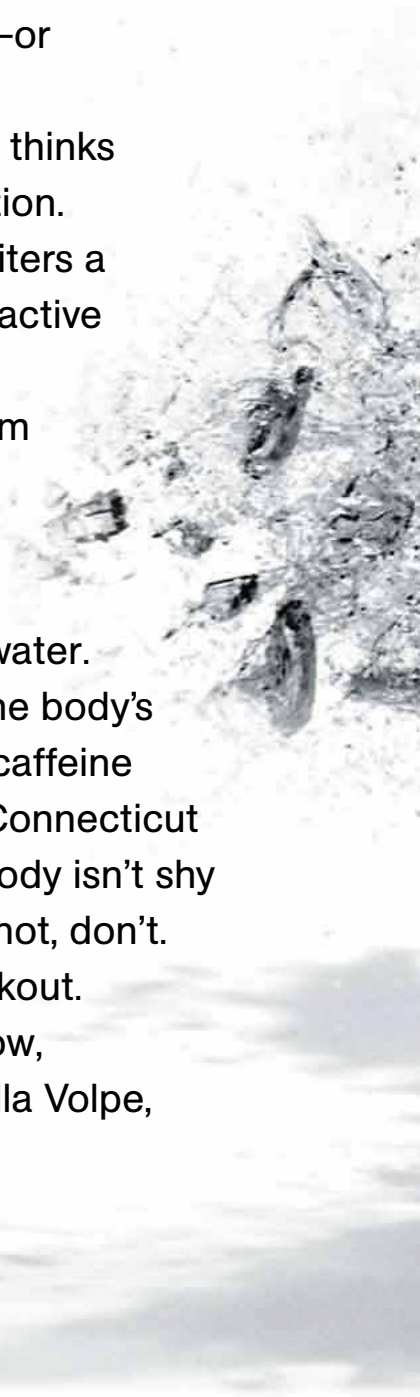
Shattering the Water Myth

Magazines, websites, even some medical texts recommend guzzling eight 8-ounce glasses of water a day. The bottled-water business loves it. Hydration experts, however, aren't exactly sure where the "8 x 8" rule came from—or whether it holds water.

Mike Sawka, a U.S. Army research scientist, thinks the origins lie in a 1933 study on rodent hydration. The research led to a recommendation of 2.5 liters a day, or 84.5 ounces of liquid, for a moderately active human to make up for water lost to sweat and excretions. Twenty percent typically comes from foods high in water—soup, ice cream, celery—leaving 67.6 ounces, or roughly "8 x 8." (Exercise or heat adds to a body's needs.)

Only you don't need eight daily glasses of water. Other beverages count, even if caffeinated. "The body's need to keep fluid trumps the small influence caffeine might have on losing fluid," says University of Connecticut exercise physiologist Douglas Casa. Plus the body isn't shy about liquid desires. Drink if you feel thirsty. If not, don't. One exception: Hydrate before an intense workout.

When in doubt, check your urine. Dark yellow, says University of Pennsylvania nutritionist Stella Volpe, is the hue of dehydration. *—Marc Silver*



Hydration experts are ready to rewrite the popular dictum that people should drink eight glasses of water a day.

PHOTO: MARK THIESSEN, NGM STAFF, WITH DAN HAVENS

Crisis Cartography When disaster strikes, accurate maps can be lifesavers. After a magnitude 7 earthquake rocked Haiti on January 12, first responders were hampered by the scarcity of street maps—but not for long. Within hours, volunteers in the capital city, Port-au-Prince, and elsewhere had filled in cartographic blanks, creating far more detailed, accessible, and immediate maps and images than most of those available online.

Using text messages, GPS, and plain old pencils and paper, they dispatched thousands of alerts a day about street names, building collapses, and injury locations. Disaster-response nerve centers synthesized the information with satellite data, which helped guide emergency workers, including the U.S. Marine Corps and Red Cross.

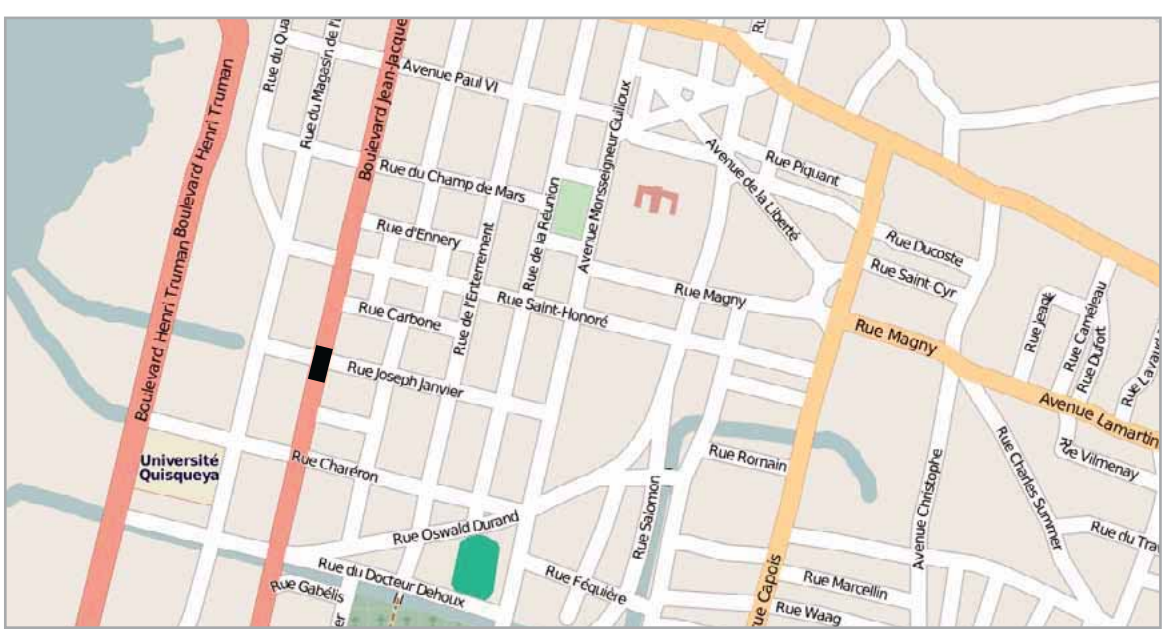
User-generated maps can present pitfalls. Accuracy, for instance, isn't guaranteed. But in Haiti benefits outweighed drawbacks. "Don't stop mapping," came a January 17 call from the Federal Emergency Management Agency to Ushahidi-Haiti, a student-run project at Tufts University. Crisis mappers won't. *—Hannah Bloch*

MORE

The January 12 quake reduced this section of Port-au-Prince's Boulevard Jean-Jacques Dessalines to rubble—which still remained by May 2010, when the photos in this panorama were taken.

DECEMBER 30, 2009
Two weeks before the quake, this user-generated map of Port-au-Prince included minimal information about streets and landmarks.

PHOTOS: MAGGIE STEBER. MAPS: OPENSTREETMAP AND CONTRIBUTORS, LICENSED CC-BY-SA 2.0



JANUARY 13, 2010
OpenStreetMap elicited street names the day after.

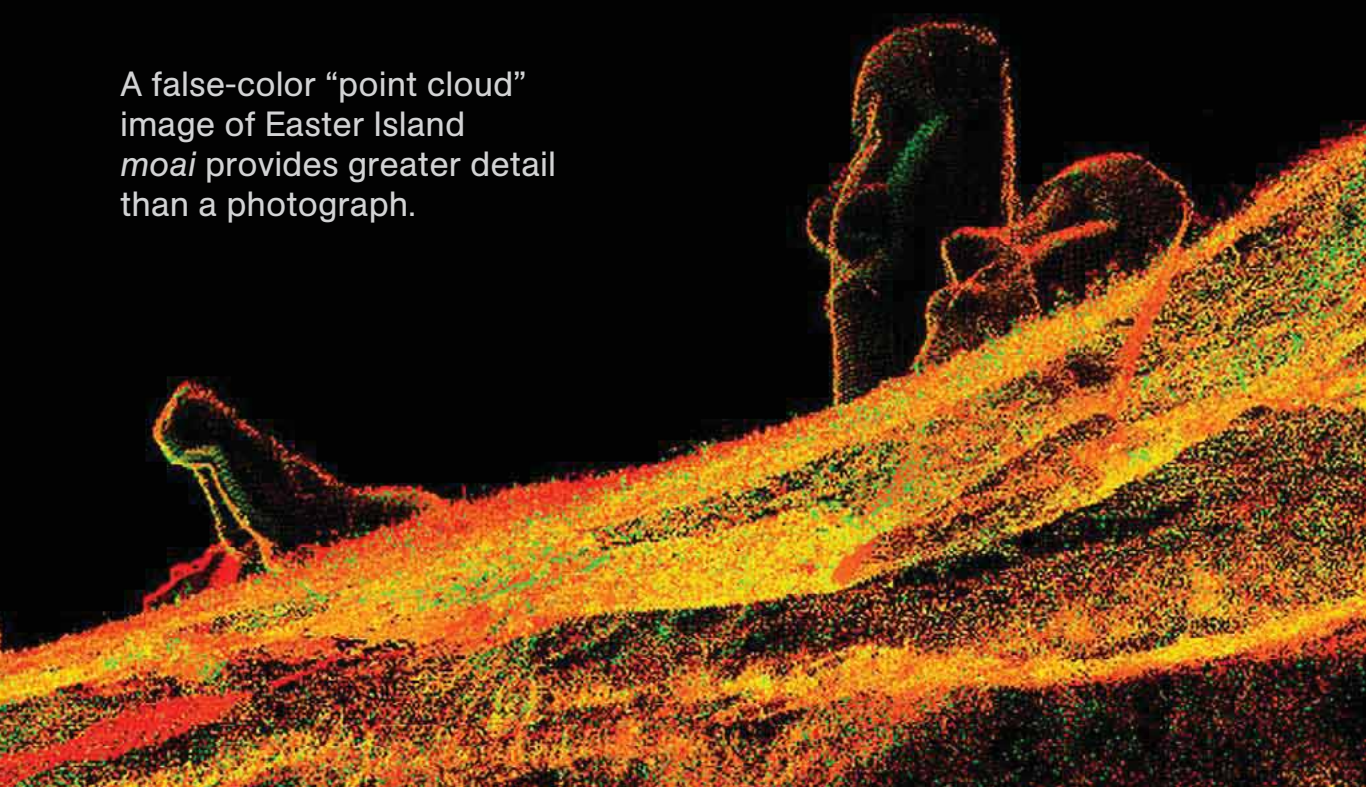
JANUARY 29, 2010

Clinic and shelter locations were soon pinpointed as well.

PHOTOS: MAGGIE STEBER. MAPS: OPENSTREETMAP AND CONTRIBUTORS, LICENSED CC-BY-SA 2.0

Backing Up History

With portable 3-D laser scanners, preservationists are making digital records of the world's most vulnerable landmarks.



A false-color "point cloud" image of Easter Island *moai* provides greater detail than a photograph.

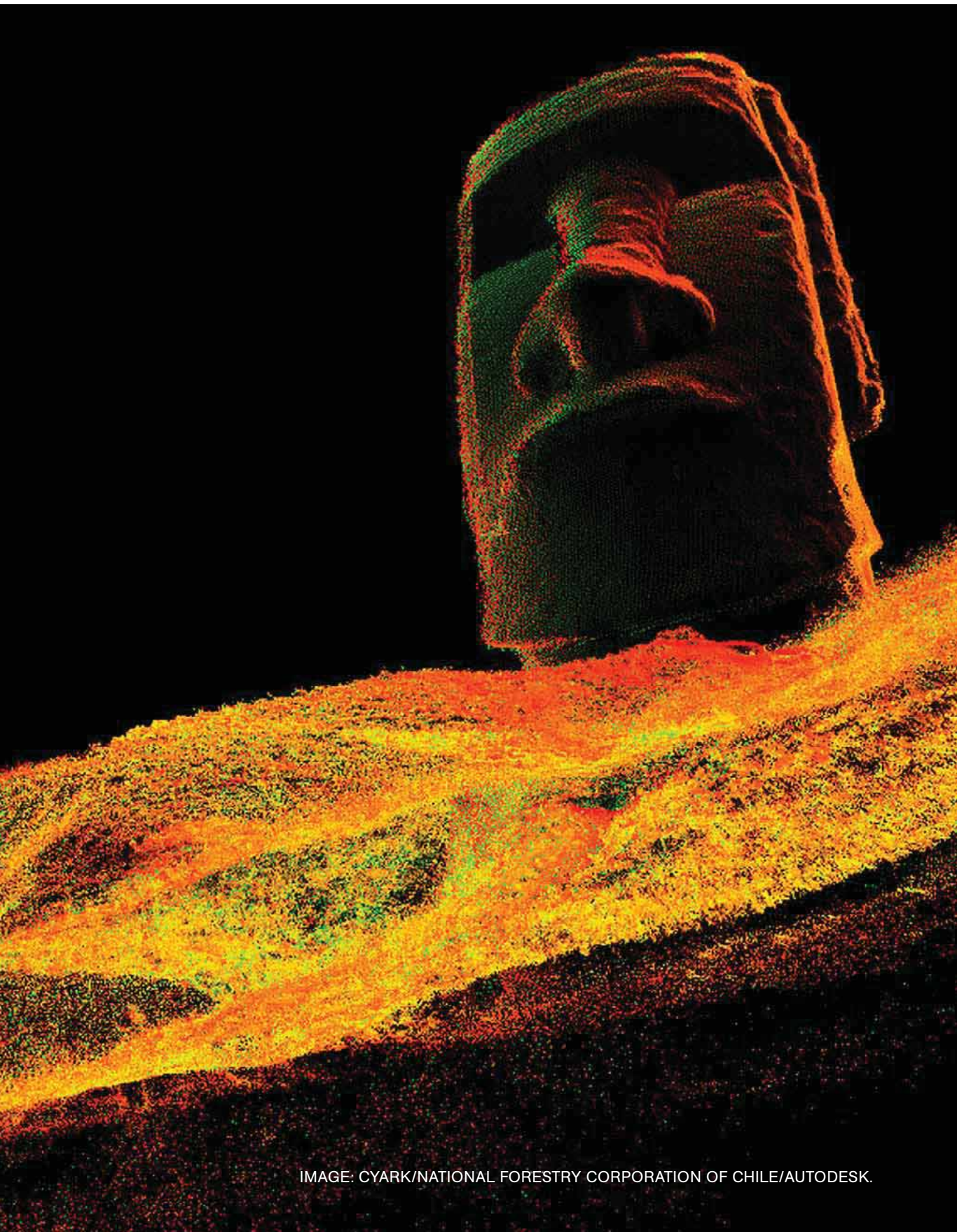
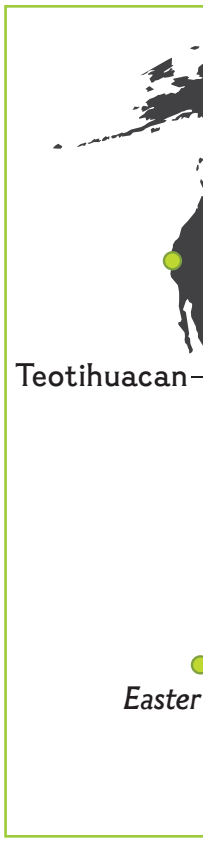


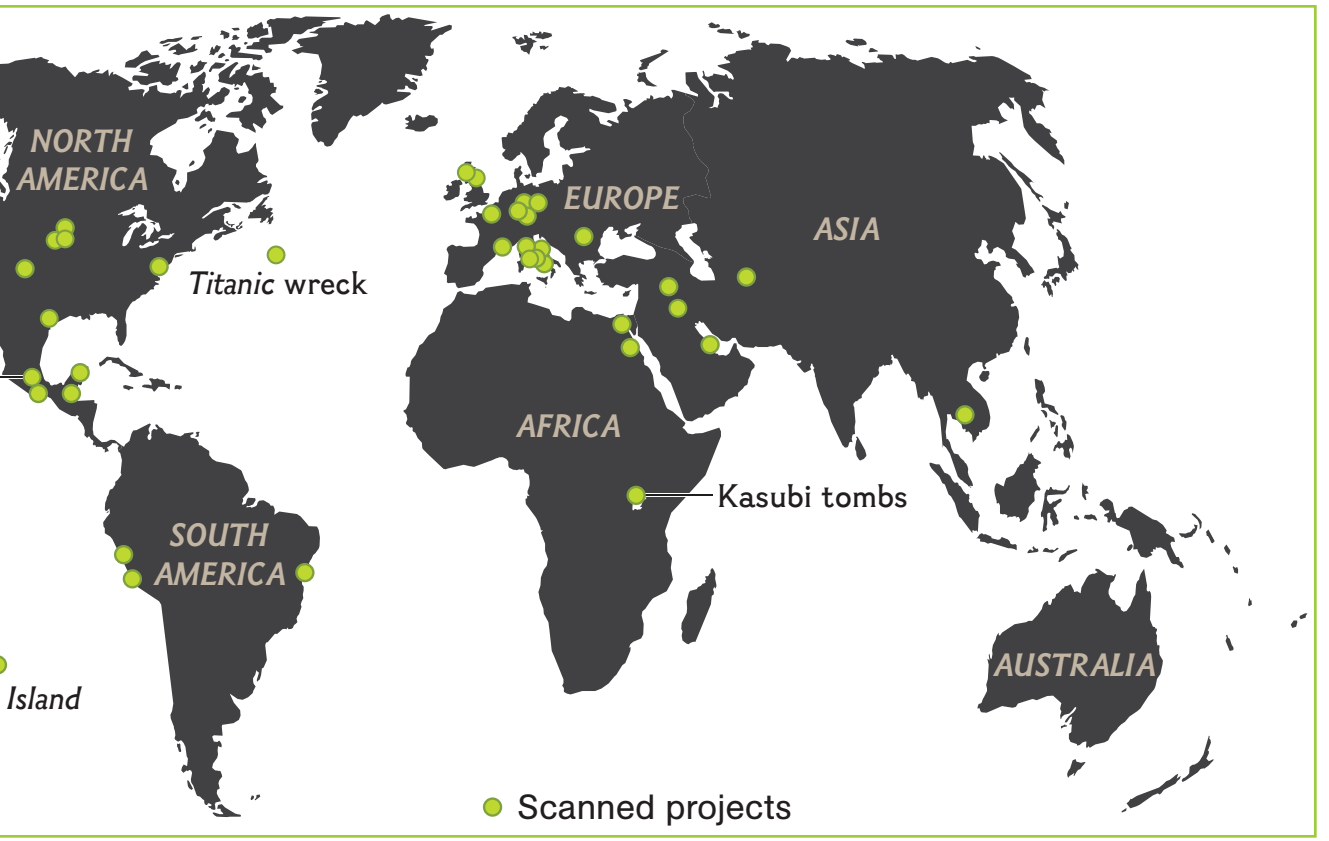
IMAGE: CYARK/NATIONAL FORESTRY CORPORATION OF CHILE/AUTODESK.

The stone giants called *moai* have kept watch—and secrets—on Easter Island for centuries. Now preservationists have found a way to learn more about them. In 2007, six workers who'd partnered with the nonprofit CyArk arrived on the island with a 3-D laser scanner and other surveying equipment. They made high-resolution scans of carvings and caves, producing a data set so accurate they call it "reality capture."

CyArk's mission is to collect detailed digital records of cultural heritage sites around the world (see map at right), from the *Titanic* wreck to Mexico's Teotihuacan. Its key tool is a portable 3-D laser scanner that sweeps an area with a pulsing laser and returns a high-definition map of the surrounding surfaces. With data recorded as close as every half centimeter, the resulting surface map shows a "point cloud" that can include hundreds of millions of pieces of data. In addition to 3-D coordinates, the laser scanner records each point's "intensity return," a value that represents the color and brightness of the scanned object's surface. These values are shown with a false coloring. Analysts can use this information to see where cracks are developing or whether newer materials have been incorporated into a structure.

Ben Kacyra was one of the inventors of the laser scanner used in the surveys and is also CyArk's founder. He was inspired to start the nonprofit after the Taliban demolished Afghanistan's Bamian Buddhas in 2001. If detailed laser scans are available, he reasoned, at





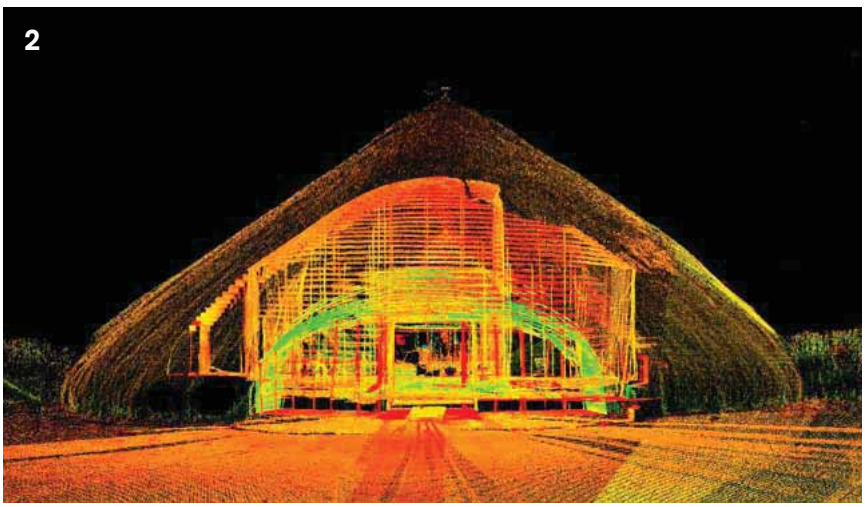
The nonprofit CyArk has created digital records of important cultural heritage sites around the world.

least something remains in the event of a site's loss.

Such a loss occurred earlier this year, when fire consumed the royal Kasubi tombs in Uganda. Four kings of Buganda—a kingdom within the country—were entombed in the wood-and-thatch structure. A year earlier, though, CyArk had collected scans there. Within days of the fire, a Buganda prince was talking to CyArk about rebuilding. **MORE**

NGM MAPS


1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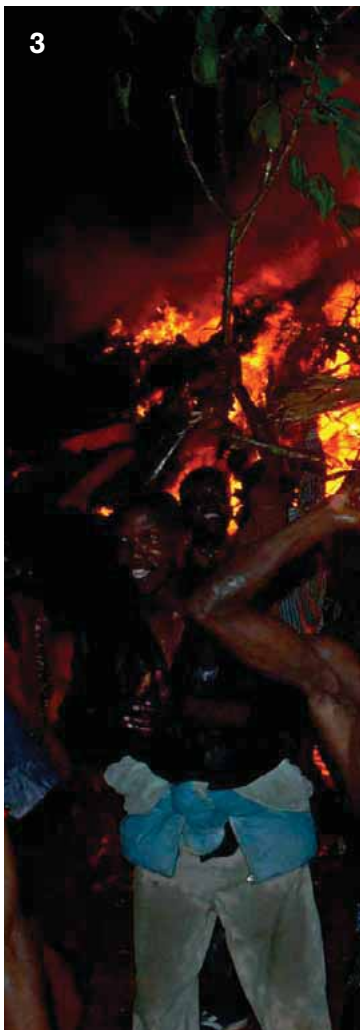

3

CyArk has identified more than 800 at-risk sites to survey. Where resources allow, it works with an international network of partners to scan the sites—38 so far. All data collected is archived and publicly available at *cyark.org.*

"Our collective memory is in the works of man," Kacyra says. "This is really not just a matter of preserving this site or that site. It's a matter of preserving our human collective memory." *—Elizabeth Preston*

1 **Built in 1882**
Uganda's Kasubi tombs were declared a UNESCO World Heritage site in 2001. Four kings were buried in this thatched structure.

2 **Scanned in 2009**
A CyArk laser scan created this point cloud image revealing details, including the building's high-ceilinged interior.

3 **Destroyed in 2010**
Local people gathered as flames engulfed the tombs. The cause of the fire remains unknown.

PHOTOS: SKYBUCKET3D (1); CYARK (2); AFP/GETTY IMAGES (3)

THE GULF OF OIL

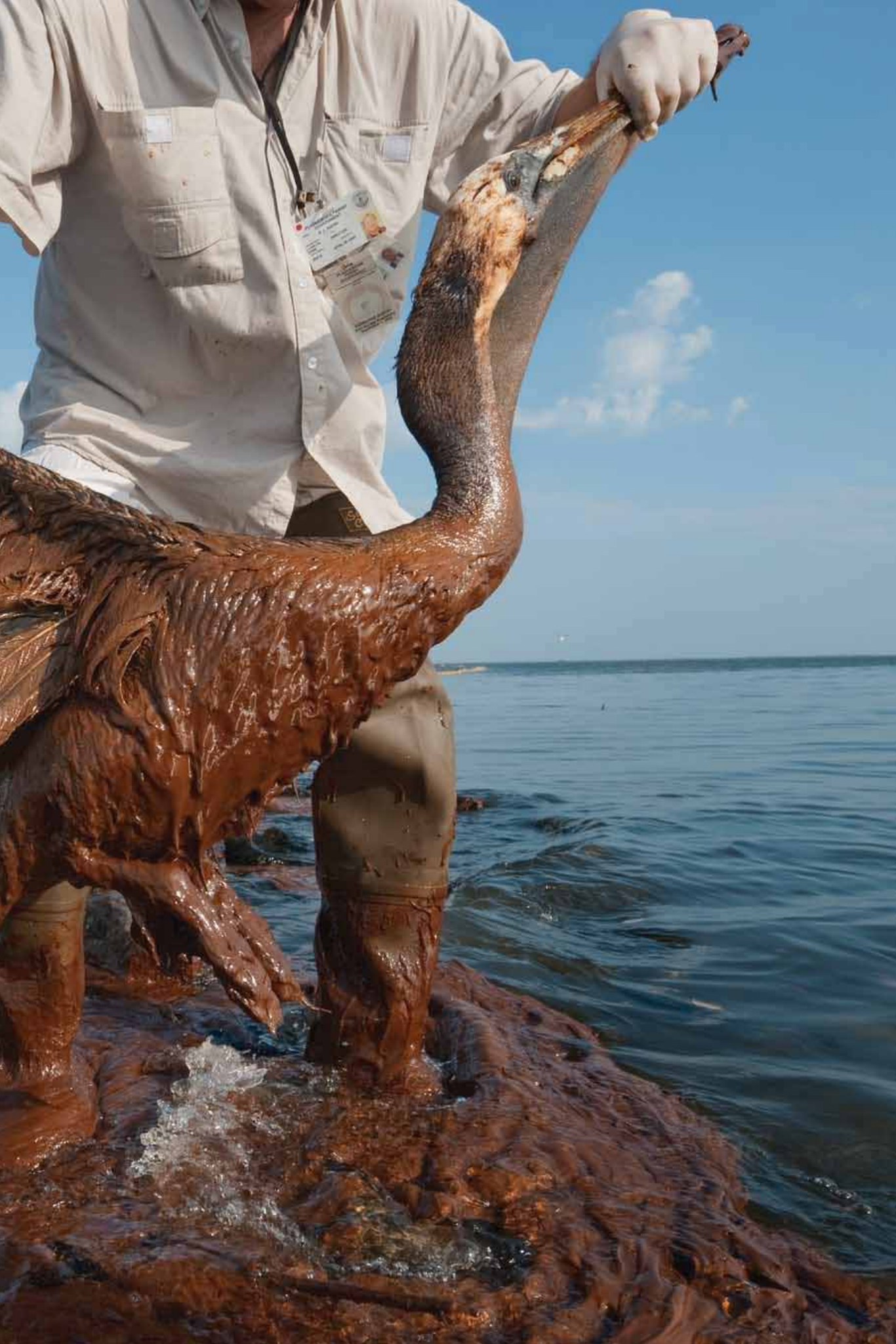
Smoke rises from surface oil being burned by cleanup crews near the *Deepwater Horizon* blowout. The well spewed nearly five million barrels, making it the world's largest accidental marine oil spill. JOEL SARTORE (BOTH)

UNFLAGGING DEMAND
FOR OIL PROPELLED THE
INDUSTRY INTO DEEP WATER.
BUT THE BLOWOUT IN THE
GULF FORCES THE QUESTION:

IS IT WORTH THE RISK?

"You could see the life draining out of it," says parish official P. J. Hahn, who impulsively rescued this severely oiled brown pelican on Queen Bess Island, La. The bird lived.

JOEL SARTORE



Bottlenose dolphins slip through oiled waters in Chandeleur Sound, La. An adult dolphin can weigh up to 600 pounds. Because of their size, only a few were rescued and relocated to clean waters.
ALEX BRANDON, AP IMAGES

"Mix two parts sugar white sand with one part crystal blue water," reads a tourism slogan for Orange Beach, Ala. In early June *Deepwater Horizon* oil was added to the recipe.

TYRONE TURNER

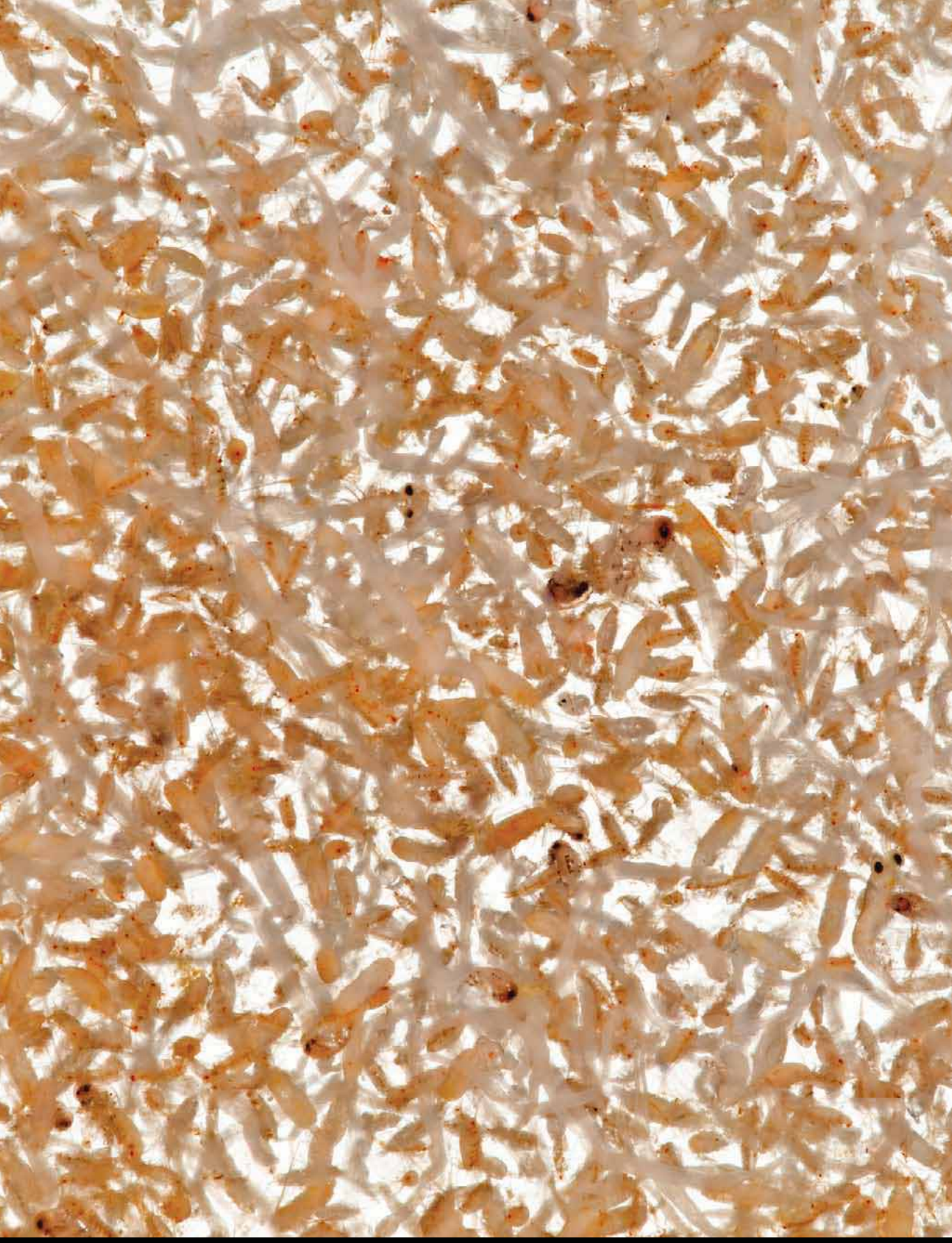
A shrimp the size of a staple swims amid dark brown globules of oil. The effect of the spill on the eggs and larvae of shrimps, crabs, and fish, all key to the local economy, remains unknown. DAVID LIITTSCHWAGER

THE SPILL'S UNSEEN TOLL

In time-lapse video, three formaldehyde-filled jars tell a tale of diminishing life in a water column about 90 miles north of the well. The initial May 4 sample, collected by the Dauphin Island Sea Lab, Ala., shows a normal amount of plankton—minute plants and animals that are the foundation of the ocean's food chain. The June 2 jar holds only 40 percent of the first. The June 28 jar is down to 10 percent. Plankton cannot survive as waters become hypoxic—depleted of oxygen. The probable cause in this case: microbes digesting oil and methane gas from the spill. DAVID LIITTSCHWAGER

MAY 4

D I N G



DEEP TROUBLE Waters sampled about 35 feet deep on June 28 support a thriving population of tiny crustaceans called copepods (left). Twenty feet farther below was a hypoxic layer almost devoid of life. Deep waters are more likely to remain hypoxic. DAVID LIITTSCHWAGER (BOTH)

Their waters closed by the spill, fishermen in St. Bernard Parish, La., attended a May 1 BP training for cleanup crews—and bowed heads for an archbishop's impromptu prayer.

TYRONE TURNER

THE GUL

THE DEEP DILEMMA

BY JOEL K. BOURNE, JR.

FORLORN IN THE BAYOU

BY BRUCE BARCOTT

F OF OIL

HOW THE GULF WORKS

EXCLUSIVE INTERACTIVE GRAPHICS

MY BLUE WILDERNESS

BY SYLVIA EARLE

BY JOEL K. BOURNE, JR.

THE DEEP DILEMMA

The depths of the Gulf of Mexico are one of the most dangerous places to drill on the planet.

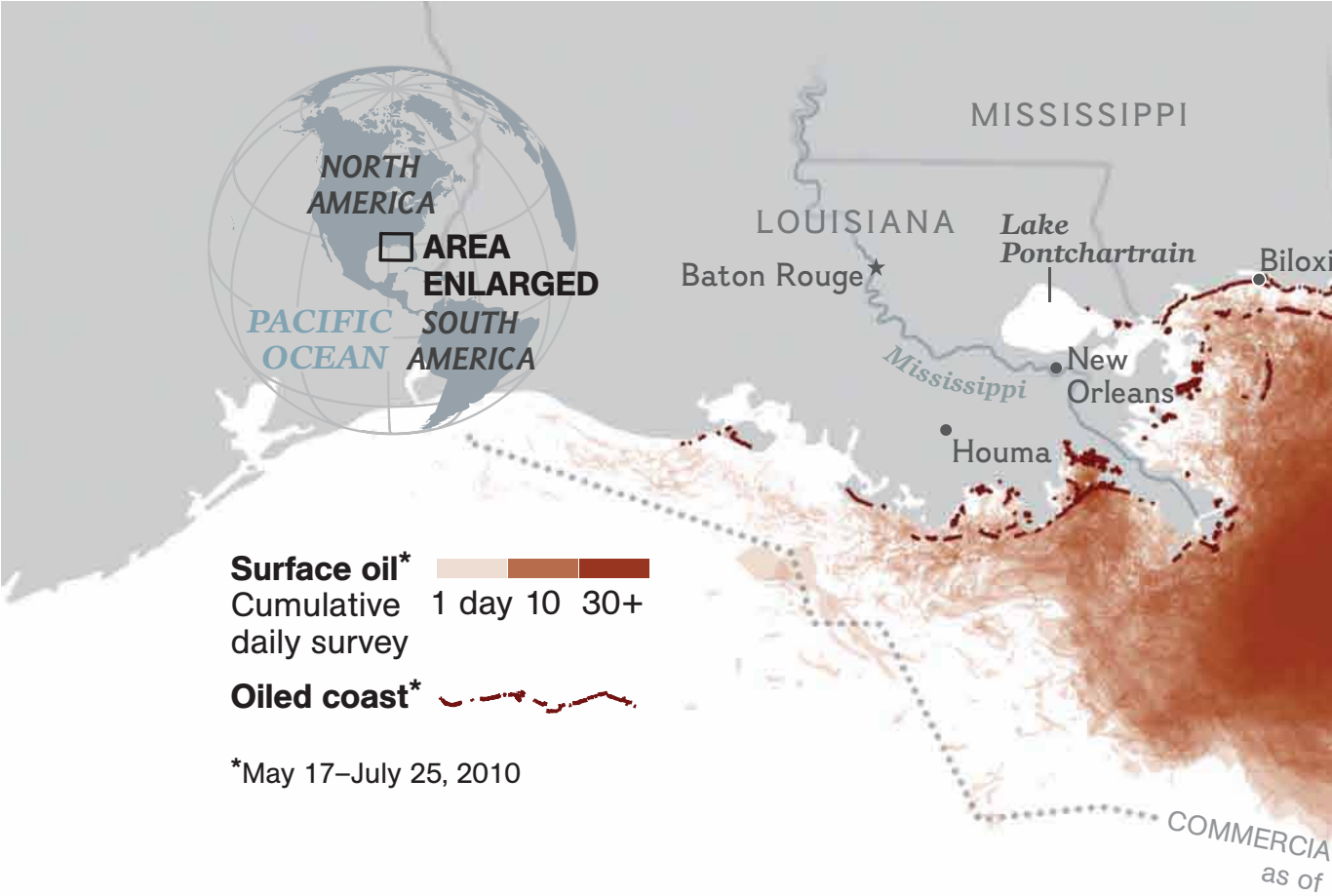
ON A BLISTERING JUNE DAY in Houma, Louisiana, the local offices of BP—now the *Deepwater Horizon* Incident Command Center—were swarming with serious men and women in brightly colored vests. Top BP managers and their consultants wore white, the logistics team wore orange, federal and state environmental officials wore blue. Reporters wore purple vests so their handlers could keep track of them. On the walls of the largest "war room," huge video screens flashed spill maps and response-vessel locations. Now and then one screen showed a World Cup soccer match.

Mark Ploen, the silver-haired deputy incident commander, wore a white vest. A 30-year veteran of oil spill wars, Ploen, a consultant, has helped clean up disasters around the world, *(Touch* Text *button to read more.)*

Joel Bourne is a contributing writer. His article about California's water supply appeared in April.

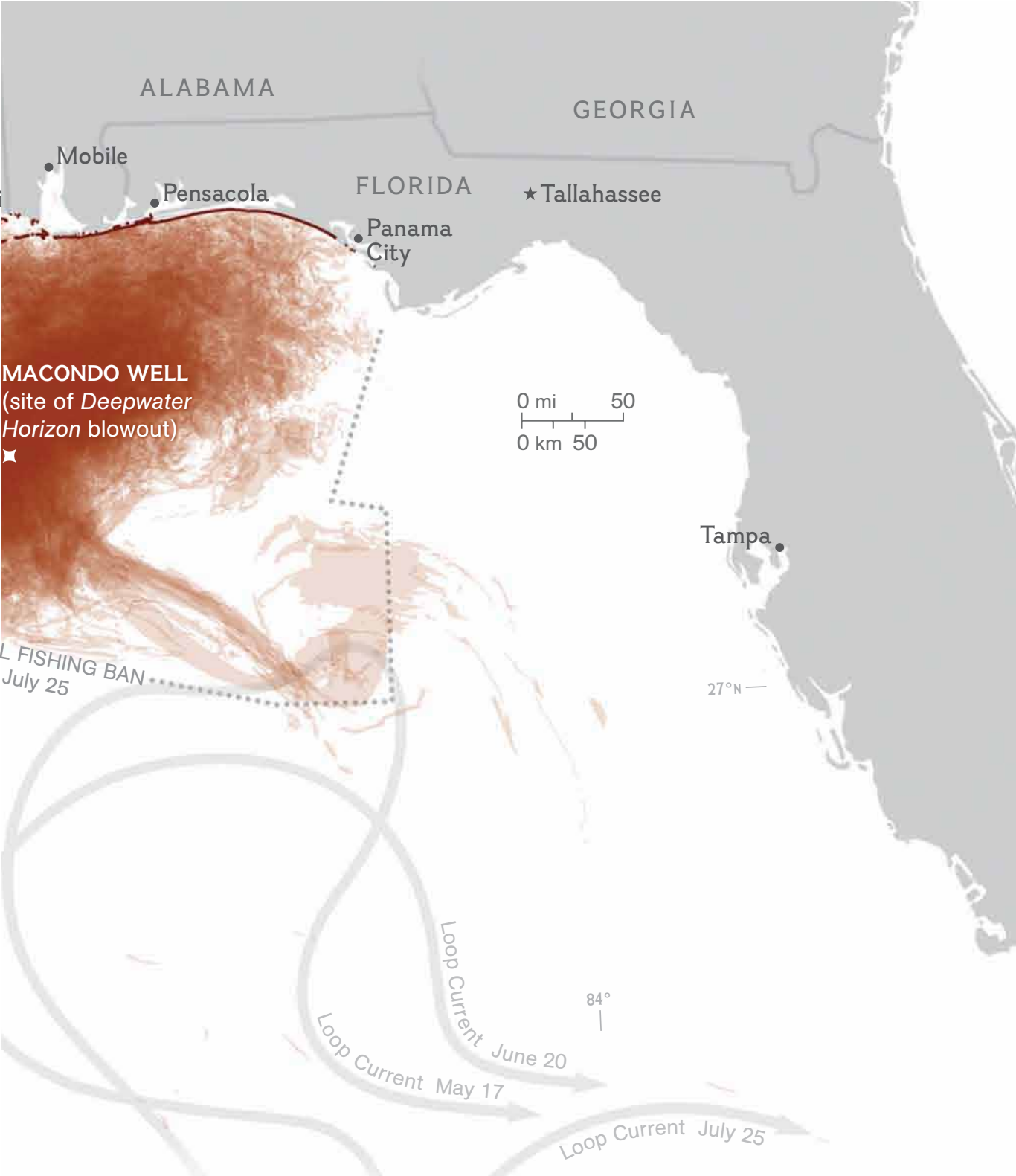
The $560-million *Deepwater Horizon* drilling rig burns after the April 20 well blowout. Eleven workers died in the explosion and flames that followed. On April 22 the rig sank.

GERALD HERBERT, AP IMAGES



THE BATTERED GULF COAST

Two centuries of efforts to tame the Mississippi River with levees, pumps, and channels have left its vast wetlands ecosystem dwindling and on the verge of collapse. “We know there was a crisis in the Gulf prior to what happened April 20,” Tom Strickland, an assistant secretary of the interior, said after the Deepwater Horizon spill. Coastal-restoration plans have been authorized by Congress but are not yet under way. They include breaking open levees to restore the flow of rivers to marshlands. Environmentalists are lobbying to apply oil spill penalty funds to restoration.



AN OILY STAIN Winds and currents spread surface oil, contaminating more than 625 miles of coastline, most in Louisiana. The spill prompted a fishing ban in one-third of federal waters (partly rescinded in late July) and a massive and ongoing cleanup effort. Experts believe much of the oil never reached the surface and remains in voluminous and elusive underwater plumes.

SAM PEPPLE AND LISA R. RITTER, NGM STAFF. SOURCES: NOAA (SURFACE OIL); U.S. NAVAL RESEARCH LABORATORY (LOOP CURRENT); NOAA AND UNIFIED AREA COMMAND (OILED COAST)

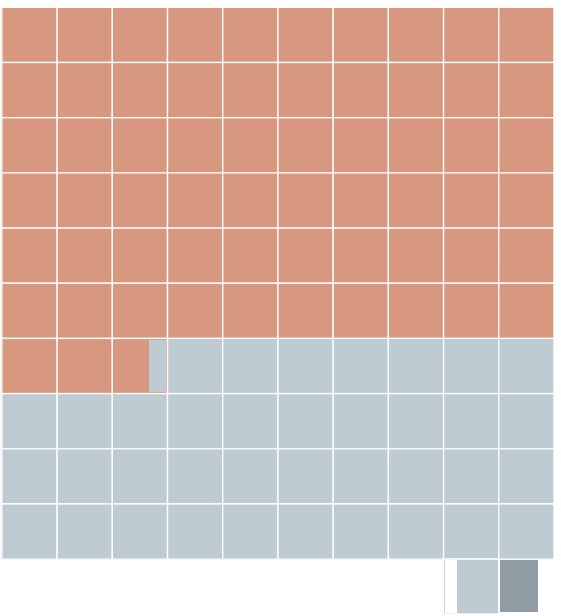
Canals carved through Golden Meadow, La., and elsewhere hold pipelines that deliver oil and gas from offshore wells. This chopping up of the wetlands is one of many forces contributing to the decline of the Mississippi Delta. JOEL SARTORE

WORKING GULF

Oil dominates revenues from the Gulf, but the employment giant is tourism. Louisiana, regional leader in commercial fishing before the spill, normally harvests a third of the U.S. shrimp and oyster catch.

Annual Revenue

$101.5 billion



OIL AND GAS
62.7

TOURISM
38.1

COMMERCIAL FISHING
0.7

1 block = $1 billion

NGM ART. SOURCES: EIA (OIL, 2008); TOURISM DEPARTMENTS OF ALABAMA, LOUISIANA, MISSISSIPPI, AND TEXAS, AND FLORIDA DEPARTMENT OF REVENUE (TOURISM, 2009); NOAA (FISHING, 2008, DOCKSIDE VALUE). JOBS: MOST RECENT AVAILABLE DATA FROM MULTIPLE SOURCES

Jobs*

645,000

OIL AND GAS

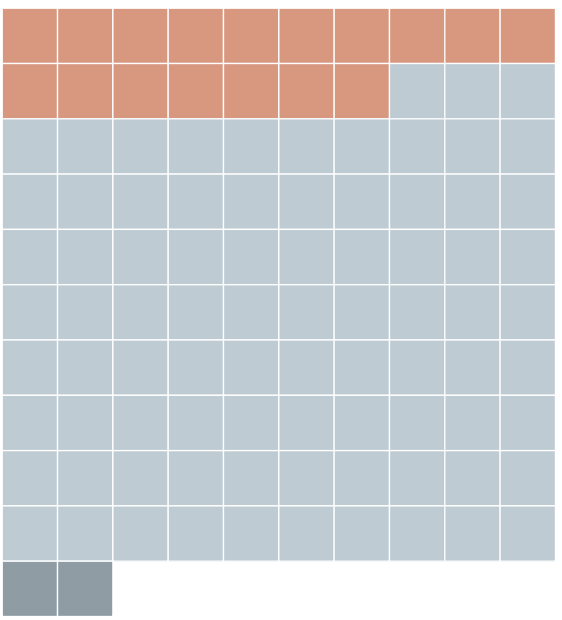
107,000

TOURISM

524,000

COMMERCIAL FISHING

14,000



1 block = 6,324 jobs

*Estimates

BY BRUCE BARCOTT

FORLORN IN THE BAYOU

Louisiana's wetlands have bounced back before. But no one knows how long this recovery will take.

WHERE LAND MEETS THE SEA in the Mississippi River Delta, down at the bottom of the Louisiana boot, the term "coastline" doesn't really apply. There is no line. There are only the dashed pen strokes of the barrier islands,a dozen or so thin beachheads, and beyond, a porous system of open bays, canals, salt and brackish marshes, and freshwater swamps running inland for 25 to a hundred miles.

These are the Louisiana wetlands—12,355 square miles of one of the most productive ecosystems in North America. Mullet are so profuse they will literally jump into a fisherman's boat. Brown pelicans, tricolored herons, roseate spoonbills, great egrets, and blue-winged teal ducks call this place home.

One-third of the *(Touch* Text *button to read more.)*

Environmental journalist Bruce Barcott lives on Bainbridge Island, Washington. This is his fourth feature for National Geographic.

Workers bag oil-collecting pom-poms near a bird rookery in Barataria Bay, La. Absorbent boom snakes at their feet. By the end of July, the cleanup had generated almost 40,000 tons of solid waste.

JOEL SARTORE

A dead juvenile sea turtle lies marooned in oil in Barataria Bay, La. More than 500 sea turtles died in the spill area. As of August 2, eggs from 134 turtle nests had been moved to oil-free beaches, and 2,134 hatchlings released. JOEL SARTORE

In mid-May pools of oil moved into Louisiana's wetlands. BP boats laid yellow and orange boom to corral the oil for clean-up, white boom to soak it up. Oil covered the grass, but by mid-July new growth had sprouted.
TED JACKSON, *TIMES-PICAYUNE*

Workers wipe oil from marsh grass in St. Tammany Parish, La. It does look silly, a parish spokesman concedes, using diaper-like cloths to “wipe up seven billion blades of grass.” But the task helped gauge the degree of marsh grass contamination, which turned out to be small, and provided oil samples for testing. SCOTT THRELKELD, *TIMES-PICAYUNE*

Rust-colored crude oil coats a blue crab's face and claws at Grand Isle State Park, La.
C. C. LOCKWOOD

Oil-stained brown pelican chicks huddle on Cat Island, a barrier island forming the westernmost point of Gulf Islands National Seashore. Unsullied juveniles stand behind.

JOEL SARTORE

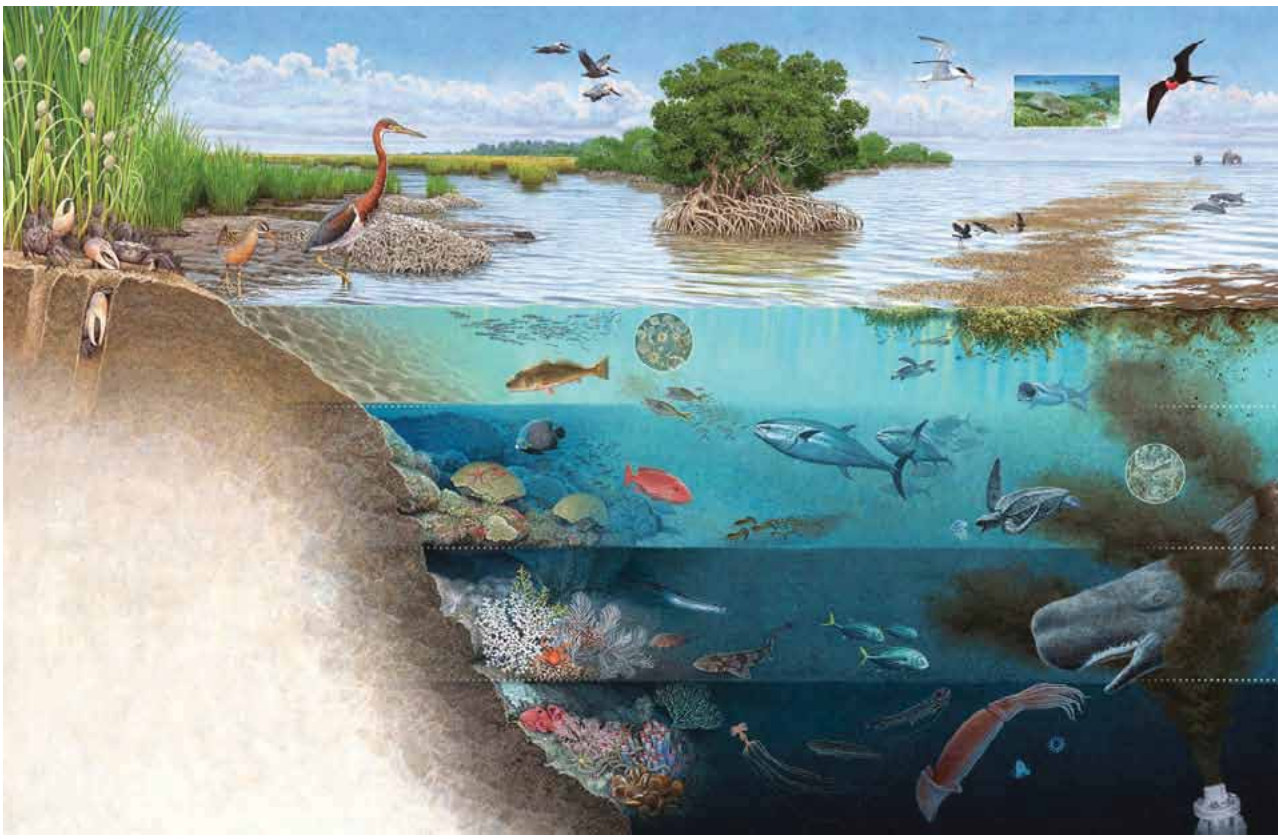
A brown pelican rests at the Fort Jackson Bird Rehabilitation Center in Buras, La., after a cleaning. Only a tiny fraction of birds are retrieved and released. No one yet knows how oil and dispersants will affect reproduction. JOEL SARTORE

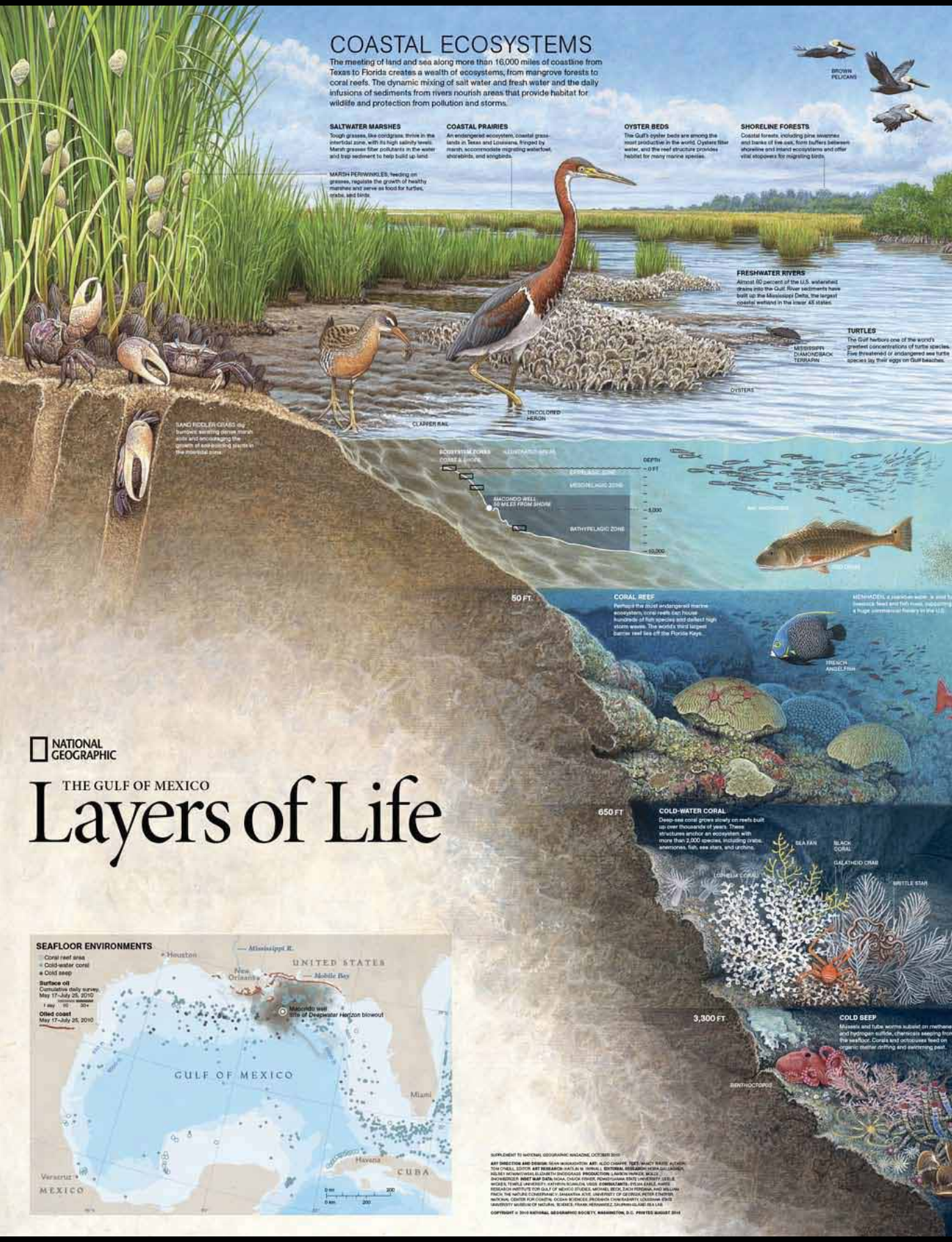
LAYERS OF LIFE

The rich habitats of the Gulf of Mexico help make it one of the most ecologically and economically productive bodies of water in the world. Its environments range from sandy, ever shifting barrier islands to muddy, tide-washed marshes, from frigid dark zones miles deep to immense islands of floating seaweed. Even before the *Deepwater Horizon* rig explosion on April 20, 2010, which spewed millions of barrels of oil into the water, the Gulf was battling serious problems, including overfishing, extensive wetlands loss, and a huge oxygen-starved "dead zone" at the mouth of the Mississippi River. The oil spill is affecting every habitat, testing the Gulf's resilience.

MORE

Detailed art on
next page




COASTAL ECOSYSTEMS
The meeting of land and sea along more than 16,000 miles of coastline from Texas to Florida creates a wealth of ecosystems, from mangrove forests to coral reefs. The dynamic mixing of salt water and fresh water and the daily infusions of sediments from rivers nourish areas that provide habitat for wildlife and protection from pollution and storms.
SALTWATER MARSHES
Tough grasses, like cordgrass, thrive in the intertidal zone, with its high salinity levels. Marsh grasses filter pollutants in the water and trap sediment to help build up land.
COASTAL PRAIRIES
An endangered ecosystem, coastal grasslands in Texas and Louisiana, fringed by marsh, accommodate migrating waterfowl, shorebirds, and songbirds.
OYSTER BEDS
The Gulf's oyster beds are among the most productive in the world. Oysters filter water, and the reef structure provides habitat for many marine species.
SHORELINE FORESTS
Coastal forests, including pine savannas and banks of live oak, form buffers between shoreline and inland ecosystems and offer vital stopovers for migrating birds.
BROWN PELICANS
MARSH PERIWINKLES, feeding on grasses, regulate the growth of healthy marshes and serve as food for turtles, crabs, and birds.
FRESHWATER RIVERS
Almost 60 percent of the U.S. watershed drains into the Gulf. River sediments have built up the Mississippi Delta, the largest coastal wetland in the lower 48 states.
TURTLES
The Gulf harbors one of the world's greatest concentrations of turtle species. Five threatened or endangered sea turtle species lay their eggs on Gulf beaches.
MISSISSIPPI DIAMONDBACK TERRAPIN
OYSTERS
CLAPPER RAIL
TRICOLORED HERON
SAND FIDDLER CRABS dig burrows, aerating denser marsh soils and encouraging the growth of soil-binding plants in the intertidal zone.
ECOSYSTEM ZONES
CORAL & LIVE BOTTOM
MESOPELAGIC ZONE
MACONDO WELL 50 MILES FROM SHORE
BATHYPELAGIC ZONE
DEPTH
0 FT
1,000
10,000
RED DRUM
50 FT.
CORAL REEF
Perhaps the most endangered marine ecosystem, coral reefs can house hundreds of fish species and deflect high storm waves. The world's third largest barrier reef lies off the Florida Keys.
FRENCH ANGELFISH
650 FT
COLD-WATER CORAL
Deep-sea coral grows slowly on reefs built up over thousands of years. These structures anchor an ecosystem with more than 2,000 species, including crabs, anemones, fish, sea stars, and urchins.
SEA FAN
BLACK CORAL
GALATHEID CRAB
LOPHELIA CORAL
BRITTLE STAR
3,300 FT
COLD SEEP
Mussels and tube worms subsist on methane and hydrogen sulfide, chemicals seeping from the seafloor. Corals and octopuses feed on organic matter drifting and swimming past.
BENTHOCTOPUS
NATIONAL GEOGRAPHIC
THE GULF OF MEXICO
Layers of Life
SEAFLOOR ENVIRONMENTS
Coral reef area
Cold-water coral
Cold seep
Surface oil
Cumulative daily survey, May 17–July 25, 2010
1 day
10
30+
Oiled coast
May 17–July 25, 2010
Houston
Mississippi R.
UNITED STATES
New Orleans
Mobile Bay
Macondo well site of Deepwater Horizon blowout
GULF OF MEXICO
Miami
Havana
CUBA
Veracruz
MEXICO
0 km
200
0 mi
200
SUPPLEMENT TO NATIONAL GEOGRAPHIC MAGAZINE, OCTOBER 2010
ART DIRECTION AND DESIGN: SEAN MCNAUGHTON ART: ALDO CHIAPPE TEXT: NANCY RAINE AUTHOR: TOM O'NEILL, EDITOR ART RESEARCH: KATE M. N. IMHALL EDITORIAL RESEARCH: HOPE GALLAGHER, KELSEY MCNAUGHTON, ELIZABETH SHOSHKES PRODUCTION: J. AARON PARKER, MOLLY SHOWALTER INSET MAP DATA: NOAA, CHUCK FISHER, PENNSYLVANIA STATE UNIVERSITY; LESLIE MCKEE, TEMPLE UNIVERSITY; KATHRYN SCARLOW, VEGS CONSULTANTS: SYLVIA EARLE, HARTE RESEARCH INSTITUTE FOR GULF OF MEXICO STUDIES; MICHAEL BECK, ZACH FERDANA, AND WILLIAM FINCH, THE NATURE CONSERVANCY; SAMANTHA JOYE, UNIVERSITY OF GEORGIA; PETER E. NATIONAL CENTER FOR COASTAL OCEAN SCIENCES; PRODANTA CHAKRABARTY, LOUISIANA STATE UNIVERSITY MUSEUM OF NATURAL SCIENCE; FRANK HERNANDEZ, DAUPHIN ISLAND SEA LAB
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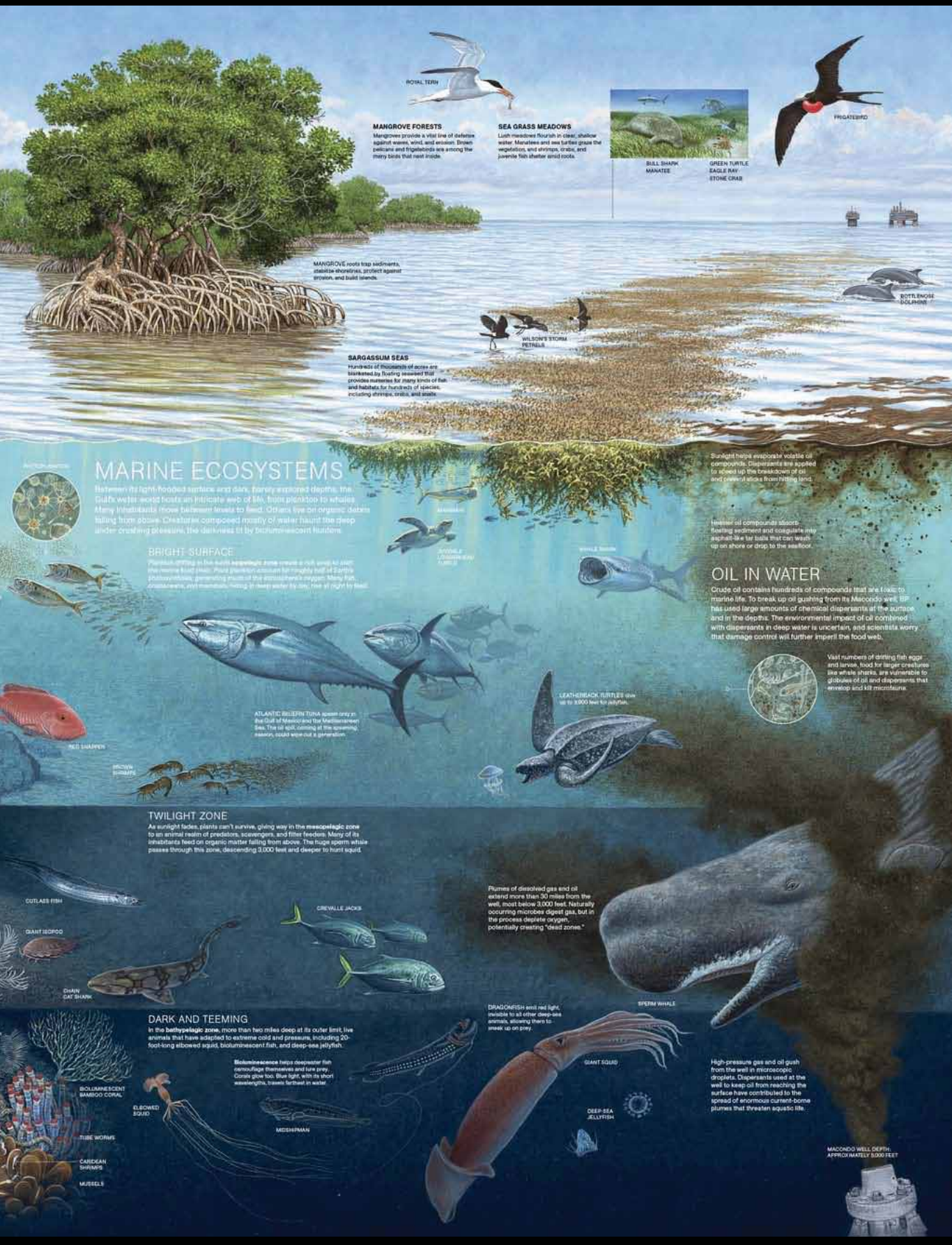
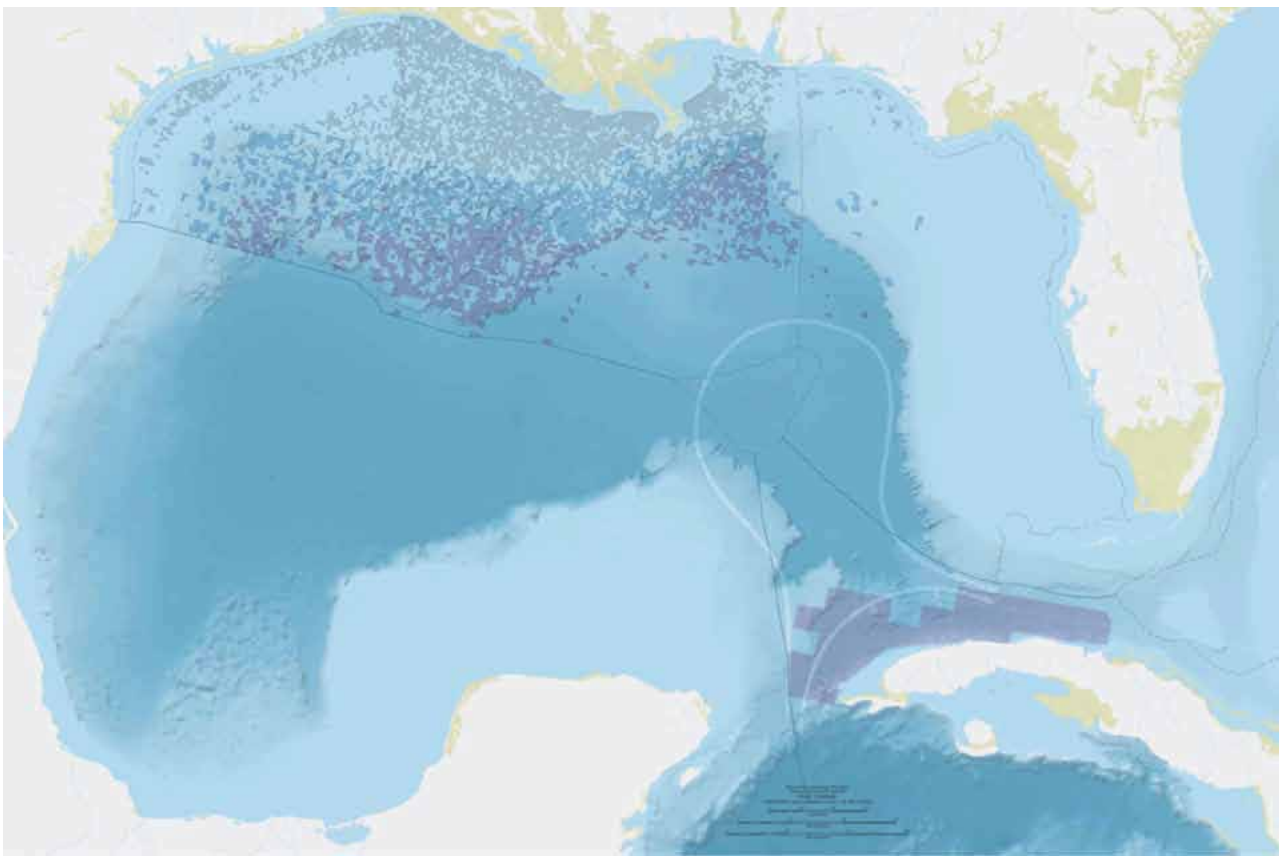

ROYAL TERN
MANGROVE FORESTS
Mangroves provide a vital line of defense against waves, wind, and erosion. Brown pelicans and frigatebirds are among the many birds that nest inside.
SEA GRASS MEADOWS
Lush meadows flourish in clear, shallow water. Manatees and sea turtles graze the vegetation, and shrimps, crabs, and juvenile fish shelter amid roots.
BULL SHARK
MANATEE
GREEN TURTLE
EAGLE RAY
STONE CRAB
FRIGATEBIRD
MANGROVE roots trap sediments, stabilize shorelines, protect against erosion, and build islands.
BOTTLENOSE DOLPHIN
WILSON'S STORM PETREL
SARGASSUM SEAS
Hundreds of thousands of acres are blanketed by floating seaweed that provides nurseries for many kinds of fish and habitats for hundreds of species, including shrimps, crabs, and snails.
MARINE ECOSYSTEMS
Between its light-flooded surface and dark, barely explored depths, the Gulf's water world hosts an intricate web of life, from plankton to whales. Many inhabitants move between levels to feed. Others live on organic debris falling from above. Creatures composed mostly of water haunt the deep under crushing pressure, the darkness lit by bioluminescent hunters.
BRIGHT SURFACE
Plankton drifting in the sunlit **epipelagic zone** create a rich soup for even the marine food web. Photosynthesis provides half of Earth's photosynthesis, generating much of the ecosystem's oxygen. Many fish, crustaceans, and mammals, rising in deep water by day, rise at night to feed.
Sunlight helps evaporate volatile oil compounds. Dispersants are applied to speed up the breakdown of oil and prevent slicks from hitting land.
Heavier oil compounds absorb floating sediment and coagulate into asphalt-like tar balls that can wash up on shore or drop to the seafloor.
OIL IN WATER
Crude oil contains hundreds of compounds that are toxic to marine life. To break up oil gushing from its Macondo well, BP has used large amounts of chemical dispersants at the surface and in the depths. The environmental impact of oil combined with dispersants in deep water is uncertain, and scientists worry that damage control will further imperil the food web.
Vast numbers of drifting fish eggs and larvae, food for larger creatures like whale sharks, are vulnerable to globules of oil and dispersants that envelop and kill microfauna.
ATLANTIC BLUEFIN TUNA spawn only in the Gulf of Mexico and the Mediterranean Sea. The oil spill, coming at the spawning season, could wipe out a generation.
LEATHERBACK TURTLES dive up to 3,000 feet for jellyfish.
RED SNAPPER
BROWN SHRIMPS
TWILIGHT ZONE
As sunlight fades, plants can't survive, giving way in the **mesopelagic zone** to an animal realm of predators, scavengers, and filter feeders. Many of its inhabitants feed on organic matter falling from above. The huge sperm whale passes through this zone, descending 3,000 feet and deeper to hunt squid.
CUTLASS FISH
GIANT ISOPOD
CREVALLE JACKS
SHARK
CAT SHARK
Plumes of dissolved gas and oil extend more than 30 miles from the well, most below 3,000 feet. Naturally occurring microbes digest gas, but in the process deplete oxygen, potentially creating "dead zones."
SPERM WHALE
DARK AND TEEMING
In the **bathypelagic zone**, more than two miles deep at its outer limit, live animals that have adapted to extreme cold and pressure, including 20-foot-long elbowed squid, bioluminescent fish, and deep-sea jellyfish.
Bioluminescence helps deepwater fish camouflage themselves and lure prey. Corals glow too. Blue light, with its short wavelengths, travels farthest in water.
DRAGONFISH emit red light, invisible to all other deep-sea animals, allowing them to sneak up on prey.
GIANT SQUID
BIOLUMINESCENT BAMBOO CORAL
ELBOWED SQUID
MEDUSA
TUBE WORMS
CARIDEAN SHRIMPS
MUSSELS
DEEP-SEA JELLYFISH
High-pressure gas and oil gush from the well in microscopic droplets. Dispersants used at the well to keep oil from reaching the surface have contributed to the spread of enormous current-borne plumes that threaten aquatic life.
MACONDO WELL DEPTH: APPROXIMATELY 5,000 FEET

A GEOGRAPHY OF OFFSHORE OIL

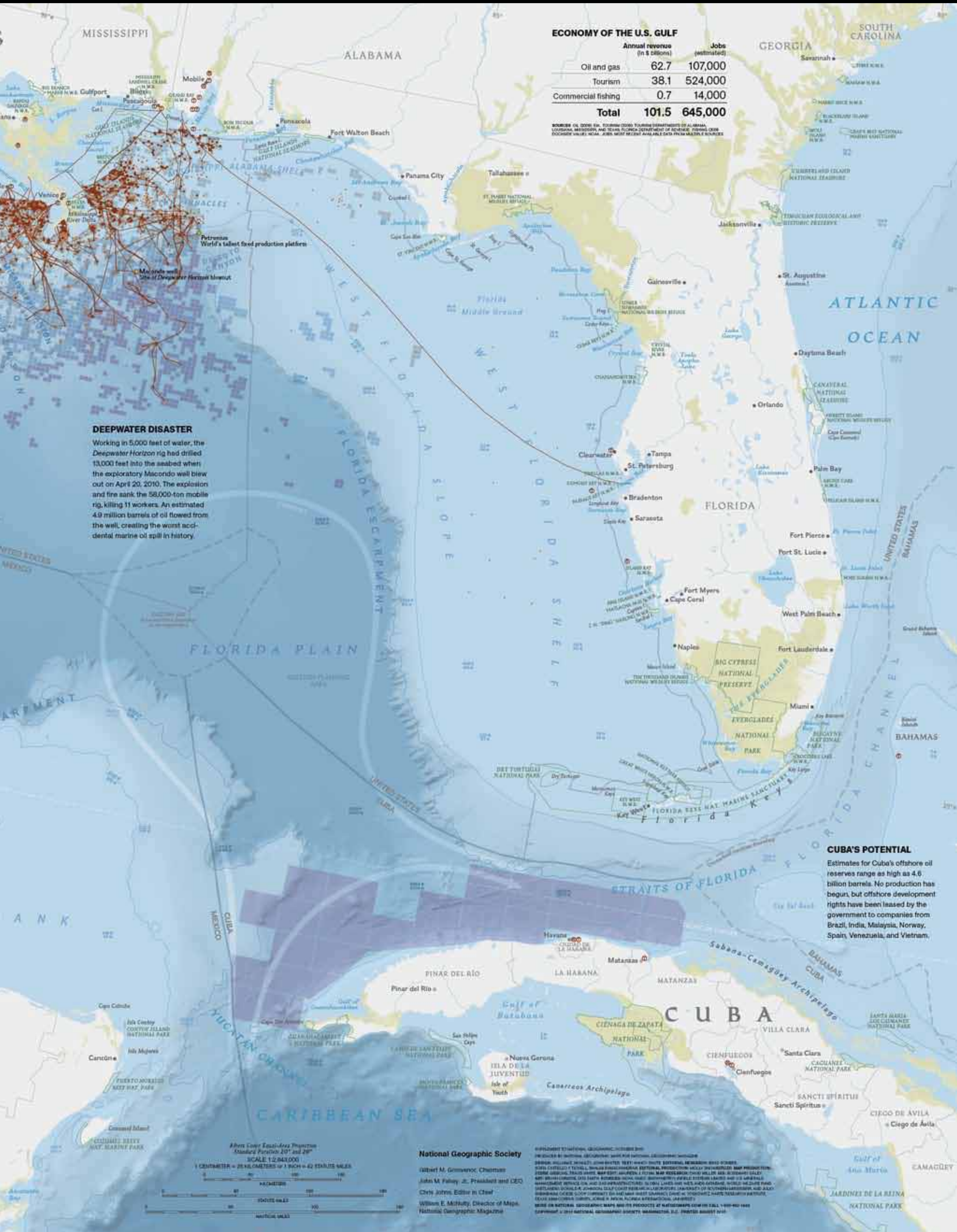
For the past half century, oil has driven the economy of the Gulf of Mexico. A third of U.S. oil production flows from nearly 3,500 platforms in the Gulf, with thousands of miles of pipeline delivering oil and natural gas to shore. Since the first Gulf well was drilled off Louisiana in 1938, in less than 15 feet of water, close-in reserves have been depleted and exploration has marched off the continental shelf, onto the continental slope, and beyond. Today Gulf oil is deep oil; the bulk of U.S. production draws from wells in more than a thousand feet of water. U.S. Gulf oil reserves are estimated at 44.9 billion barrels, but as the *Deepwater Horizon* disaster showed, the challenges of deep drilling are formidable.

MORE

Detailed map on
next page




UNITED STATES
TEXAS
LOUISIANA
MEXICO
NUEVO LEÓN
TAMAULIPAS
VERACRUZ
YUCATÁN
YUCATÁN PENINSULA
CAMPECHE
QUINTANA ROO
TABASCO
BAY OF CAMPECHE
CAMPECHE CANYON
SIGSBEE PLAIN
Houston
New Orleans
Gulf Stream
Detached eddy
Loop Current
Miami
Florida Current
Havana
CUBA
Yucatán Current
Veracruz
Corpus Christi
Galveston
Port Arthur
Lake Charles
Baton Rouge
Morgan City
Houma
Brownsville
Matamoros
Tampico
Tuxpan
Veracruz
Xalapa
Campeche
Mérida
Ixtoc I
Coatzacoalcos
Minatitlán
Tiber well
World's deepest offshore well (art at left)
Perdido
Floating production platform operating in world-record 8,000 feet of water
The Gulf holds more than 50,000 wells and some 42,000 miles of pipeline.
The maximum depth of the Gulf is unknown. Estimates range from 12,303 to 14,370 feet.
Map Legend
Coastal wetland
Coastal protected area
Active federal leases as of March 2010
Shallow water
Deep water (1,000 to 4,999 feet)
Ultradeep water (5,000 feet or more)
Oil or gas offshore platform
Oil or gas well
Crude oil or gas terminal
Oil refinery
Oil- or gas-related pipeline
Maritime boundary
Planning area boundary
OFFSHORE WELL PROFILES
TIBER Water depth 4,132 ft
MACONDO (Deepwater Horizon) Water depth 5,000 ft
PERDIDO Operating in deepest water 8,000 ft
MACONDO Total depth 18,000 ft
TIBER Total depth 35,000 ft
U.S. Gulf oil from federal leases by depth
350 million barrels
300
250
200
150
100
50
0
Shallow water
Deep
Ultradeep
1980 1990 1995 2000 2005 2009
NATIONAL GEOGRAPHIC
Gulf of Mexico
A GEOGRAPHY OF OFFSHORE OIL
U.S. PLATFORMS
A waterborne city of oil rigs rises off the coasts of Texas, Louisiana, Alabama, and Mississippi—but not Florida. Exploration off the Florida coast, starting in the 1940s, yielded largely dry holes, and the potential threat to the state's top industry, tourism, has been considered too great a risk.
THE LOOP CURRENT
The Gulf's largest current, the Loop Current, enters from the Caribbean as the Yucatán Current. Running to depths of 2,600 feet, it can swing directly east to join the Gulf Stream or surge north before curling back through the Straits of Florida. If it penetrates deeply into the Gulf, it often sheds a great eddy, which drifts westward. The Loop Current could carry oil from a Gulf spill up the Atlantic coast.
MEXICO'S OIL DROP
Daily output of Pemex, the state-owned oil monopoly, hit 3.4 million barrels in 2004 but has fallen to 2.6 million. The drop is blamed on poor management and declining close-in reserves. Three-quarters of the oil comes from the Gulf, where Mexico has estimated reserves of at least 11.3 billion barrels. Oil and gas sales fund a third of the federal budget; the U.S. is the top importer.
IXTOC I OIL SPILL
Mexico's Ixtoc I well blew out in the Bay of Campeche in 1979 and flowed for 295 days. Some 3.5 million barrels of oil fouled hundreds of miles of shore as far as Padre Island, Texas. Most habitat recovered, but three-inch-thick tar mats remain in some lagoons. Ixtoc I ranked as the world's largest accidental marine spill until it was surpassed by Macondo.
NEW DEPTHS
The world's deepest offshore well, the Tiber well (art, above) reaches nearly six miles below the Gulf's seafloor. Not yet operational, it was drilled in late 2009 by the rig *Deepwater Horizon*, which was destroyed months later drilling the Macondo well. Other record holders in the Gulf: The floating production platform *Perdido* operates in the deepest water—8,000 feet—and the Petronius tower, the tallest fixed platform, stands in 1,754 feet of water.



ECONOMY OF THE U.S. GULF

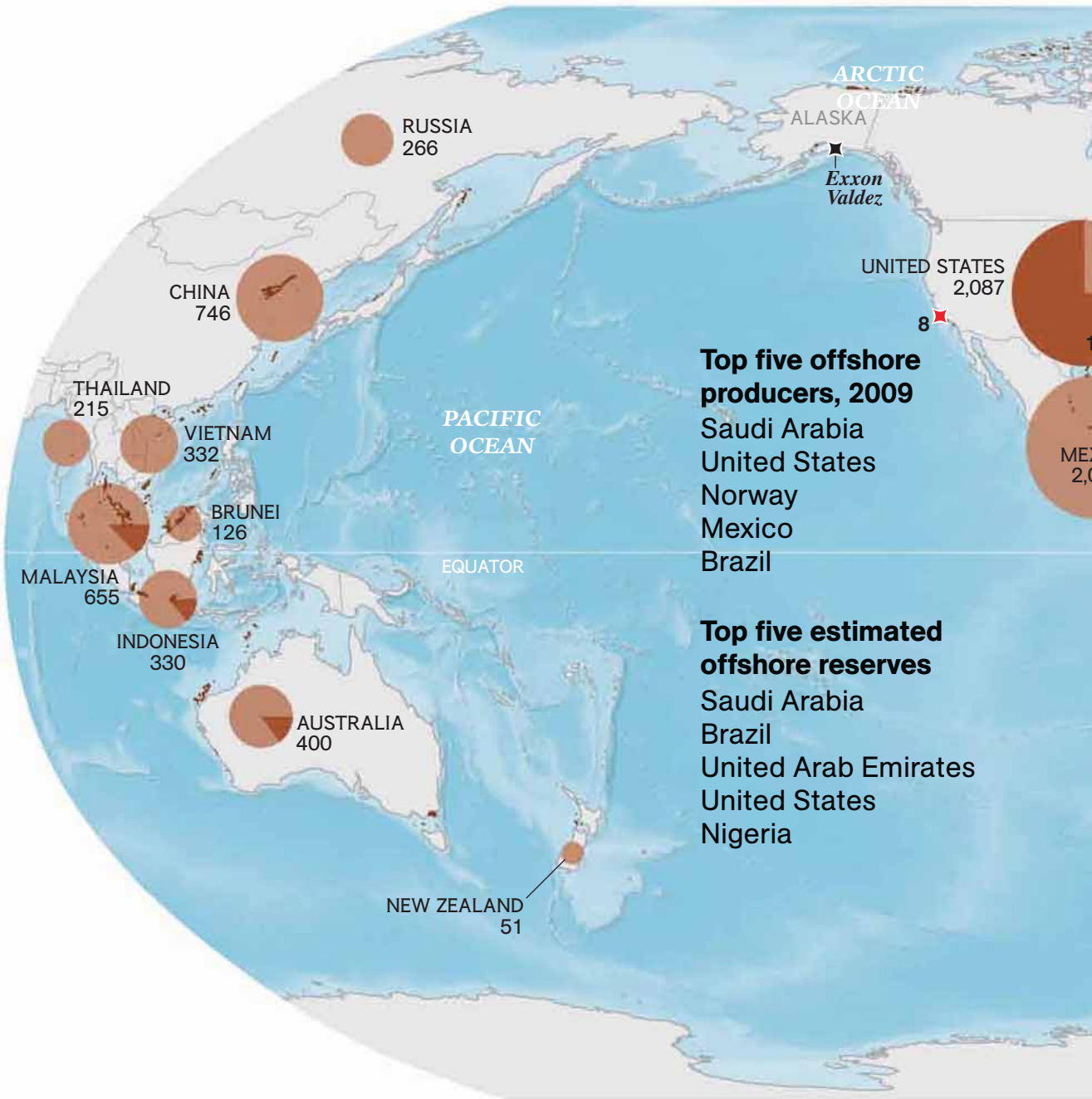
	Annual revenue (in $ billions)	Jobs (estimated)
Oil and gas	62.7	107,000
Tourism	38.1	524,000
Commercial fishing	0.7	14,000
Total	**101.5**	**645,000**

DEEPWATER DISASTER

Working in 5,000 feet of water, the *Deepwater Horizon* rig had drilled 13,000 feet into the seabed when the exploratory Macondo well blew out on April 20, 2010. The explosion and fire sank the 58,000-ton mobile rig, killing 11 workers. An estimated 4.9 million barrels of oil flowed from the well, creating the worst accidental marine oil spill in history.

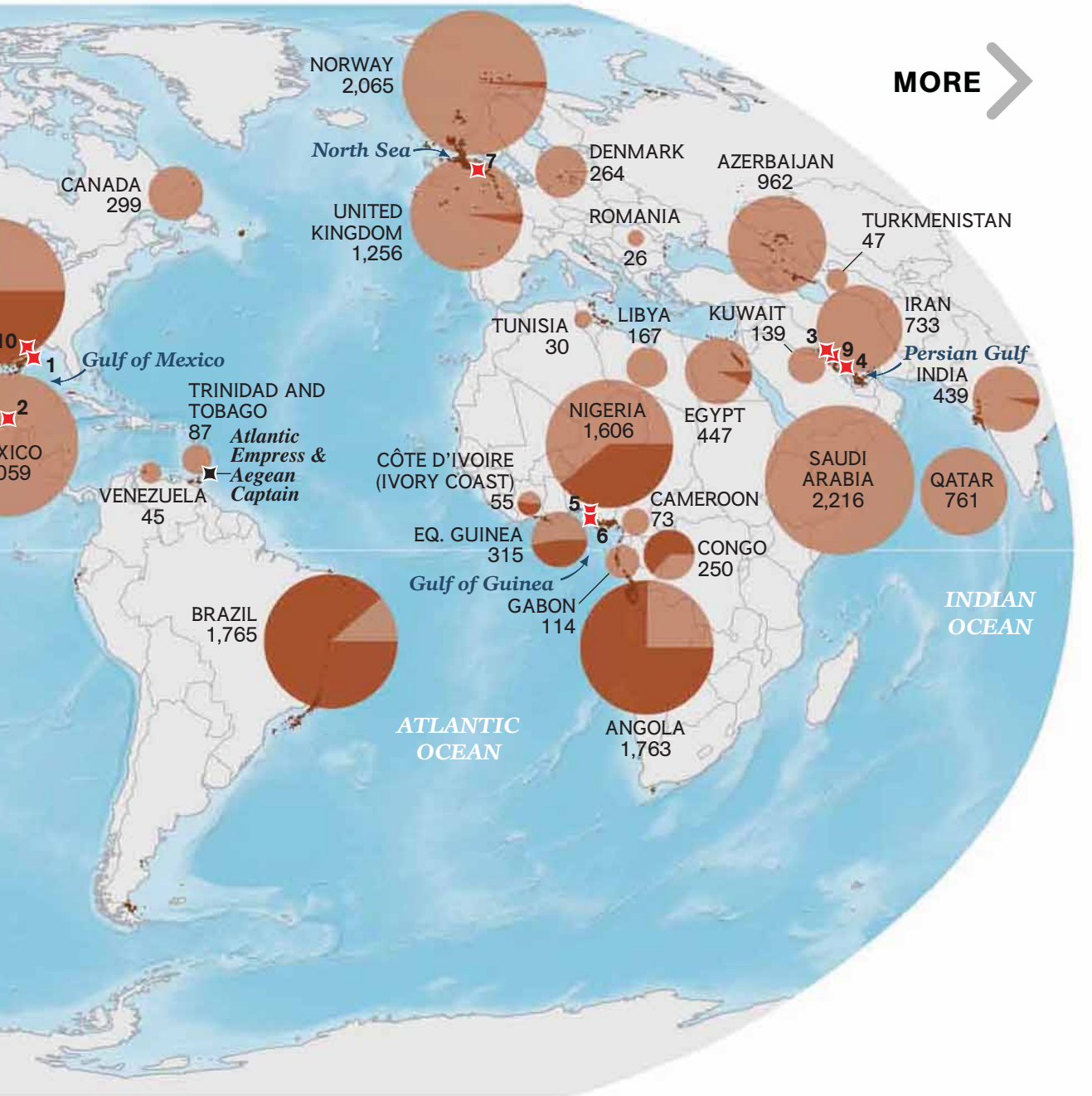
CUBA'S POTENTIAL

Estimates for Cuba's offshore oil reserves range as high as 4.6 billion barrels. No production has begun, but offshore development rights have been leased by the government to companies from Brazil, India, Malaysia, Norway, Spain, Venezuela, and Vietnam.

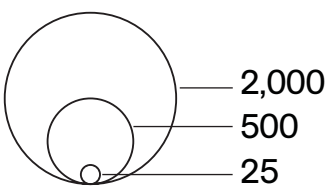


DRILLING FOR OFFSHORE OIL

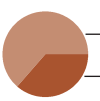
Undersea oil provides an increasing amount of the global supply, as exploration heads ever deeper in search of new "plays." In 2020 wells more than 400 meters below the sea surface will likely provide 10 percent of the world's oil. But going deep poses technical challenges and safety risks.



OFFSHORE OIL PRODUCTION, 2009



Thousands of barrels a day*



Shallow water
Deep water (>400 meters)

Offshore oil fields

1 Top ten offshore platform spills, ranked by size (chart below)

*ONLY COUNTRIES PRODUCING AT LEAST 25,000 BARRELS A DAY ARE SHOWN (ONE BARREL = 42 U.S. GALLONS). FOR LEGIBILITY, SOME PIE CHARTS ARE SHOWN INLAND OR OUTSIDE THEIR COUNTRY BOUNDARIES.

Top ten offshore platform

Millions of barrels

1. *Deepwater Horizon* (Gulf of Mexico, 2010)

2. Ixtoc I (Gulf of Mexico,1979)

3. Nowruz (Persian Gulf,1983)

4. Wodeco 3 (Persian Gulf,1971)

5. Escravos (Gulf of Guinea,1978)

6. Funiwa No. 5 (Gulf of Guinea,1980)

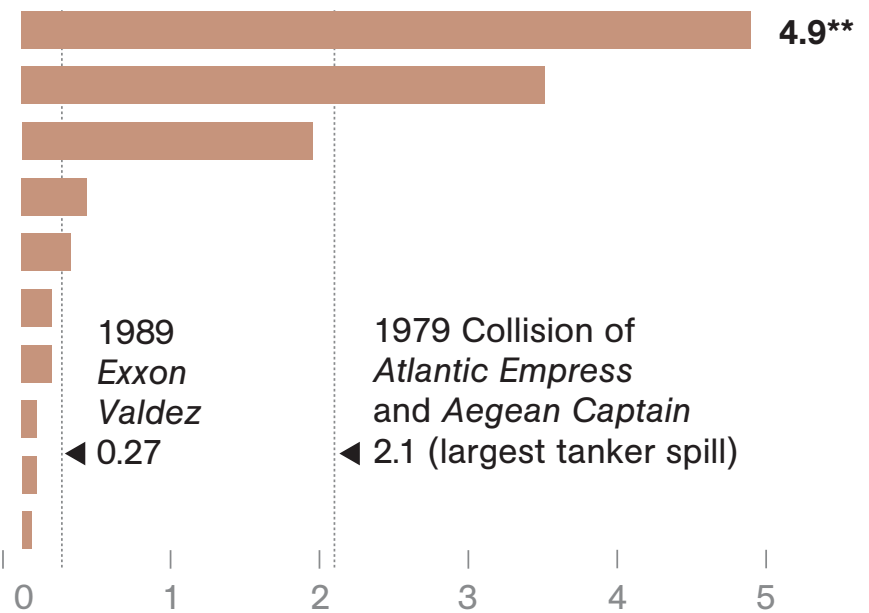
7. Phillips Ekofisk B-14 (North Sea,1977)

8. Union Oil Platform A (southern California,1969)

9. *Ron Tappmeyer* (Persian Gulf,1980)

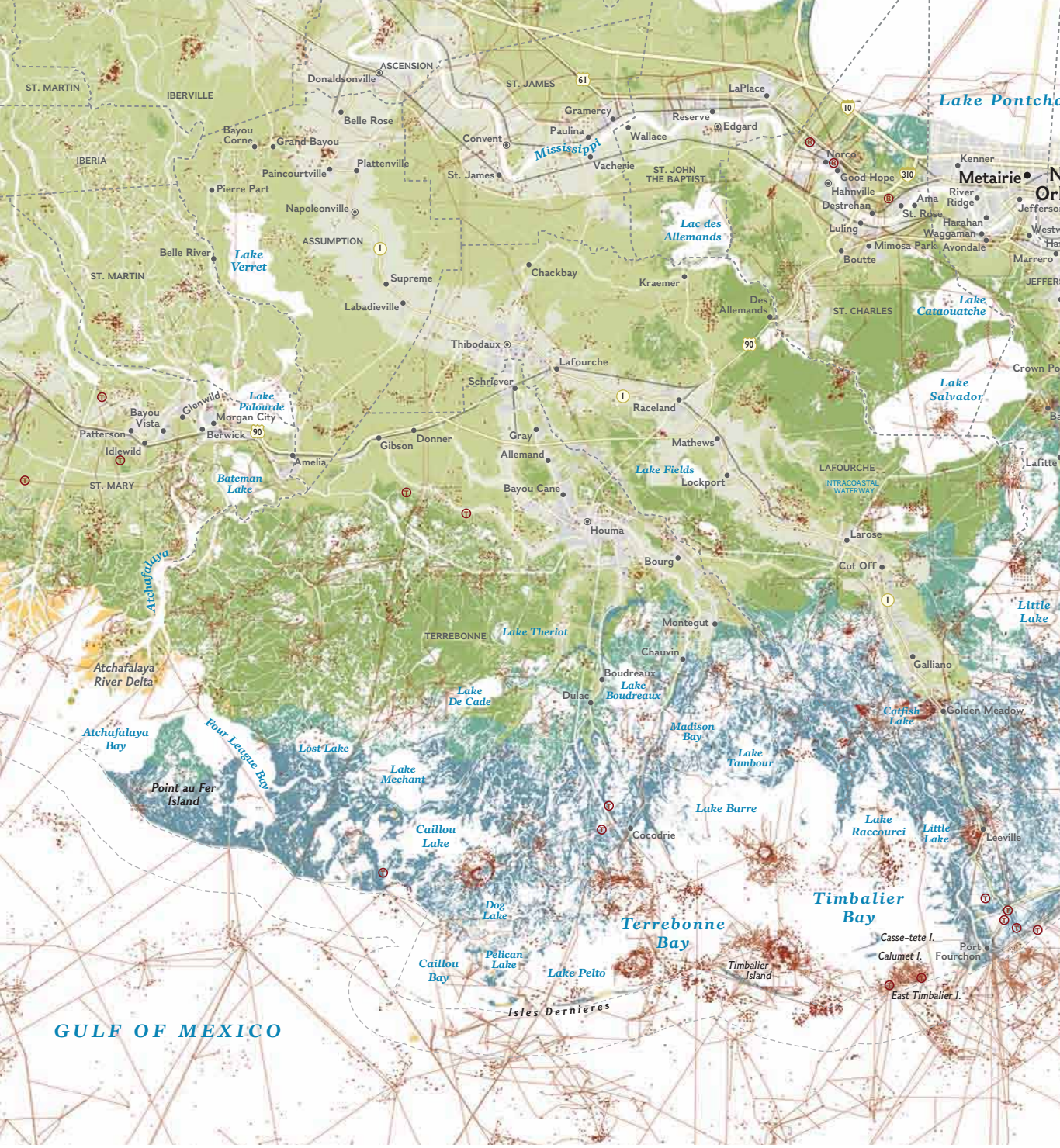
10. Chevron Block 41C (Gulf of Mexico,1970)

spills, 1969-2010



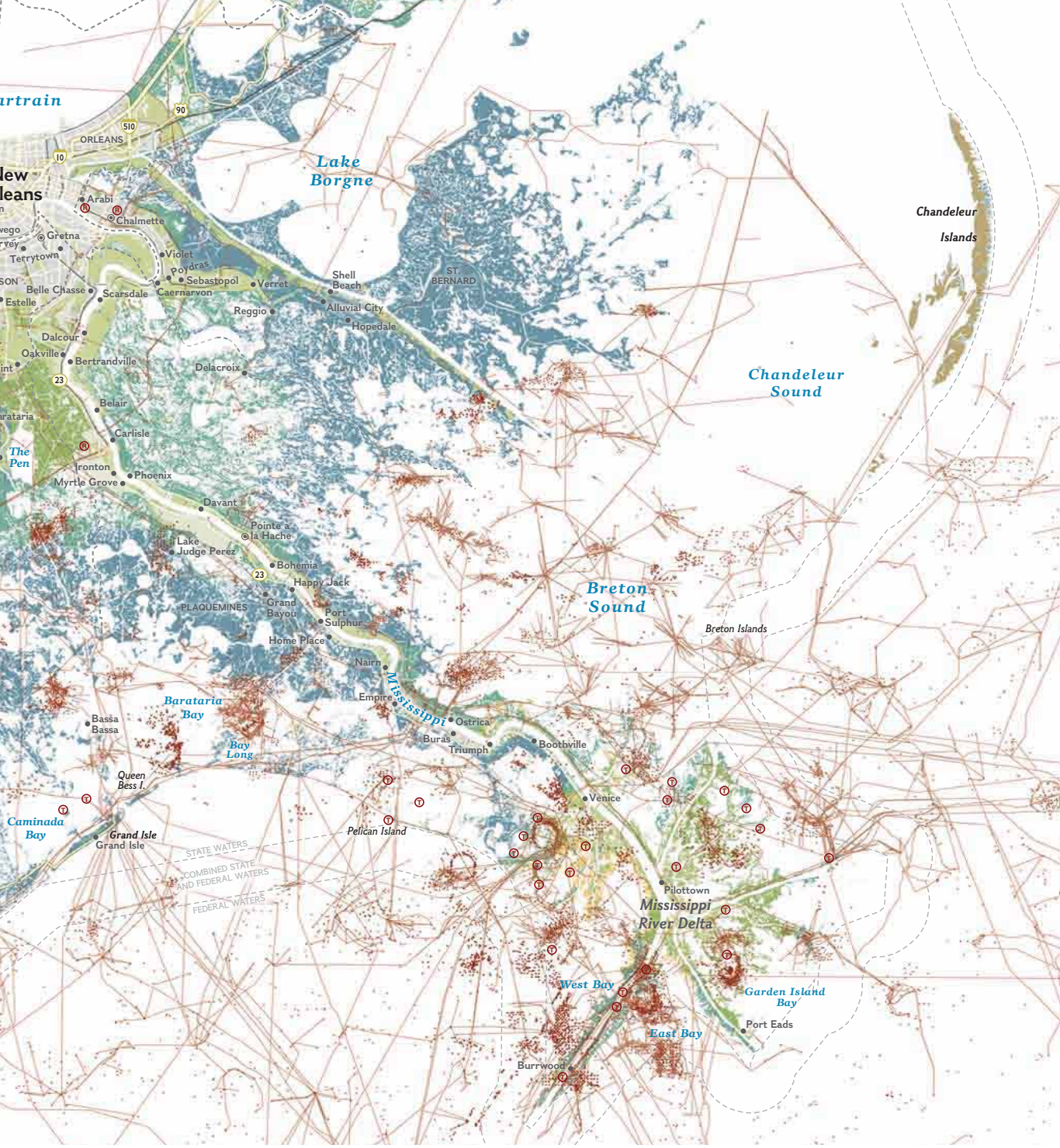
**AUGUST 2, 2010, ESTIMATE; OF THIS TOTAL, 800,000 BARRELS OF OIL WERE CAPTURED BY BP AT THE WELL.

MARTIN GAMACHE, NGM STAFF. SOURCES: PETER BURGHERR, PAUL SCHERRER INSTITUTE (PLATFORM SPILLS); FLOW RATE TASK GROUP (DEEPWATER ESTIMATES); IHS ENERGY (RESERVES); MICHAEL R. SMITH, DATAMONITOR, "GLOBAL OIL AND GAS ANALYZER" (2009 PRODUCTION)



ENDANGERED WETLANDS

The *Deepwater Horizon* spill is just the latest threat to the Mississippi River Delta and its inhabitants. Both natural processes and human interference have submerged more than 2,300 square miles of coastal marshes. Nonetheless, the area is still one of the world's richest river deltas, home to shrimp and oyster fisheries, endangered sea turtles, millions of birds, a multibillion-dollar oil industry, and two million people.



0 mi 10

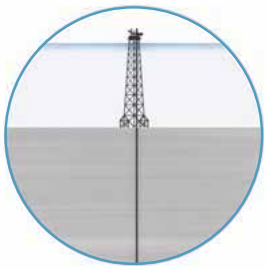
0 km 10

- Tidal flats and shoals
- Sea grass
- Saltwater marsh
- Intermediate marsh
- Freshwater marsh
- Other freshwater wetland
- Upland
- Urban area
- Oil or gas well
- Ⓣ Crude oil or gas terminal
- Ⓡ Oil refinery
- Oil or gas pipeline

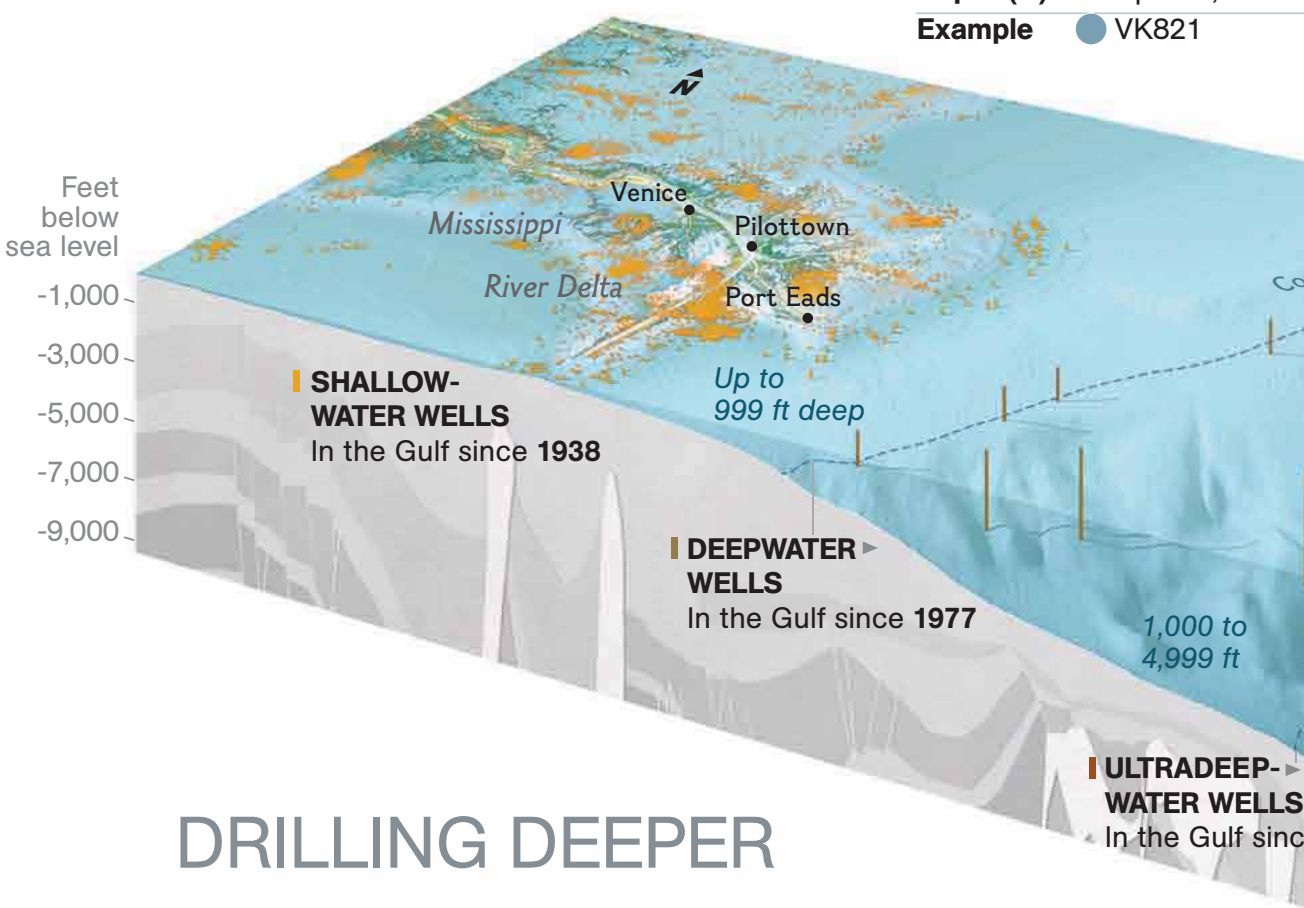
WILLIAM McNULTY, NGM STAFF; DEBBIE GIBBONS AND MAUREEN J. FLYNN, NG MAPS; THEODORE A. SICKLEY. SOURCES: NOAA AND THE NATURE CONSERVANCY (LAND COVER); MMS AND LOUISIANA DEPARTMENT OF NATURAL RESOURCES, OFFICE OF CONSERVATION AND OFFICE OF COASTAL MANAGEMENT (OIL AND GAS INFRASTRUCTURE); LANDSCAN 2008 (URBAN AREAS)

SEAFARING RIGS

Floating rigs, first developed in the 1960s, have opened deep water to petroleum exploration. Floating platforms allow siphoning of oil from wells that can be many miles from shore.



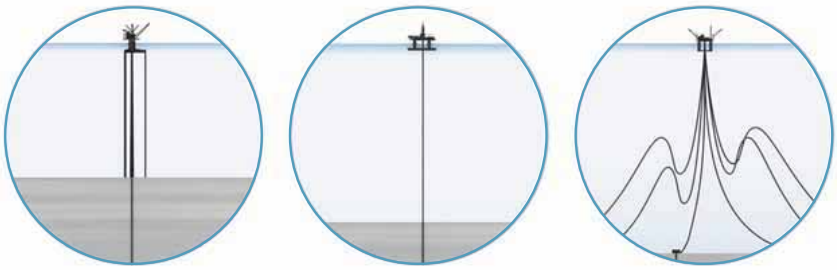
Type	FIXED
First used	1938
Depth (ft)	Up to 1,754
Example	VK821



DRILLING DEEPER

As oil and gas reserves close to shore have been pumped dry, prospectors are plumbing a new frontier: the depths of the Gulf of Mexico. In 2009 Gulf oil production jumped 34 percent—largely from waters deeper than 5,000 feet. New technologies have made it possible to drill more than 35,000 feet down through water and rock.

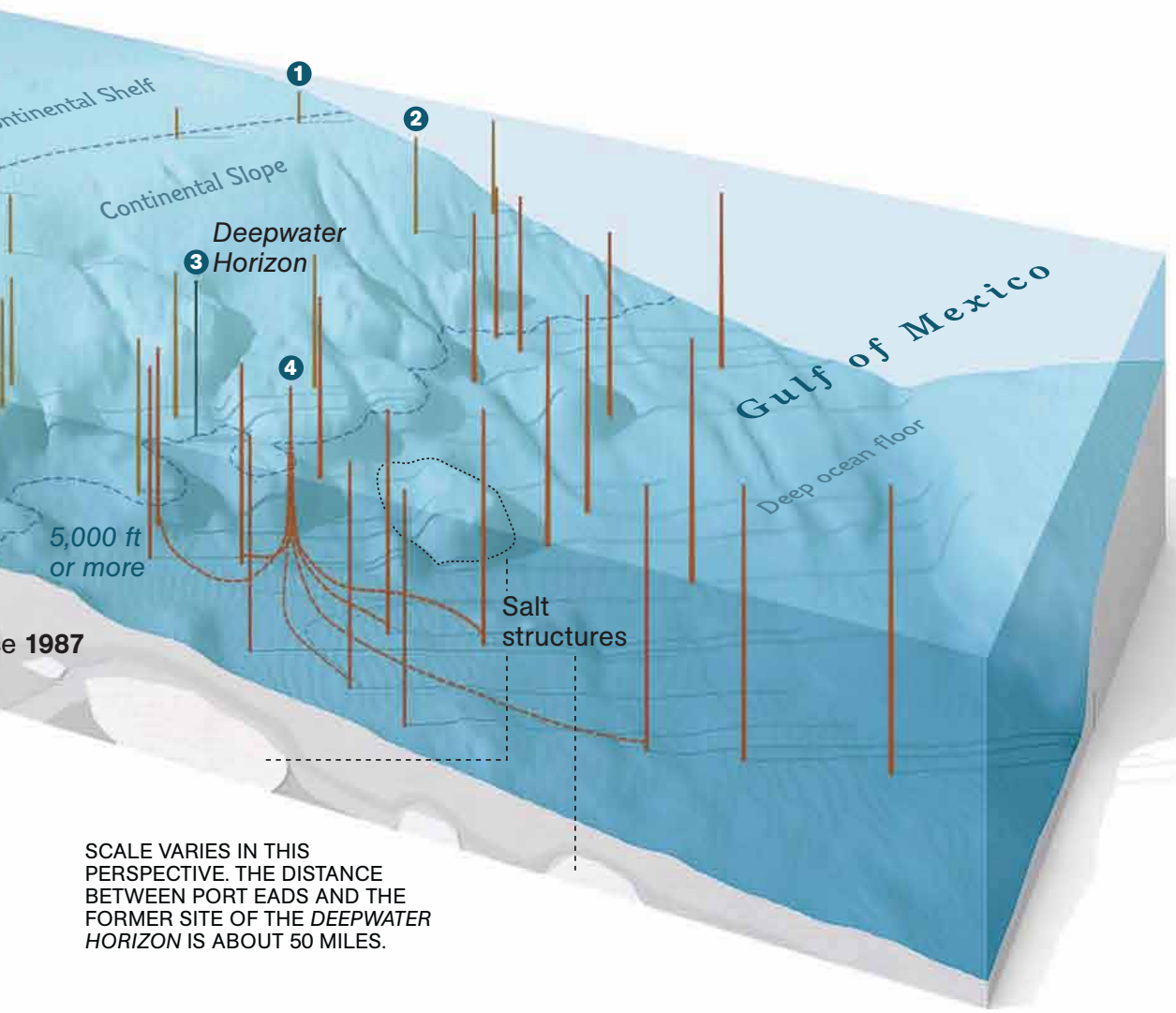
JUAN VELASCO, NGM STAFF. ART BY BRYAN CHRISTIE. SOURCES: RENAUD BOUROULLEC, COLORADO SCHOOL OF MINES, AND PAUL WEIMER, UNIVERSITY OF COLORADO (GEOLOGY AND BATHYMETRY); LOUISIANA DEPARTMENT OF NATURAL RESOURCES (SHALLOW-WATER WELLS); MMS (DEEP AND ULTRADEEP WELLS, OIL FROM FEDERAL LEASES); ENERGY INFORMATION ADMINISTRATION, OR EIA (U.S. PRODUCTION)



TENSION-LEG	SEMISUBMERSIBLE	FPS*
1989	1963	Early 2000s
Up to 5,000	Unlimited	Unlimited
Ram/Powell	*Deepwater Horizon*	*Na Kika*

*Floating Production Systems

MORE



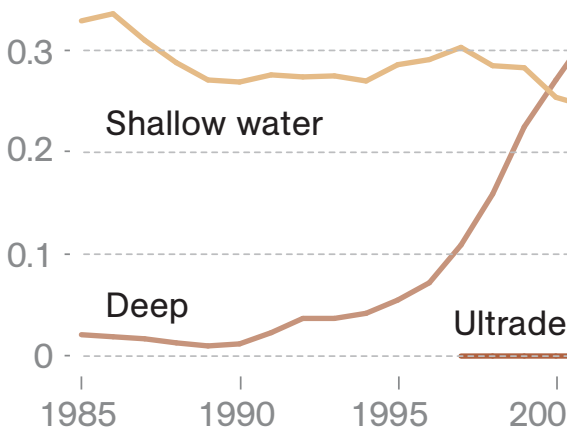
SCALE VARIES IN THIS PERSPECTIVE. THE DISTANCE BETWEEN PORT EADS AND THE FORMER SITE OF THE *DEEPWATER HORIZON* IS ABOUT 50 MILES.

ORIGINS OF GULF OIL

Organic material that settled in the Gulf over the past 120 million years was transformed into vast pools of oil and natural gas by time, pressure, and heat. The petroleum rises through faults until it is trapped by salt structures, some more than a mile below the seafloor.

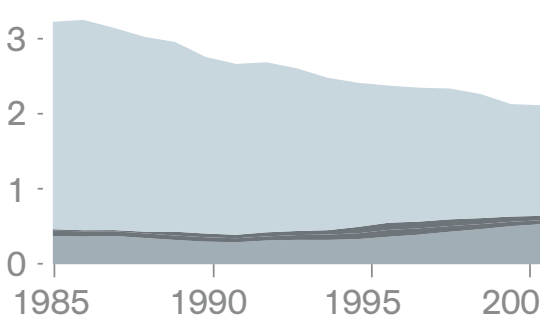
U.S. Gulf oil from federal le

Billions of barrels, by depth

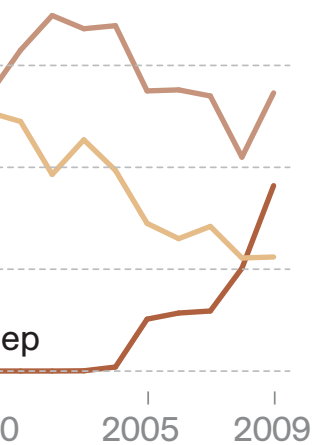


U.S. domestic oil productio

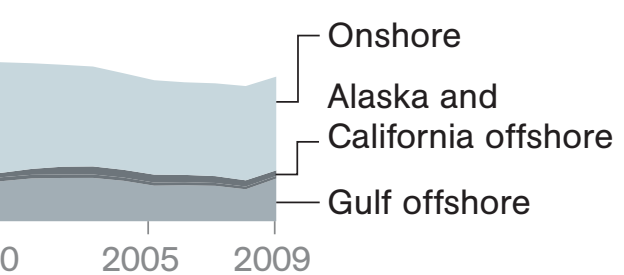
Billions of barrels



ases, 1985–2009



n, 1985–2009





BY SYLVIA EARLE

MY BLUE WILDERNESS

WHEN I FIRST VENTURED INTO the Gulf of Mexico in the 1950s, the sea appeared to be a blue infinity too large, too wild to be harmed by anything that people could do. I explored powder white beaches, dense marshes, mangrove forests, and miles of sea grass meadows alive with pink sea urchins, tiny shrimps, and seahorses half the size of my little finger. I learned to dive in unexplored areas offshore from the many rivers that flow into the Gulf, where jungles of crimson, green, and brown seaweed sprouted from rocky limestone reefs. Under the canopy of golden forests of drifting sargassum, I swam with a floating zoo of small creatures: lacy brown sea slugs, juvenile jacks, and flying fish no larger than dragonflies.

Diving into the cool water of Ichetucknee, Weeki Wachee, Wakulla, and other inland springs, I glimpsed the honeycomb plumbing of underground tunnels, sinkholes, shafts, *(Touch* Text *button to read more.)*

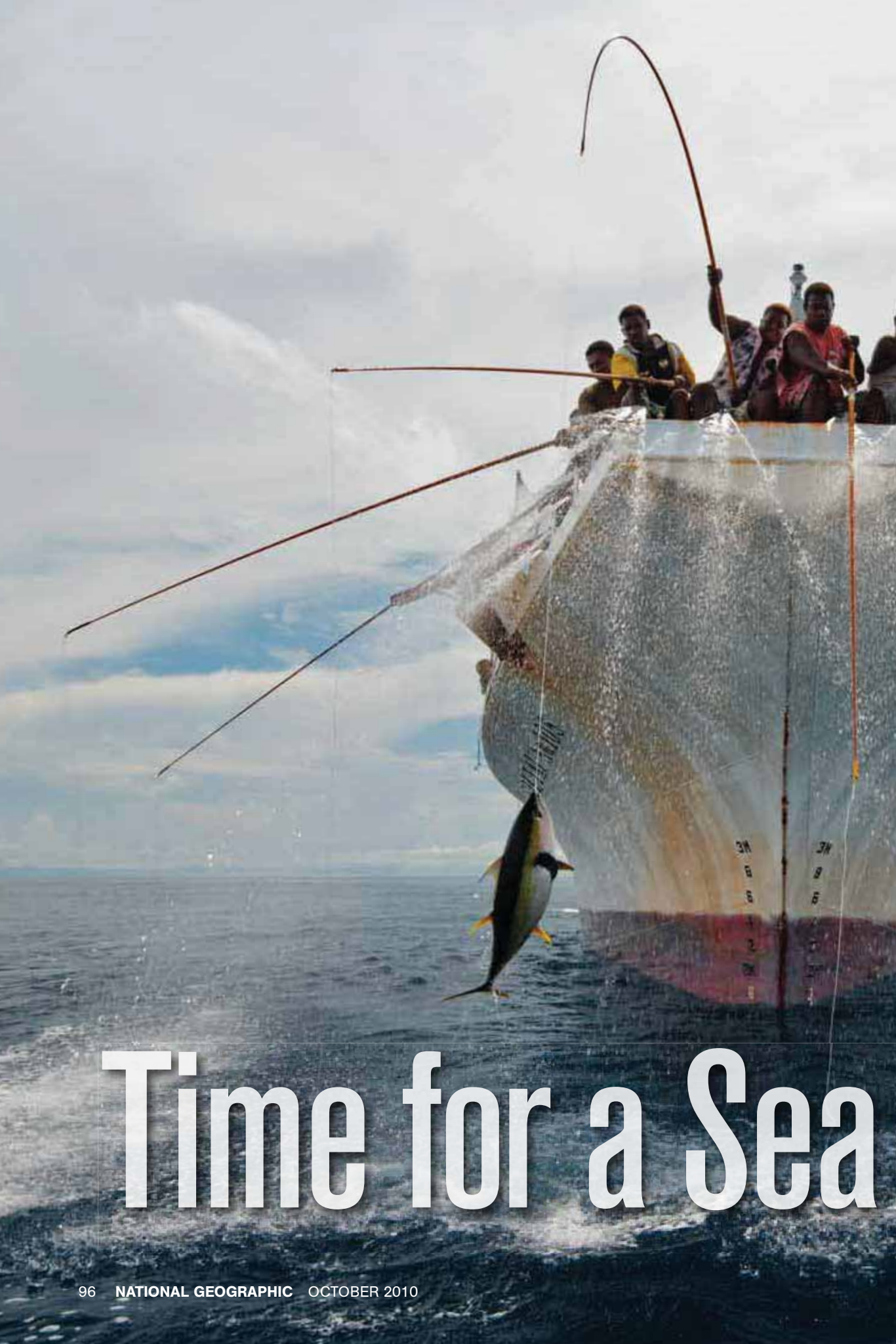
Sylvia Earle, author of The World Is Blue: How Our Fate and the Ocean's Are One*, has led more than 100 expeditions as part of her oceanographic research.*

Mission Blue Partnership

In the face of urgent threats to the oceans, the **National Geographic Society, Waitt Family Foundation, Deep Search Foundation,** and National Geographic Explorer-in-Residence Sylvia Earle and National Geographic Fellow Enric Sala have joined ranks to establish Mission Blue, a new global initiative that seeks to restore the health and productivity of the seas. One of its signal goals will be to promote the creation of marine protected areas in critical ecosystems from the Poles to the tropics. Another aim will be to support solution-based research to reduce overfishing while considering the loss of marine-based livelihoods worldwide. “This effort is not only to inspire people to care about the oceans, but also to inspire people to act,” says Sala, who is a marine ecologist. “If we do something today, we know we’ll have an impact tomorrow.” To learn how to support this new campaign to save the seas, go to *ocean.nationalgeographic.com.*

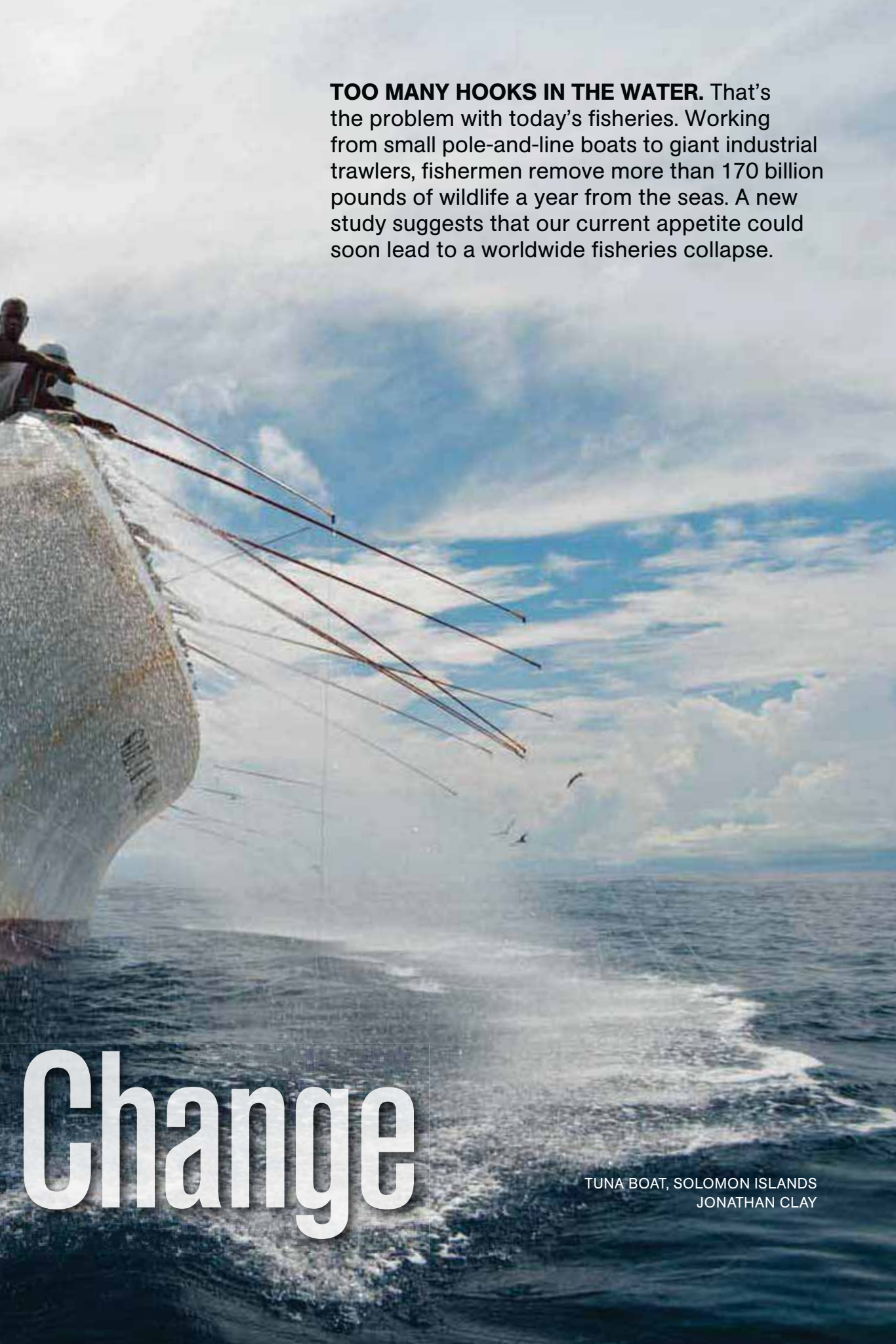
D I N G

TYRONE TURNER



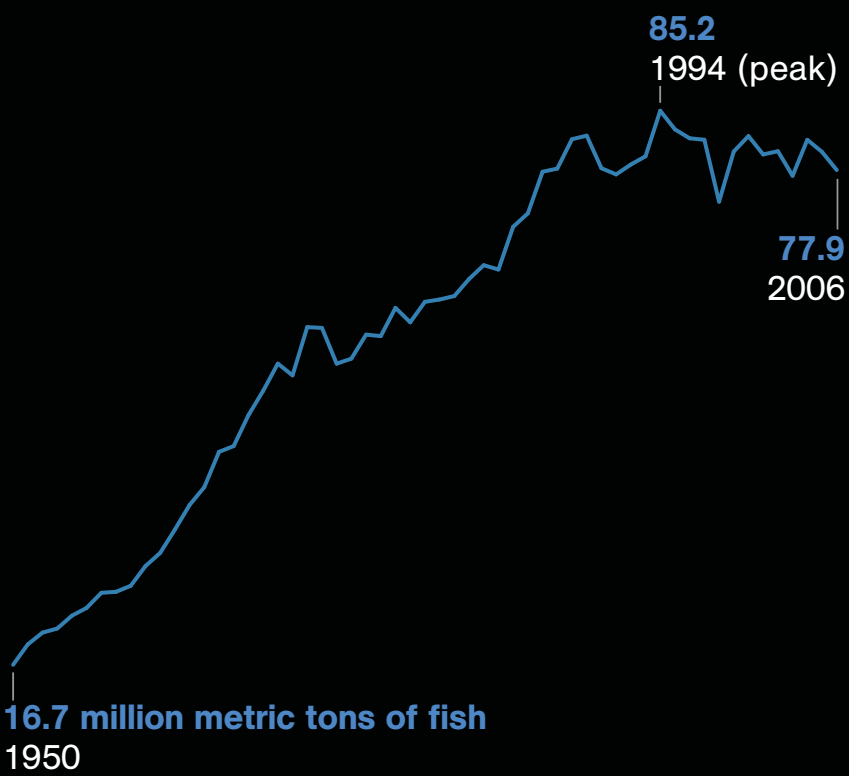
Time for a Sea

TOO MANY HOOKS IN THE WATER. That's the problem with today's fisheries. Working from small pole-and-line boats to giant industrial trawlers, fishermen remove more than 170 billion pounds of wildlife a year from the seas. A new study suggests that our current appetite could soon lead to a worldwide fisheries collapse.



Change

TUNA BOAT, SOLOMON ISLANDS
JONATHAN CLAY


85.2
1994 (peak)
77.9
2006
16.7 million metric tons of fish
1950

GLOBAL MARINE CAPTURE During the past 50 years the annual world seafood catch has more than quadrupled, as fishing fleets have added new technologies and ventured into previously unexploited regions.

Fish don't stand a chance nowadays. Factory ships like this Lithuanian trawler off Mauritania (above) roam the world, hauling in massive amounts of fish and freezing the catch along the way.

JEAN GAUMY, MAGNUM PHOTOS. CHART: MARIEL FURLONG, NGM STAFF
SOURCE: SEA AROUND US PROJECT, UNIVERSITY OF BRITISH COLUMBIA FISHERIES CENTRE


ARCADE NO. 2
Quality
FRUITS & VEGETABLES
FRESH PICKED DAILY
LOWER FLOOR
Sausage

EMPTY SEA, FULL MARKET Hundreds to thousands of pounds of salmon move through Seattle's Pike Place Market each day, much of it caught in Alaska's well-managed waters. While affluent nations may practice good fisheries management at home, they often rely on poorly monitored developing countries for much of their seafood. The result could be empty fish markets in the poorest places. DIANE COOK AND LEN JENSHEL

BY PAUL GREENBERG

Just before dawn a seafood summit convenes near Honolulu Harbor. As two dozen or so buyers enter the United Fishing Agency warehouse, they don winter parkas over their aloha shirts to blunt the chill of the refrigeration. They flip open their cell phones, dial their clients in Tokyo, Los Angeles, Honolulu—wherever expensive fish are eaten—and wait.

Soon the big freight doors on the seaward side of the warehouse slide open, and a parade of marine carcasses on pallets begins. Tuna as big around as wagon wheels. Spearfish and swordfish, their bills sawed off, their bodies lined up like dull gray I beams. Thick-lipped opah with eyes the size of hockey pucks rimmed with gold. They all take their places in the hall.

Auctioneers drill core samples from the fish and lay the ribbons of flesh on the lifeless white bellies. Buyers finger these samples, trying to divine quality from color, clarity, *(Touch* Text *button to read more.)*

Paul Greenberg is the author of Four Fish: The Future of the Last Wild Food. *He lives with his family in Manhattan.*

The Ocean Food Chain

MORE

Phytoplankton and algae drive ocean ecosystems. They capture solar energy through photosynthesis and, when eaten by zooplankton, transfer that energy up the food chain. Small fish eat zooplankton and in turn are eaten by big fish, which are targeted by fishermen.

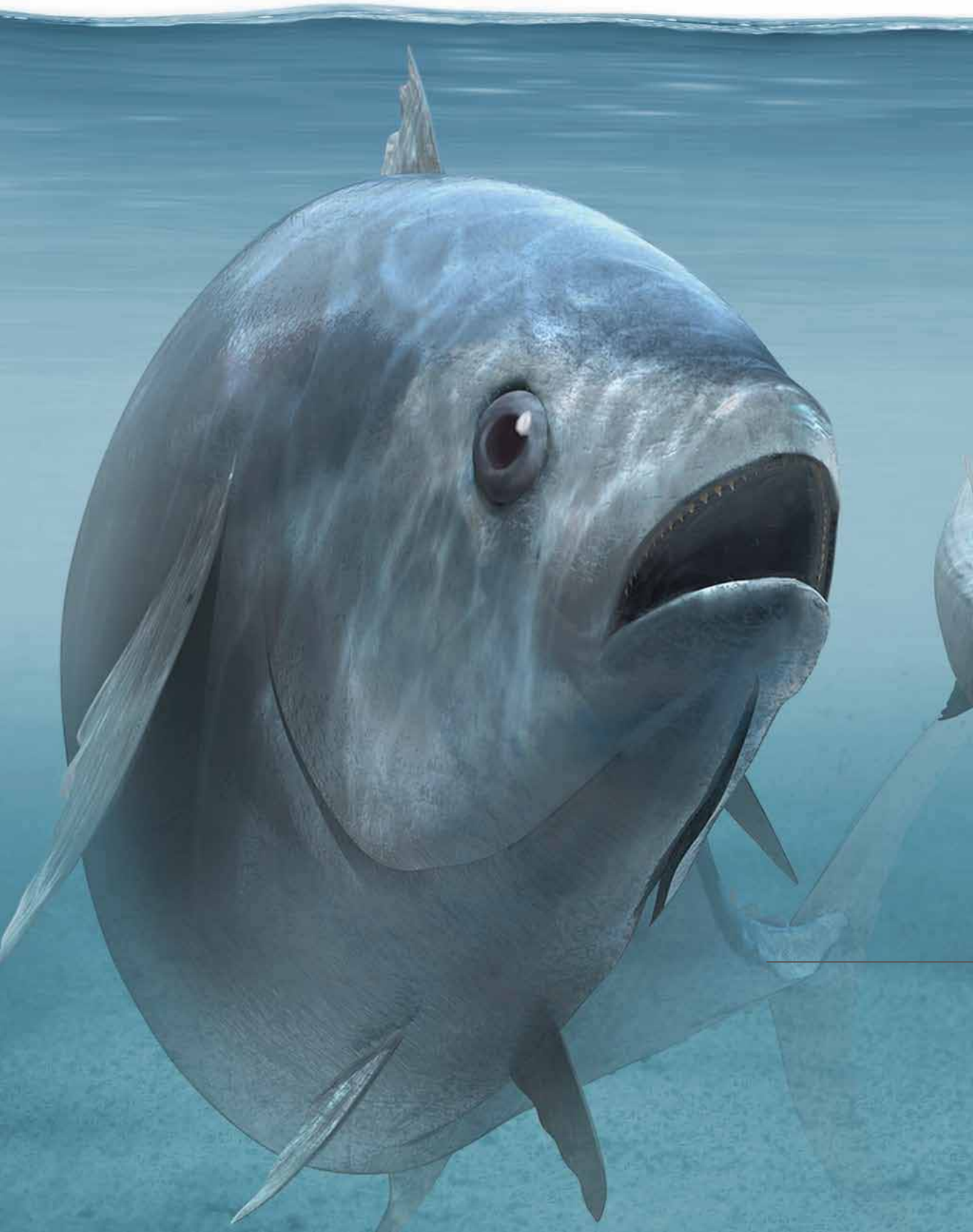
Look for the special issue *Ocean* on newsstands now and at **ngm.com/ocean-special.**

D I N G

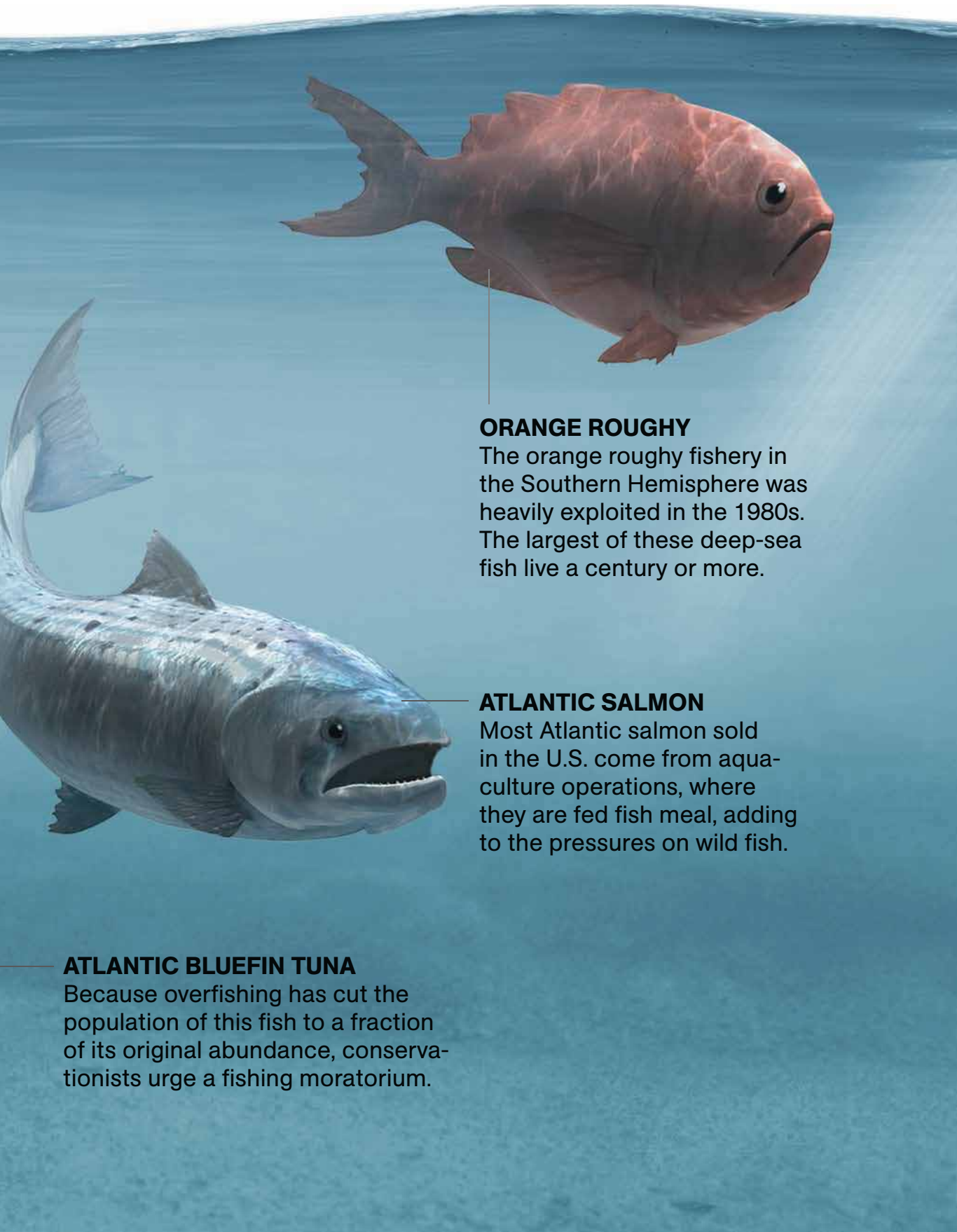
LEVEL 4

TOP PREDATORS

Slow to reproduce, these fish are among the most energy demanding in the sea.



MORE



ORANGE ROUGHY
The orange roughy fishery in the Southern Hemisphere was heavily exploited in the 1980s. The largest of these deep-sea fish live a century or more.

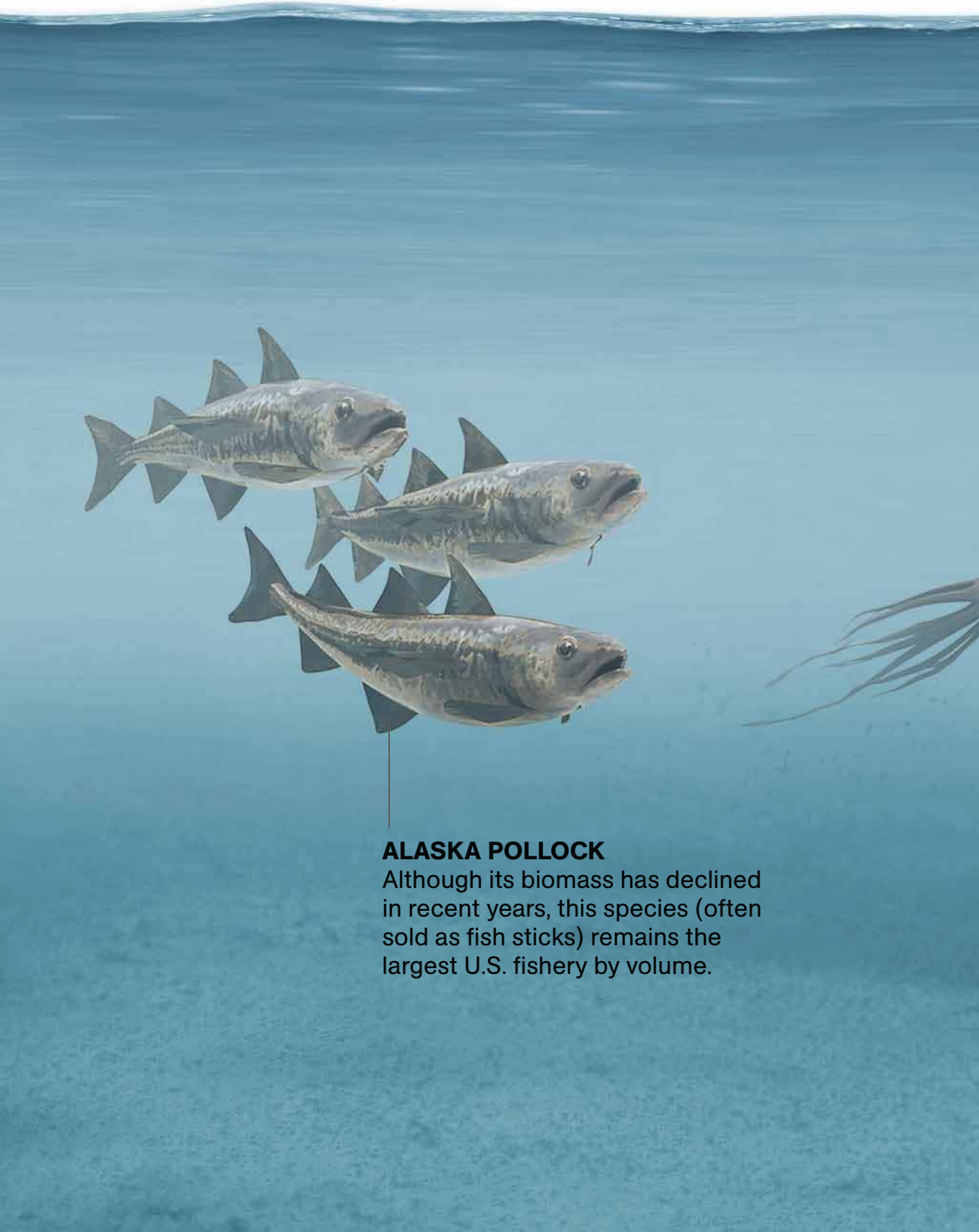
ATLANTIC SALMON
Most Atlantic salmon sold in the U.S. come from aquaculture operations, where they are fed fish meal, adding to the pressures on wild fish.

ATLANTIC BLUEFIN TUNA
Because overfishing has cut the population of this fish to a fraction of its original abundance, conservationists urge a fishing moratorium.

LEVEL 3

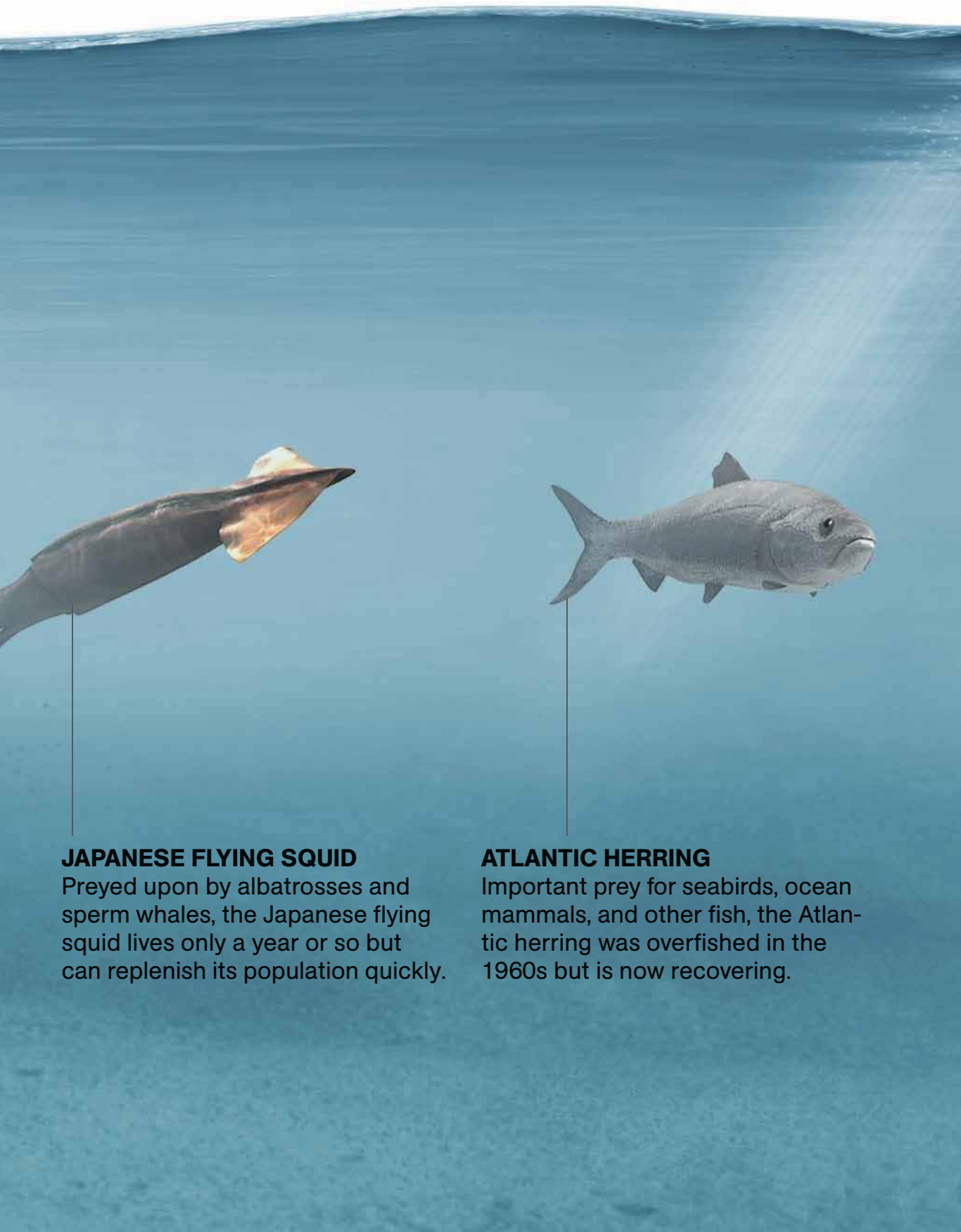
INTERMEDIATE PREDATORS

These species are vital for keeping lower-level fish populations in check.



ALASKA POLLOCK

Although its biomass has declined in recent years, this species (often sold as fish sticks) remains the largest U.S. fishery by volume.



JAPANESE FLYING SQUID
Preyed upon by albatrosses and sperm whales, the Japanese flying squid lives only a year or so but can replenish its population quickly.

ATLANTIC HERRING
Important prey for seabirds, ocean mammals, and other fish, the Atlantic herring was overfished in the 1960s but is now recovering.

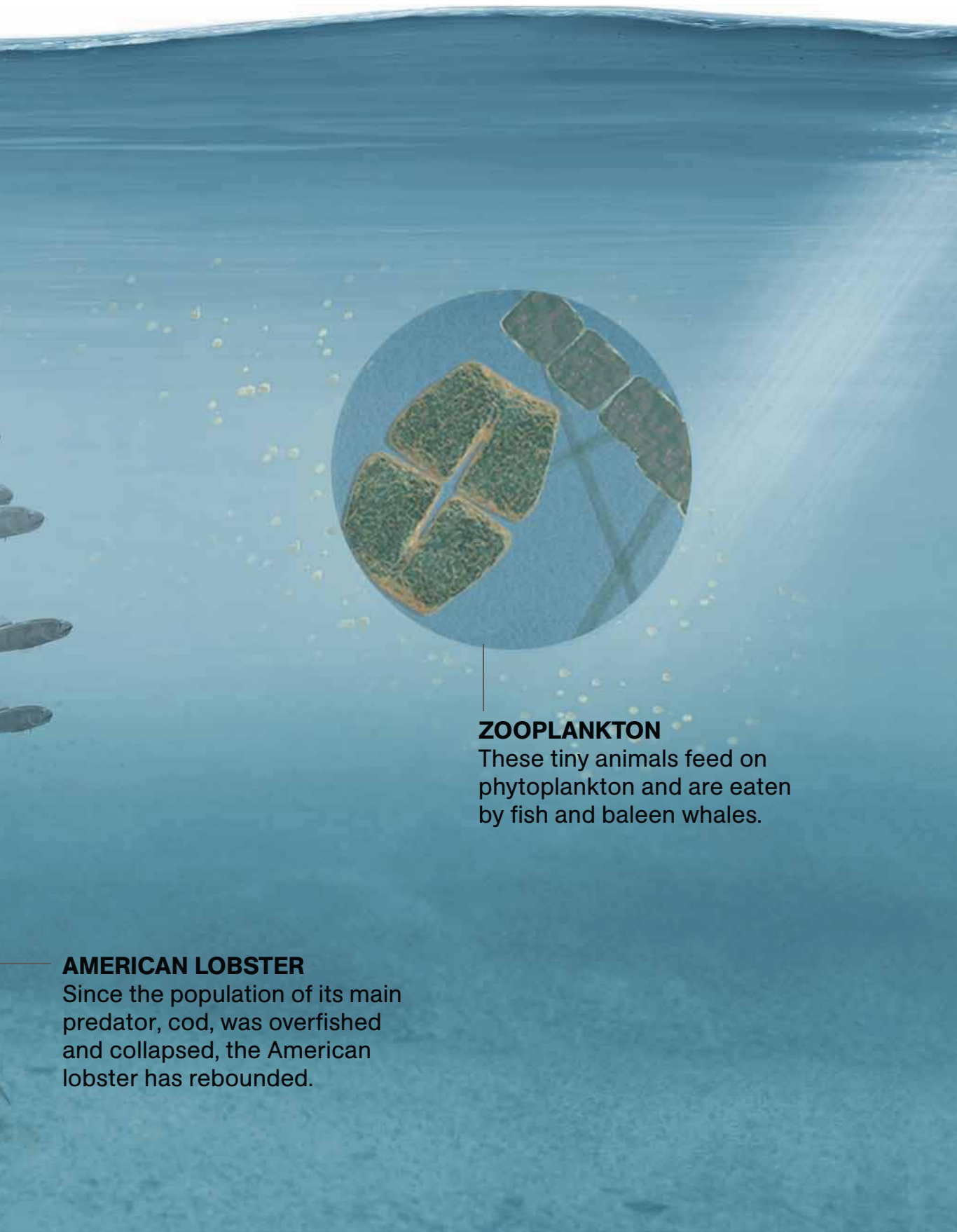
LEVEL 2

FIRST-ORDER CONSUMERS

Able to reproduce quickly, these species account for much of the ocean biomass.

PERUVIAN ANCHOVETA
The world's largest fishery by volume, anchoveta are often ground up for animal feed. El Niño events drive big ups and downs in their populations.

MORE



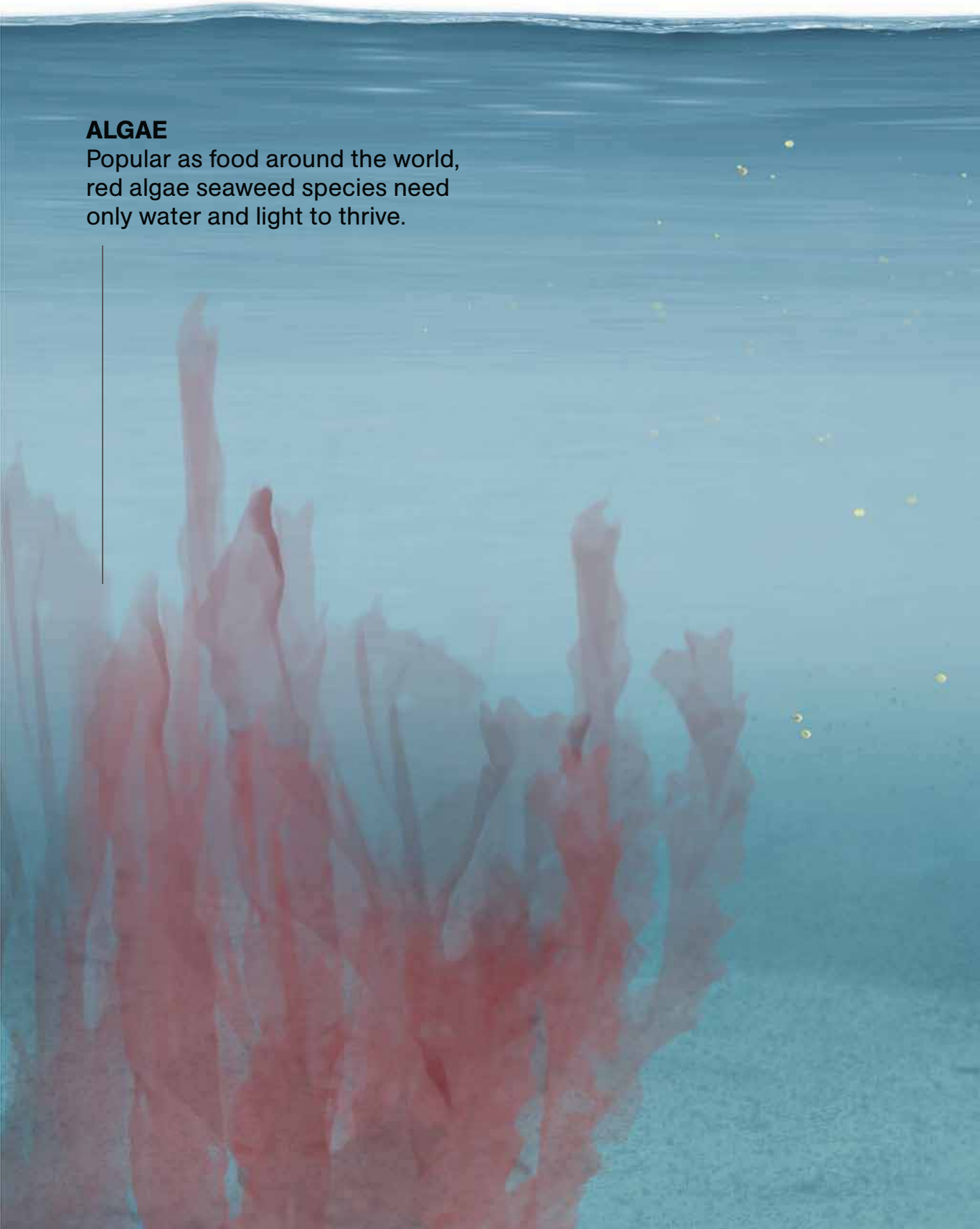
ZOOPLANKTON
These tiny animals feed on phytoplankton and are eaten by fish and baleen whales.

AMERICAN LOBSTER
Since the population of its main predator, cod, was overfished and collapsed, the American lobster has rebounded.

LEVEL 1

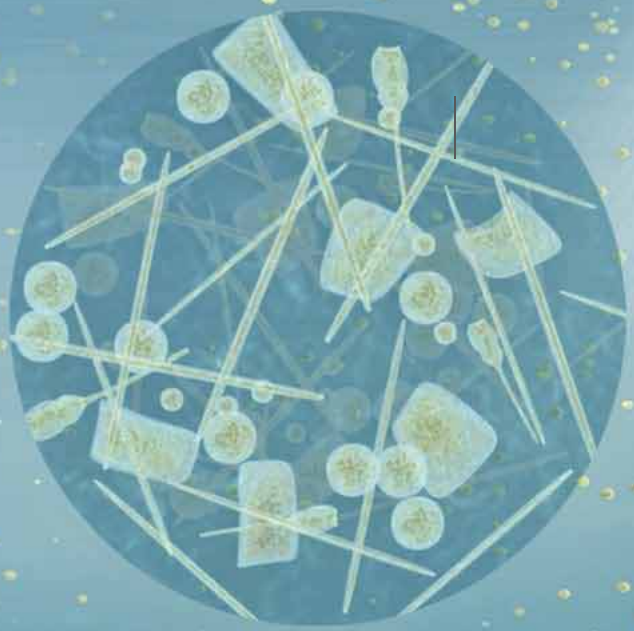
PRIMARY PRODUCERS

Organisms at the lowest level capture solar energy through photosynthesis.



ALGAE

Popular as food around the world, red algae seaweed species need only water and light to thrive.



PHYTOPLANKTON
Microscopic, plantlike organisms are so abundant in the sea that they are responsible for half of Earth's photosynthesis.

MARIEL FURLONG, NGM STAFF, AND ALEJANDRO TUMAS
ART: HERNÁN CAÑELLAS
SOURCES: ENRIC SALA; SEA AROUND US PROJECT, UNIVERSITY OF BRITISH COLUMBIA FISHERIES CENTRE; BARTON SEAVER

What We Eat Makes a Difference

LEVEL 4

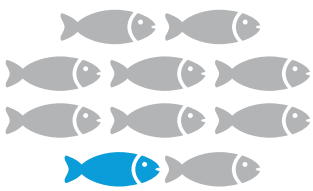
TOP PREDATORS
When you eat

1 pound
of a level 4 fish,
it's like eating ...

LEVEL 3

INTERMEDIATE PREDATORS

10 pounds
of level 3 fish



But if you consume

1 pound
of level 3 fish,
it's like eating ...

MARIEL FURLONG, NGM STAFF, AND ALEJANDRO TUMAS. SOURCE: SEA AROUND US PROJECT, UNIVERSITY OF BRITISH COLUMBIA FISHERIES CENTRE

A top predator requires exponentially more energy to survive than does a fish at a lower level of the food chain. When wealthy nations catch or buy top predators, they increase their impact on the ocean compared with poor nations, which tend to eat smaller fish.

LEVEL 2

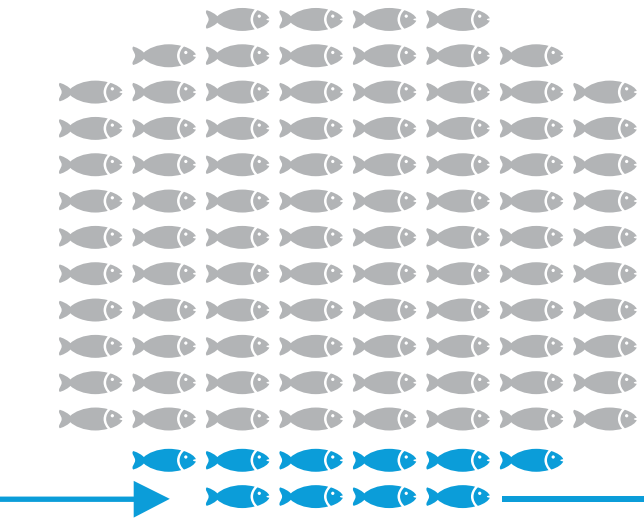
FIRST-ORDER CONSUMERS

or **100 pounds**
of level 2 fish

LEVEL 1

PRIMARY PRODUCERS

or **1,000 pounds**
of level 1 organisms



10 pounds
of level 2 fish

or **100 pounds**
of level 1 organisms

Where Fish Are Caught

HARVESTING PATTERNS

A: SOUTHEAST ASIA
The popularity of sushi has taken a toll on tuna stocks. Several species are showing signs of decline.

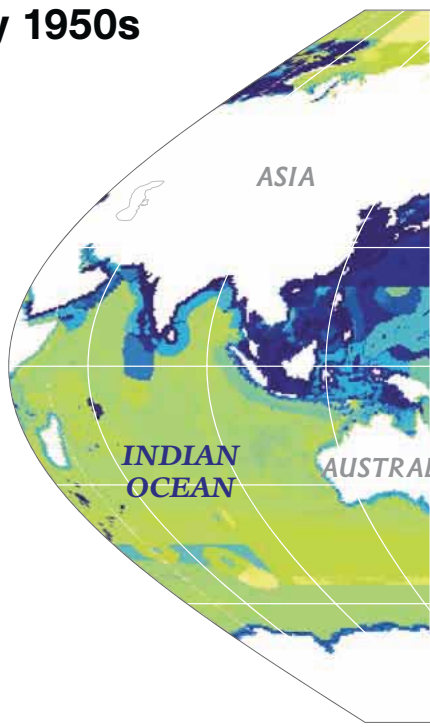
B: EXCLUSIVE ECONOMIC ZONES Created in 1982, the zones have slowed the growth of fisheries within 200 nautical miles of nations' coasts.

C: GLOBAL SOUTH
After fleets moved into waters around Antarctica, Chilean sea bass stocks were quickly depleted.

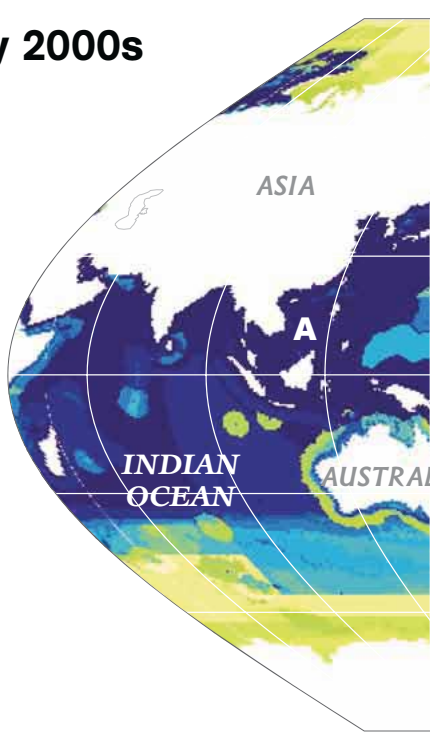
D: NORTH ATLANTIC
A thousand years of fishing by everyone from Vikings to modern Spaniards has driven cod to near collapse.

E: EASTERN ATLANTIC European fleets have targeted Africa's coasts. Leaders selling fishing rights may ignore costs to local food supplies.

Early 1950s

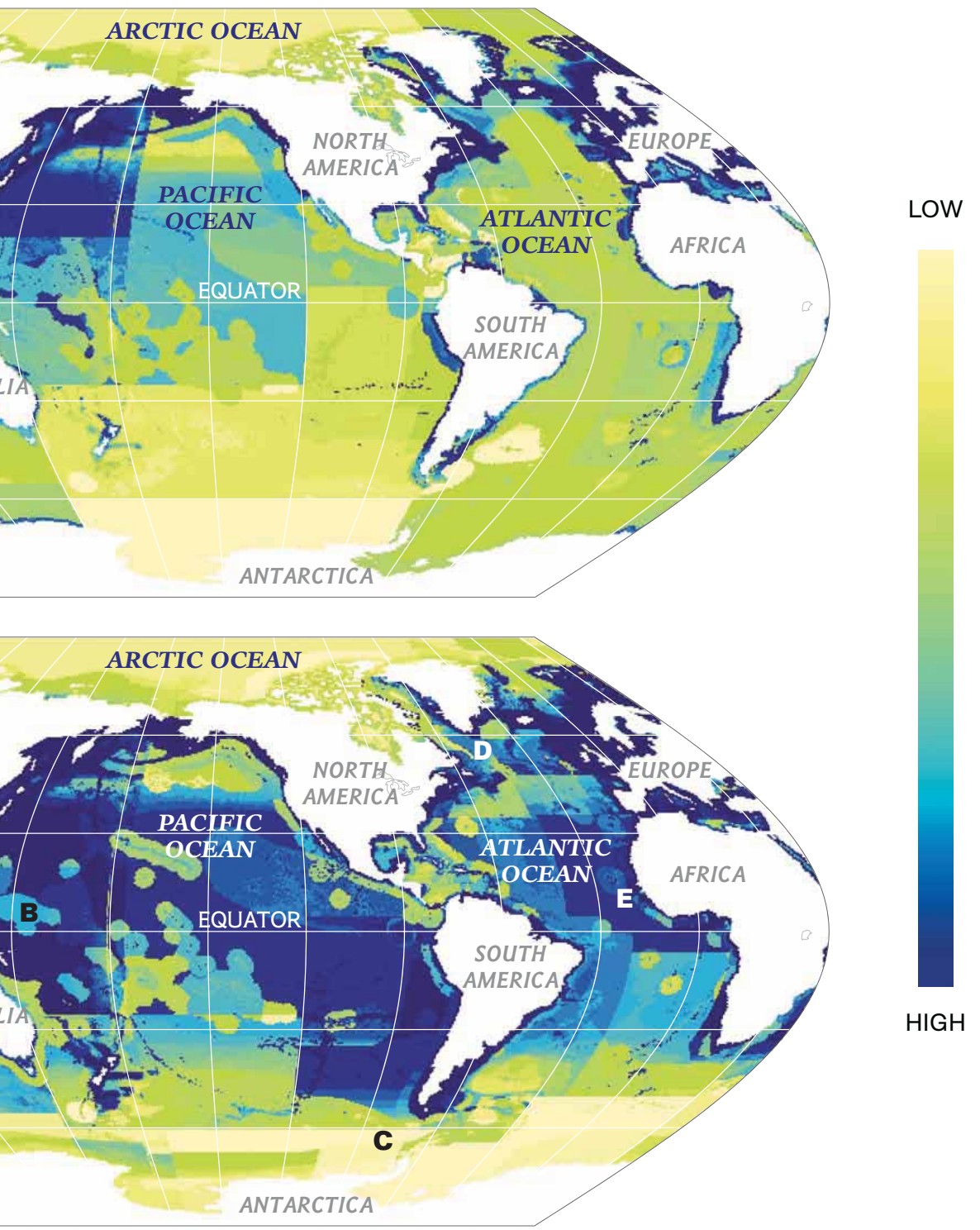


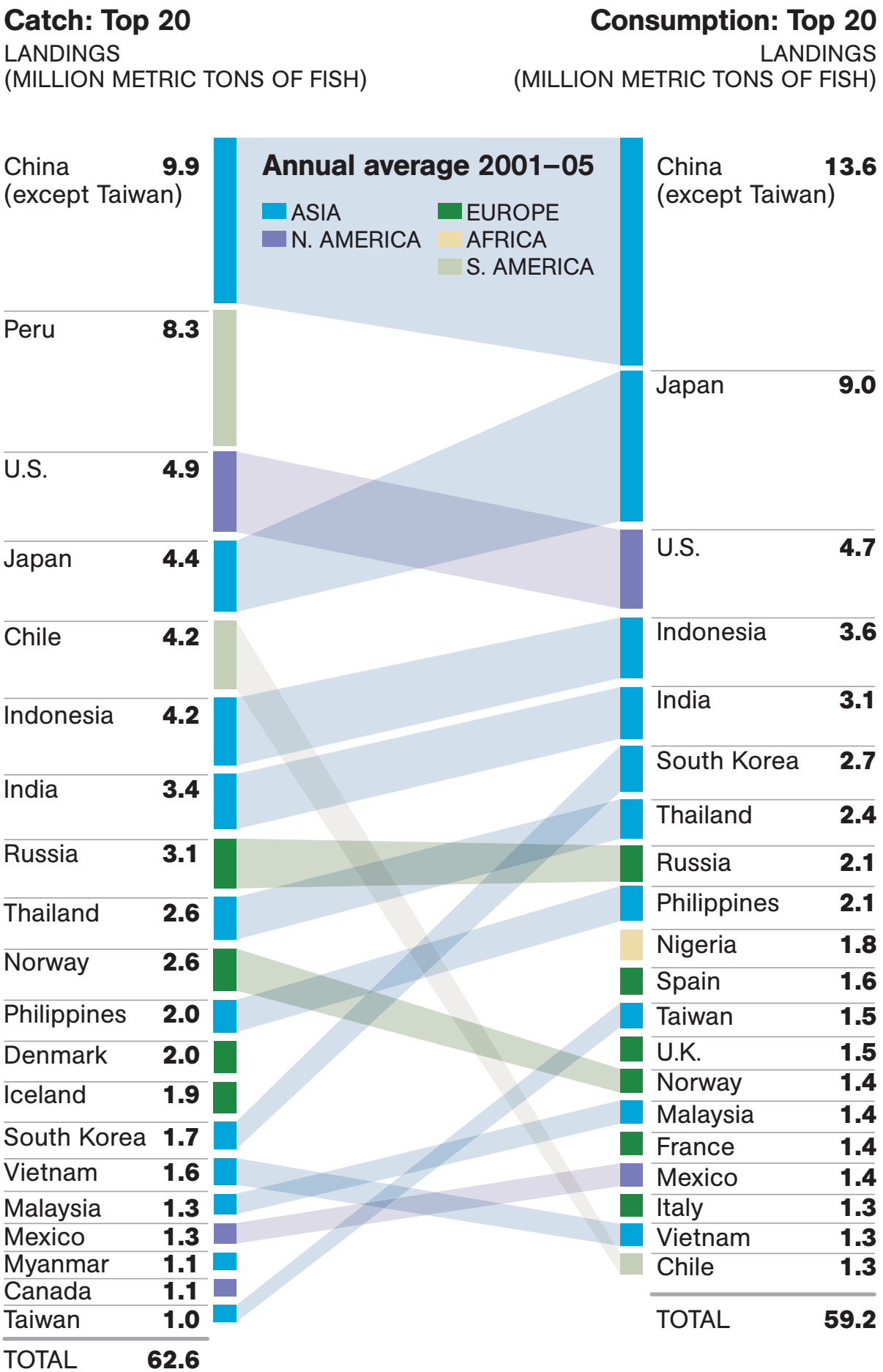
Early 2000s



MARTIN GAMACHE, NGM STAFF. SOURCE: SEA AROUND US PROJECT, UNIVERSITY OF BRITISH COLUMBIA FISHERIES CENTRE

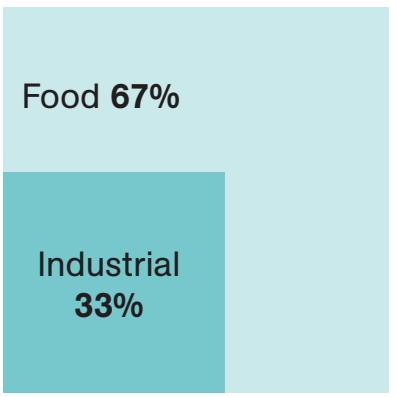
Maps show harvest intensity: ocean catch by half-degree cell (930 sq mi; 2,410 sq km), expressed in terms of primary production (metric tons of phytoplankton) over a five-year period.




Catch: Top 20
LANDINGS
(MILLION METRIC TONS OF FISH)
Consumption: Top 20
LANDINGS
(MILLION METRIC TONS OF FISH)
Annual average 2001–05
ASIA
N. AMERICA
EUROPE
AFRICA
S. AMERICA
China (except Taiwan) 9.9
Peru 8.3
U.S. 4.9
Japan 4.4
Chile 4.2
Indonesia 4.2
India 3.4
Russia 3.1
Thailand 2.6
Norway 2.6
Philippines 2.0
Denmark 2.0
Iceland 1.9
South Korea 1.7
Vietnam 1.6
Malaysia 1.3
Mexico 1.3
Myanmar 1.1
Canada 1.1
Taiwan 1.0
TOTAL 62.6
China (except Taiwan) 13.6
Japan 9.0
U.S. 4.7
Indonesia 3.6
India 3.1
South Korea 2.7
Thailand 2.4
Russia 2.1
Philippines 2.1
Nigeria 1.8
Spain 1.6
Taiwan 1.5
U.K. 1.5
Norway 1.4
Malaysia 1.4
France 1.4
Mexico 1.4
Italy 1.3
Vietnam 1.3
Chile 1.3
TOTAL 59.2

Who Catches and Who Consumes

Wealthy nations once obtained most of their fish by fishing. Today they're more likely to buy a swordfish than to catch it. Japan consumes more than twice as much fish as it catches, while Peruvians, the number two seafood producers in the world, consume barely any at all.



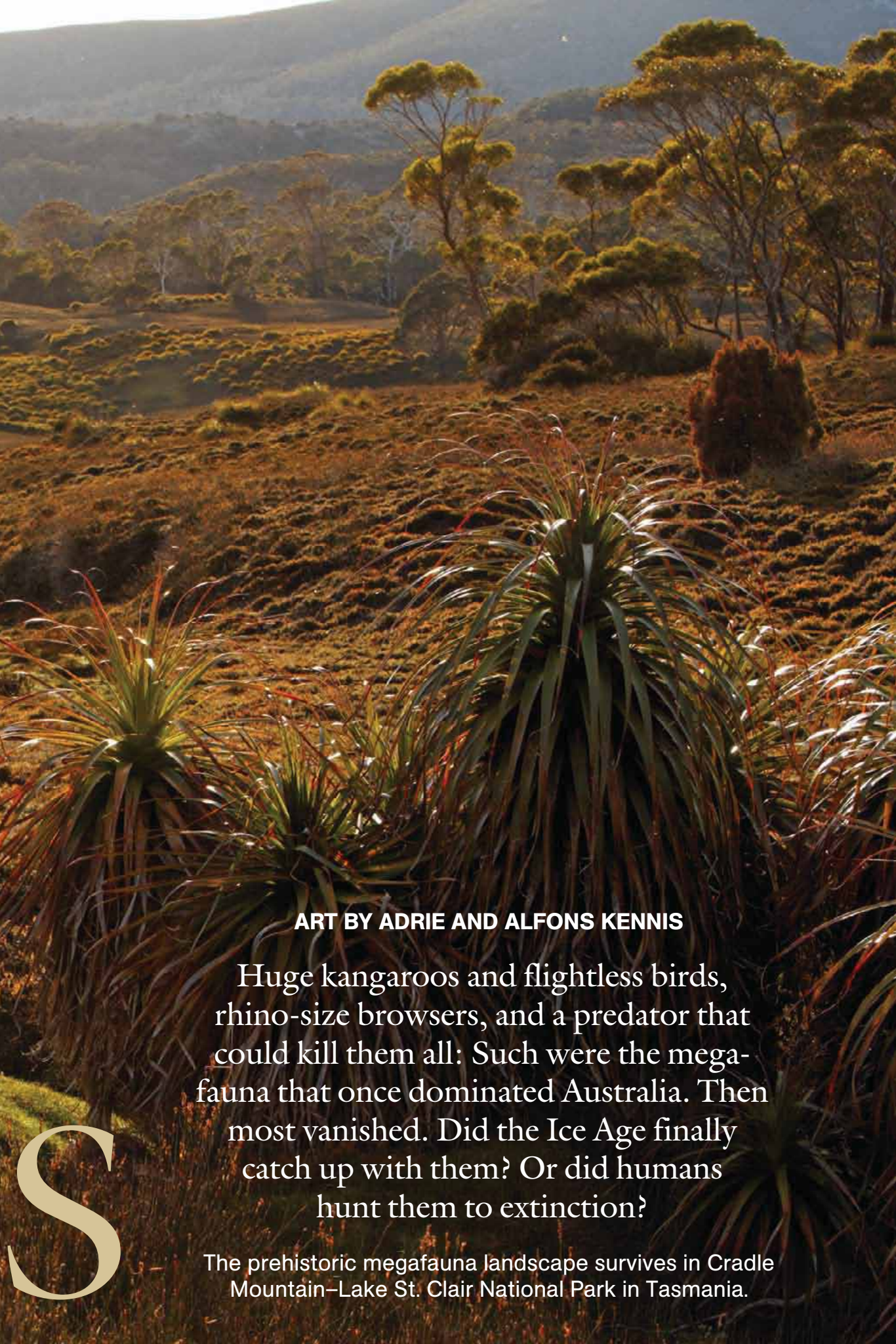
TOTAL CONSUMPTION

Annual average 2001-05

Not all of the fish that are caught are eaten. A third of today's catch is used for industrial purposes, such as the manufacturing of paints and cosmetics or feed for farm-raised salmon, tuna, and even pigs and chickens.

MARIEL FURLONG, NGM STAFF, AND ALEJANDRO TUMAS. SOURCE: SEA AROUND US PROJECT, UNIVERSITY OF BRITISH COLUMBIA FISHERIES CENTRE

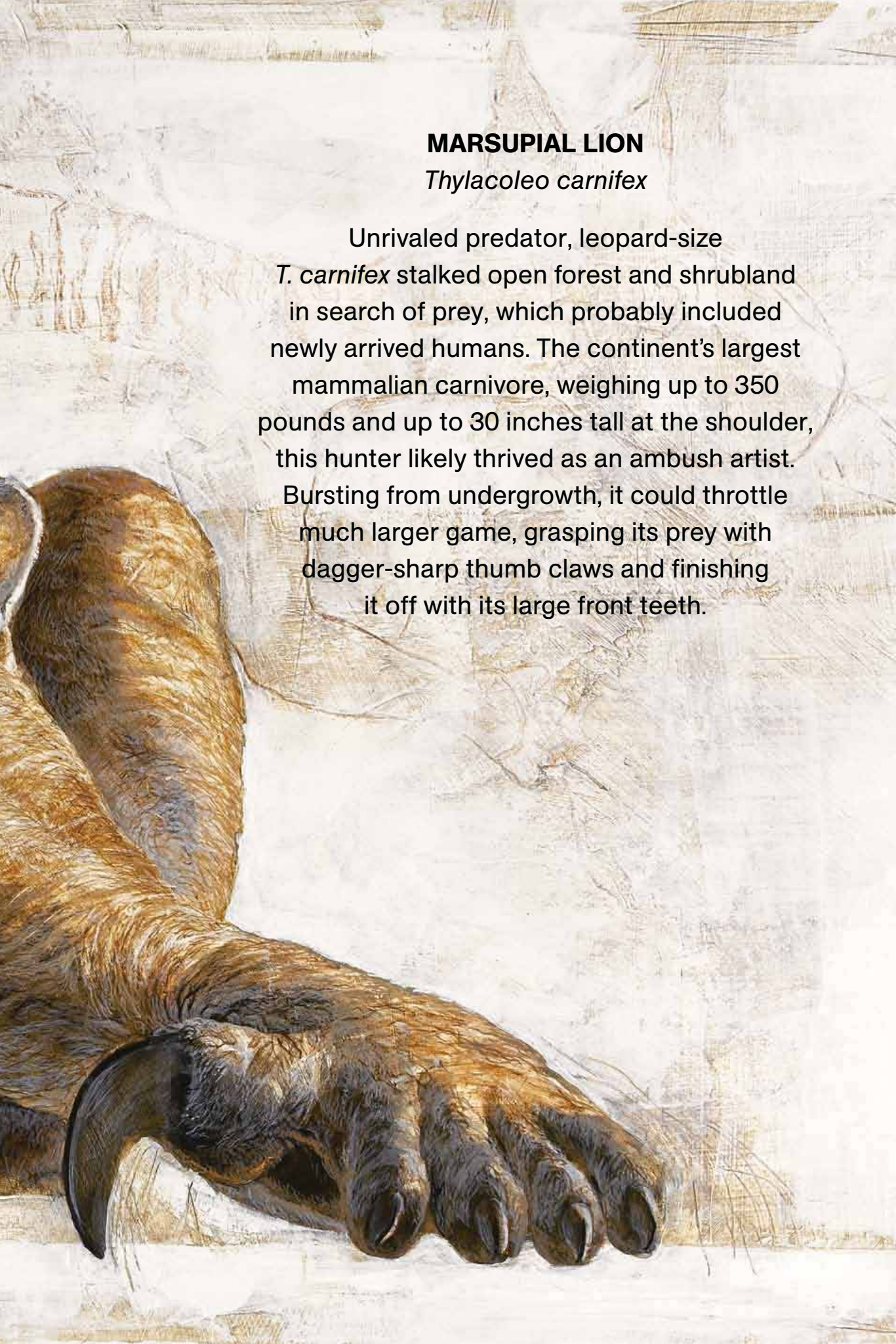
LOST GIANT



ART BY ADRIE AND ALFONS KENNIS

Huge kangaroos and flightless birds, rhino-size browsers, and a predator that could kill them all: Such were the mega-fauna that once dominated Australia. Then most vanished. Did the Ice Age finally catch up with them? Or did humans hunt them to extinction?

The prehistoric megafauna landscape survives in Cradle Mountain–Lake St. Clair National Park in Tasmania.



MARSUPIAL LION

Thylacoleo carnifex

Unrivaled predator, leopard-size *T. carnifex* stalked open forest and shrubland in search of prey, which probably included newly arrived humans. The continent's largest mammalian carnivore, weighing up to 350 pounds and up to 30 inches tall at the shoulder, this hunter likely thrived as an ambush artist. Bursting from undergrowth, it could throttle much larger game, grasping its prey with dagger-sharp thumb claws and finishing it off with its large front teeth.

BY JOEL ACHENBACH
PHOTOGRAPHS BY AMY TOENSING

YOU WILL FIND THE NARACOORTE CAVES in the pastoral wine country of South Australia, four hours from Adelaide on lonely roads heading toward what the Aussies call the Southern Ocean. The grapevines thrive in red soil that sits like a layer of icing on porous limestone. It's lovely country, but it can be treacherous. The ground is pocked with holes, many no wider than a café table, known as pitfall traps. They're deep. They plunge into the blackest of caverns. Pitfall traps have gobbled up many a kangaroo bounding through the night.

One day in 1969 a fledgling fossil hunter named Rod Wells came to Naracoorte to explore what was then known as Victoria Cave. It was an old tourist attraction, with steps and handrails and electric lights. But Wells and half a dozen colleagues ventured beyond the tourist section, clawing through dark, narrow passages. When they felt a suggestive breeze wafting from a pile of loose rubble, they knew there was a chamber beyond. Wells and one other slithered into the huge room. Its expansive floor of red soil was littered with strange objects. It took Wells a moment to realize what they were looking at. Bones: lots of bones. Pitfall-trap victims galore.

Victoria Fossil Cave, as the cavern is now known, warehouses

the bones of something like 45,000 animals. Some of the oldest bones belonged to creatures far larger and more fearsome than any found today in Australia. They were the ancient Australian megafauna—huge animals that roamed the continent during the Pleistocene epoch.

In boneyards across the continent, scientists have found the fossils of a giant snake; a huge flightless bird; a wombat-like creature the size of a rhinoceros; and a seven-foot-tall kangaroo with a strangely short face. They've found the remains of a tapir-like creature; a hippo-like beast; and a lizard, 20 feet long, that ambushed its prey and swallowed everything down to the last feather.

The Australian megafauna dominated their ecosystems—and then were gone in an extinction spasm that swept away nearly every animal that weighed a hundred pounds or more. What, exactly, killed them off?

Given how much ink *(Touch* Text *button to read more.)*

Joel Achenbach is reporting on the Gulf oil spill for the Washington Post. *Amy Toensing covered the drought in Australia's Murray-Darling River Basin in April 2009. Dutch twin brothers and artists, Adrie and Alfons Kennis specialize in paintings and models of extinct animals and humans.*

Park guides scout bone-rich sediment in Kelly Hill Caves on Kangaroo Island, possibly one of the last places mega-fauna survived in Australia. Scientists are finding abundant remains of animals that fell into the caves.

GIANT WOMBAT

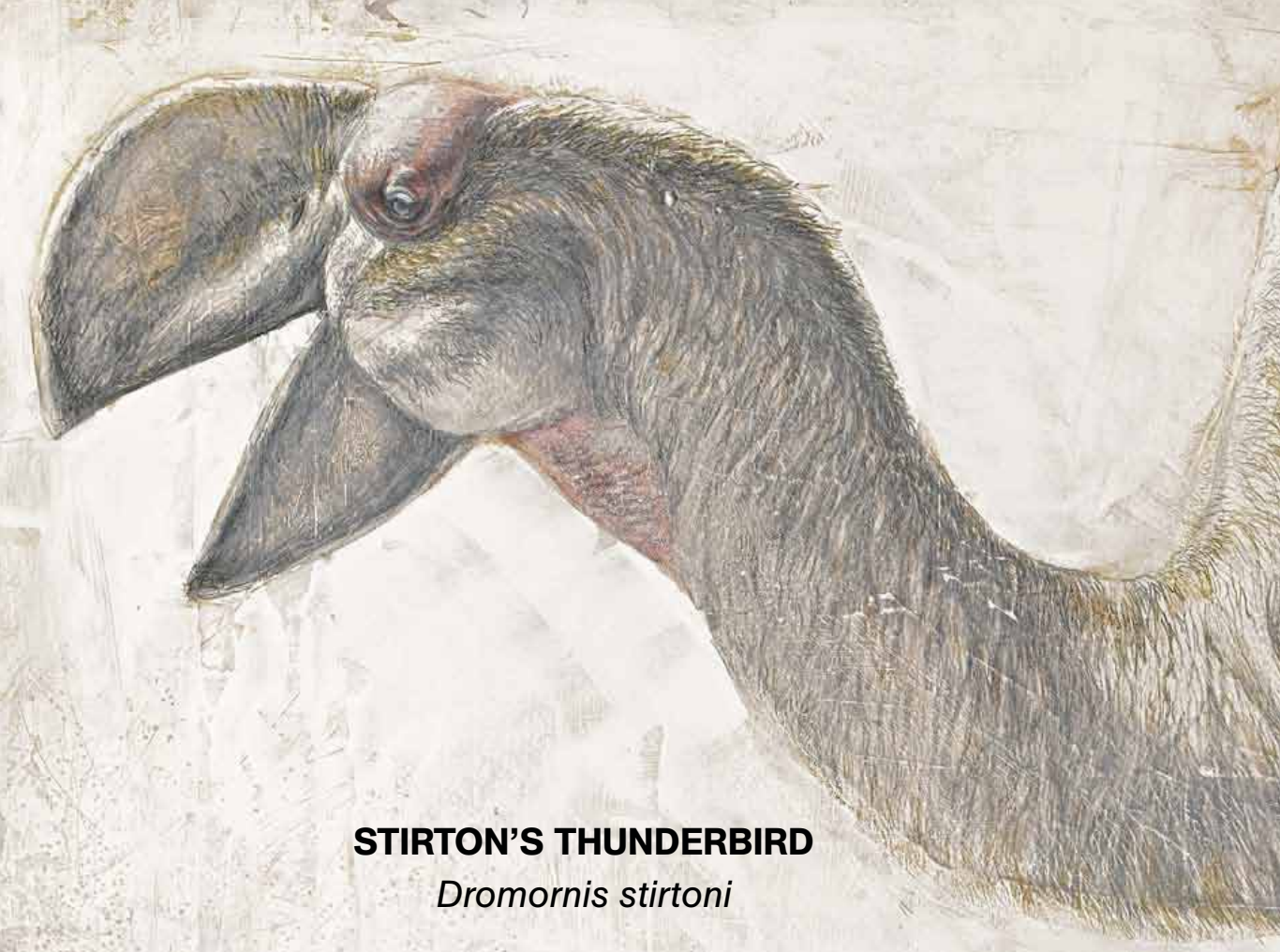
Diprotodon optatum

A plodding colossus, *D. optatum,* the largest known marsupial, grew to rhinoceros size. The biggest ones reached over six feet tall at the shoulder and ten feet long, their furry, pillar-like legs supporting three tons of weight. *Diprotodon* occupied a niche similar to the African elephant, browsing on shrubs and collecting at water holes. Its SUV size and lack of agility would have made it a tempting target for marsupial lions and human hunters.

GIANT SHORT-FACED KANGAROO

Procoptodon goliah

No living kangaroo can do this: reach above its head and pull leaves off a tree. Long, clawed fingers and forelimbs that could extend upward like human arms allowed *P. goliah,* the largest kangaroo ever, to thrive as a browser in open forests. The seven-foot-tall marsupial with hooflike toes was one of the last of the megafauna to go extinct, overlapping with humans for thousands of years and likely inspiring Aboriginal tales about a long-limbed fighting roo.



STIRTON'S THUNDERBIRD

Dromornis stirtoni

Perhaps the largest known bird, *D. stirtoni* never left the ground. Ten feet tall and weighing a thousand pounds, it belonged to a family of giant flightless birds, the dromornithids. Humans never saw Stirton's thunderbird; it lived about eight million years ago in the late Miocene, when Australia was drying out.

MARSUPIAL TAPIR

Palorchestes painei

"Tree wreckers": that's how paleontologist Tim Flannery describes *Palorchestes,* cow-size marsupials that used powerful limbs, a trunk-like nose, and a long giraffe-type tongue to strip bark and tear up roots. Scientists first mistook their teeth for those of giant kangaroos but wombats and koalas are their closest kin.

MYSTERIOUS EXTINCTIONS

Between 50,000 and 10,000 years ago, two-thirds of all large animal genera in the world, from mastodons to giant kangaroos, disappeared. Was climate change, with shifts in rainfall patterns and vegetation, responsible for the die-off of megafauna (large-bodied animals weighing about a hundred pounds or more)? Or, as mounting evidence suggests, did the fanning out of humans from Africa and Asia—a new, sophisticated predator—contribute to rapid, continent-wide extinctions?

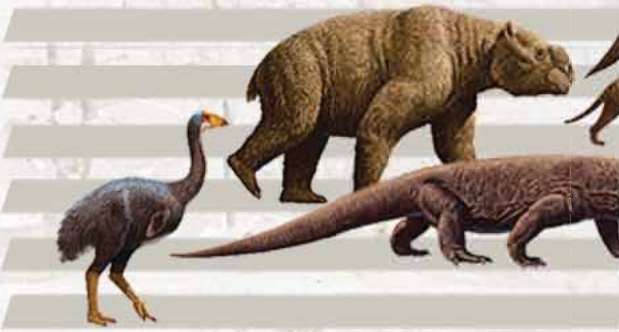
HIRAM HENRIQUEZ AND PATRICIA HEALY. ART: RAÚL MARTÍIN. SOURCES: ANTHONY D. BARNOSKY, UNIVERSITY OF CALIFORNIA, BERKELEY; AARON CAMENS, UNIVERSITY OF ADELAIDE; ARAPATA HAKIWAI, MUSEUM OF NEW ZEALAND; RICHARD N. HOLDAWAY, PALAECOL RESEARCH LTD; JOHN A. LONG, NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY; DENNIS STANFORD AND HANS-DIETER SUES, NATIONAL MUSEUM OF NATURAL HISTORY; ROD T. WELLS, FLINDERS UNIVERSITY

DISAPPEARING MEGAFAUNA

MORE

Australia

Extinction of a majority of megafauna genera appears to coincide with human settlement over a 5,000-year period. Contributing factors included hunting and changes in vegetation caused by fire and a falling population of giant herbivores.



North and South America

North America once harbored an array of large mammal species rivaling Africa's. Within a few millennia of a major influx of hunters from Siberia about 13,000 years ago, most megafauna in North and South America were gone.

New Zealand

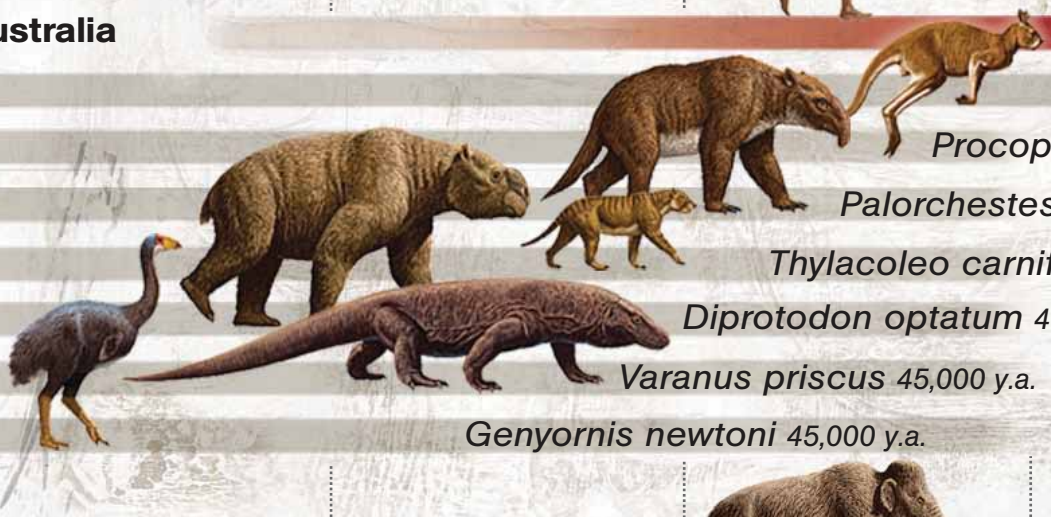
A century or so after the arrival of Polynesians, who became the Maori, hunting and land clearing eliminated giant birds, most notably the wingless moa and its main predator, Haast's eagle, the world's largest known eagle.

70,000 YEARS AGO (Y.A.) 60,000 50,000 40,000

*Approximate extinction dates**

Humans arrive about 50,000 years ago.

Australia



Procoptodon gol

Palorchestes azael 45,(

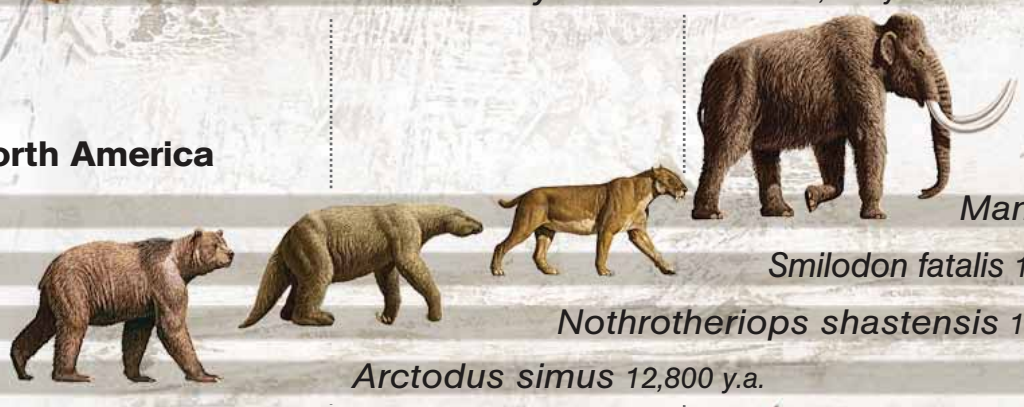
Thylacoleo carnifex 45,000 y

Diprotodon optatum 45,000 y.a.

Varanus priscus 45,000 y.a.

Genyornis newtoni 45,000 y.a.

North America



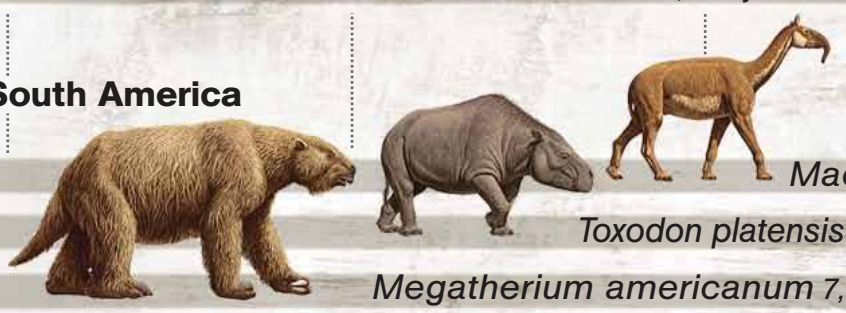
Mammuthus pr

Smilodon fatalis 13,000 y.a.

Nothrotheriops shastensis 13,000 y.a.

Arctodus simus 12,800 y.a.

South America

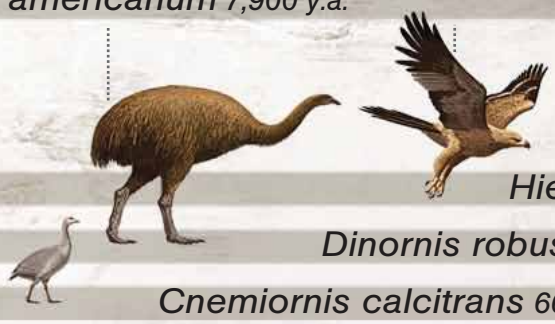


Macrauchenia patachonica

Toxodon platensis 13,000 y.a.

Megatherium americanum 7,900 y.a.

New Zealand



Hieraae

Dinornis robustus 6

Cnemiornis calcitrans 660 y.a.

70,000 YEARS AGO 60,000 50,000 40,000

30,000 | 20,000 | 10,000 | TODAY

* DATES INDICATE THE LAST TIME THE ANIMALS WERE ABUNDANT. EXTINCTION LIKELY FOLLOWED SOON AFTER.
** ISOLATED ISLAND POPULATION EXTINCTION 3,900 YEARS AGO

Thylacinus cenocephalus *74 y.a.*

iah *45,000 y.a.*

000 y.a.

.a.

The striped Tasmanian tiger, a dog-size marsupial, survived until the early 20th century on Tasmania.

Humans arrive between 30,000 and 13,000 years ago.

imigenius *10,500 y.a.***

a *13,500 y.a.*

Humans first settle about 700 years ago.

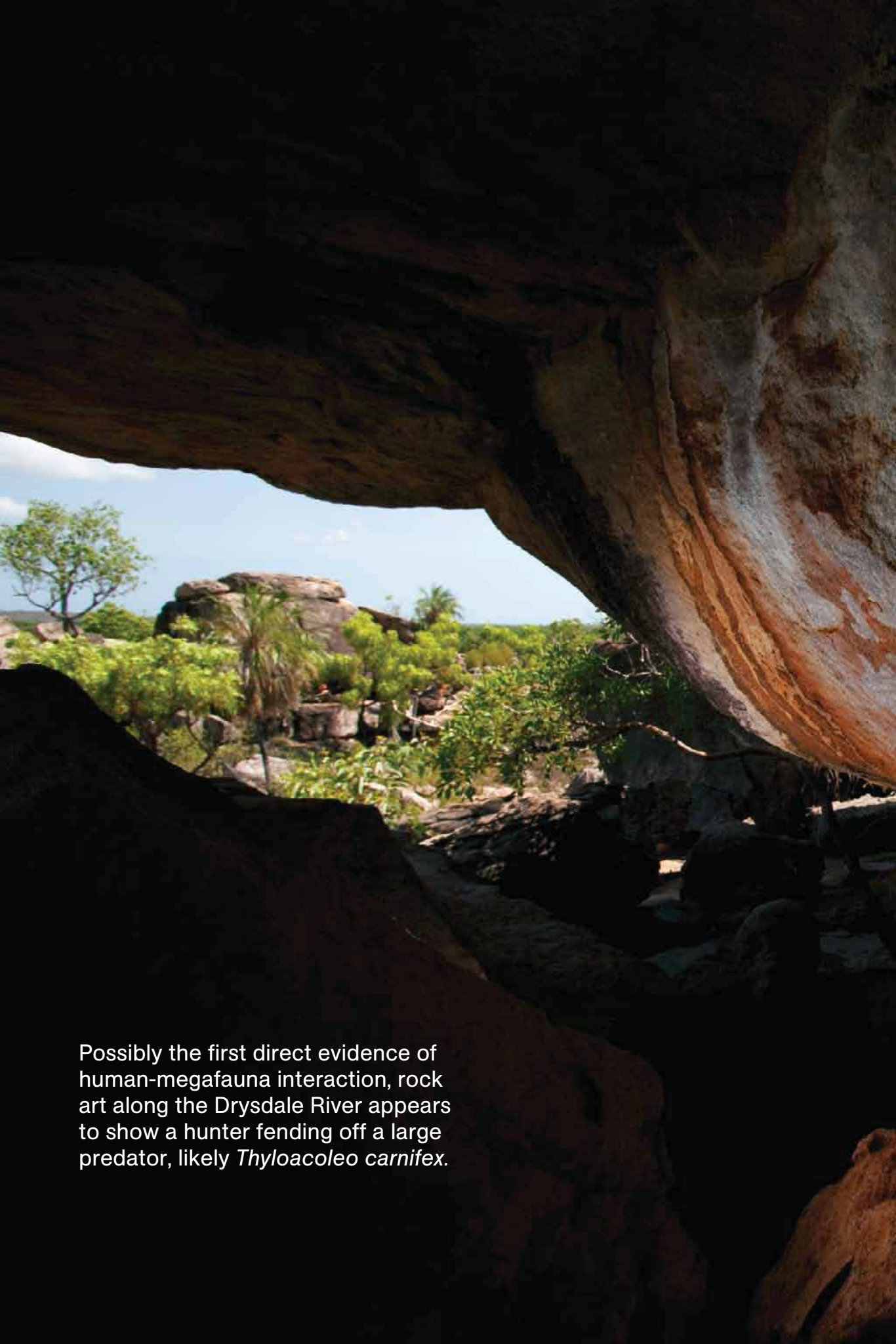
tus moorei *720 to 590 y.a.*

660 to 560 y.a.

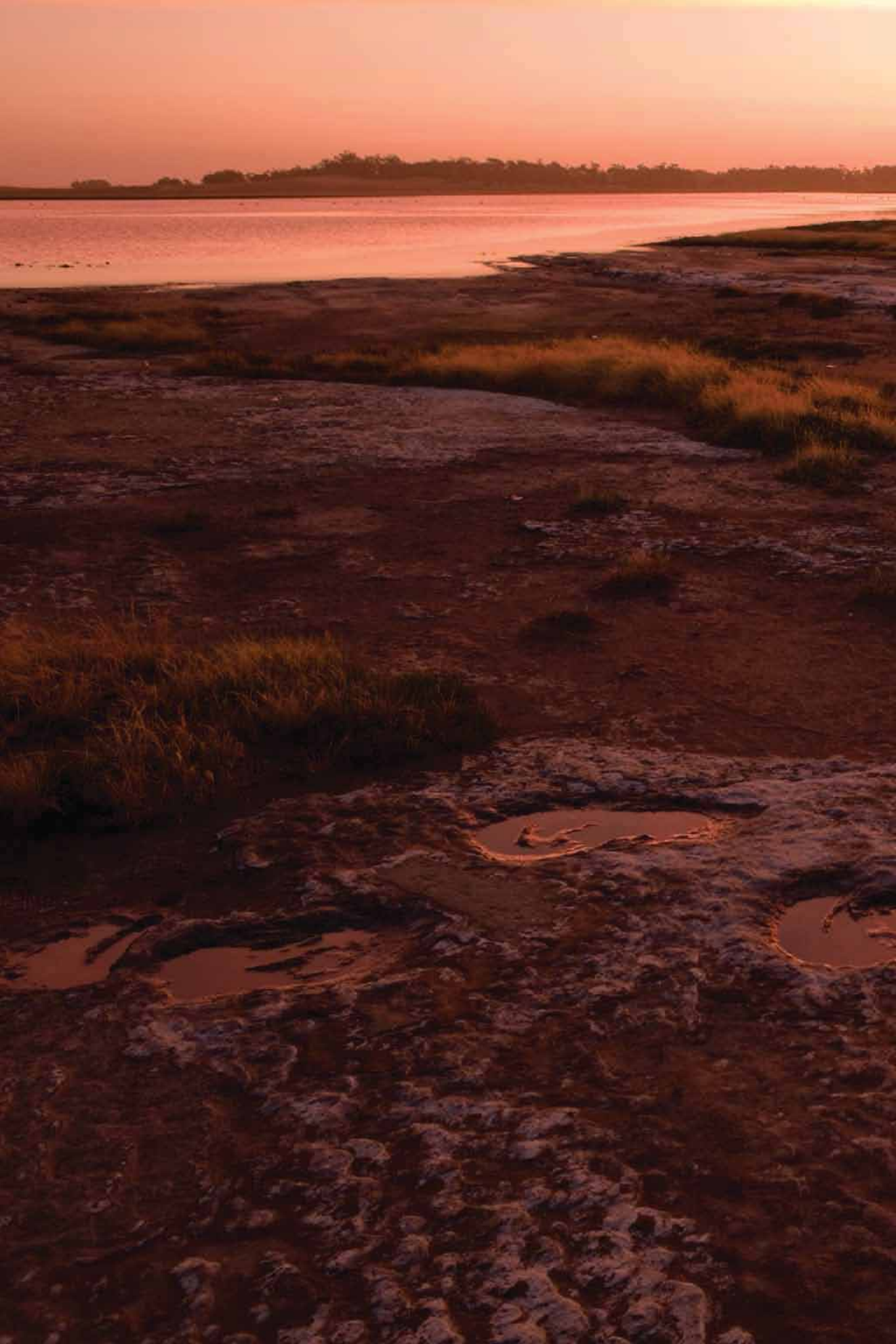
30,000 | 20,000 | 10,000 | TODAY

Imagine an Aboriginal hunting party 45,000 years ago crouched under an outcrop on the southern coast of Kangaroo Island. The semiarid scrubland they saw, similar to today's landscape, harbored megafauna the humans targeted for food.

The massive jaws and teeth of this predator, *Thylacoleo carnifex,* look lethal on a cast skeleton at Adelaide's South Australian Museum.



Possibly the first direct evidence of human-megafauna interaction, rock art along the Drysdale River appears to show a hunter fending off a large predator, likely *Thyloacoleo carnifex.*



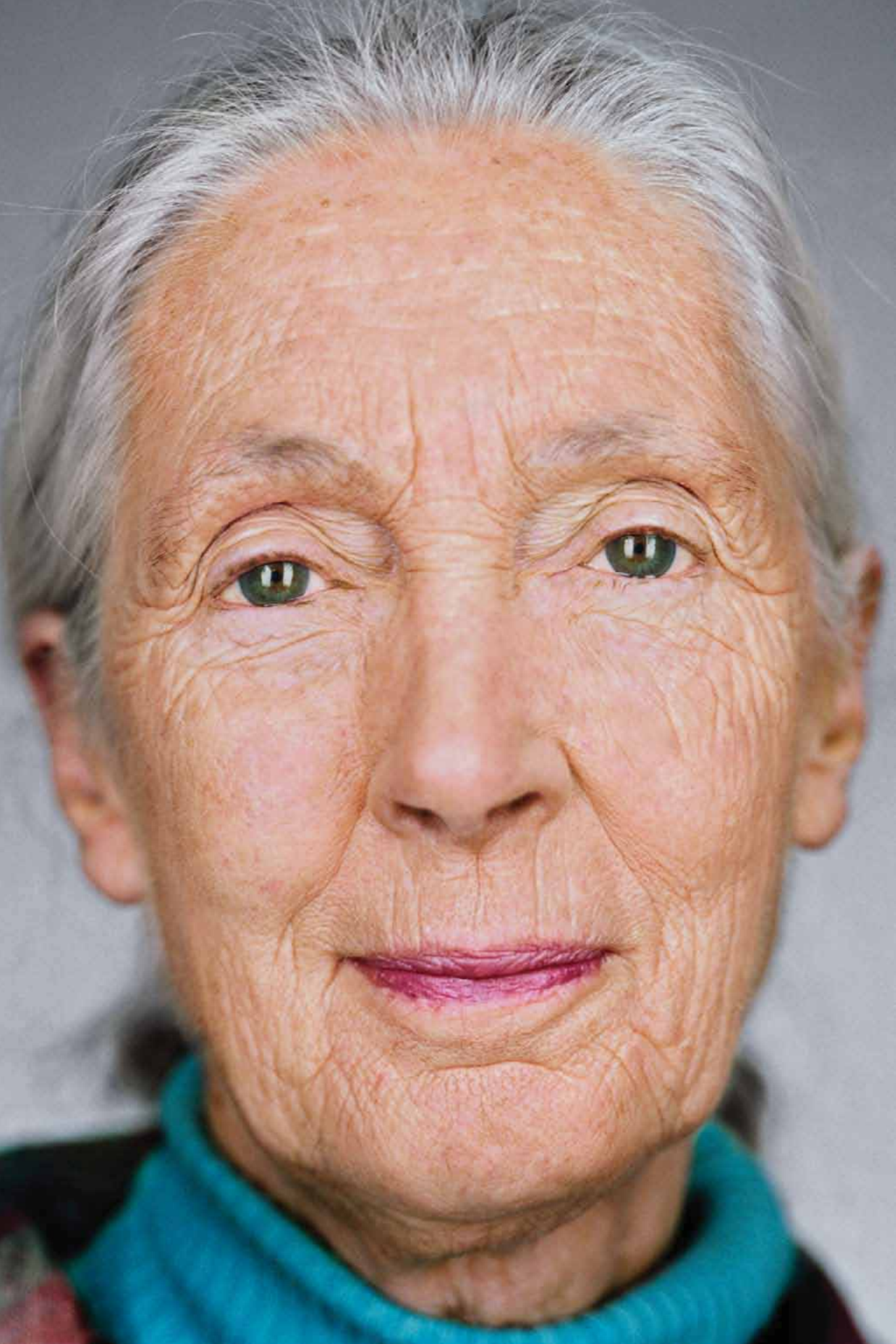
On a drying lake bed in Victoria, a farmer in 2007 alerted scientists to a major find: well-preserved tracks of a *Diprotodon.* The slow-moving behemoth had been crossing a volcanic plain 100,000 years ago, when megafauna still walked tall.

Jane

Fifty Years at Gombe

In 1960 a spirited animal lover with no scientific training set up camp in Tanganyika's Gombe Stream Game Reserve to observe chimpanzees. Today Jane Goodall's name is synonymous with the protection of a beloved species. At Gombe—one of the longest, most detailed studies of any wild animal—revelations about chimps keep coming.

MARTIN SCHOELLER



HUGO VAN LAWICK

LOA

BY DAVID QUAMMEN

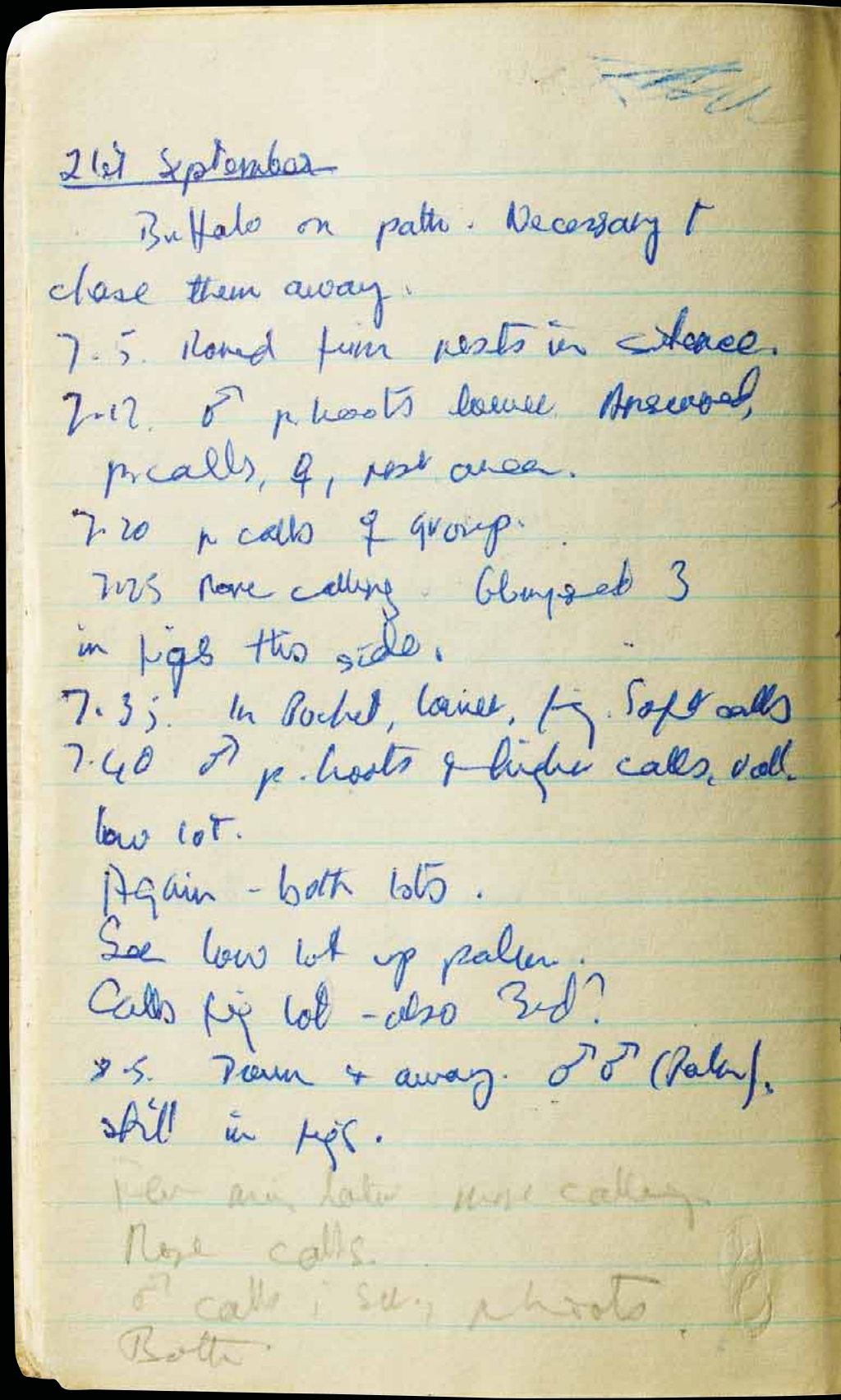
MOST OF US DON'T ENTER upon our life's destiny at any neatly discernible time. Jane Goodall did.

On the morning of July 14, 1960, she stepped onto a pebble beach along a remote stretch of the east shore of Lake Tanganyika. It was her first arrival at what was then called the Gombe Stream Game Reserve, a small protected area that had been established by the British colonial government back in 1943. She had brought a tent, a few tin plates, a cup without a handle, a shoddy pair of binoculars, an African cook named Dominic, and—as a companion, at the insistence of people who feared for her safety in the wilds of pre-independence Tanganyika—her mother. She had come to study chimpanzees. Or anyway, to try. Casual observers expected her to fail. One person, the paleontologist Louis Leakey, who had recruited her to the task up in Nairobi, believed she might succeed.

A group of local men, camped near their fishing nets along the beach, greeted *(Touch* Text *button to read more.)*

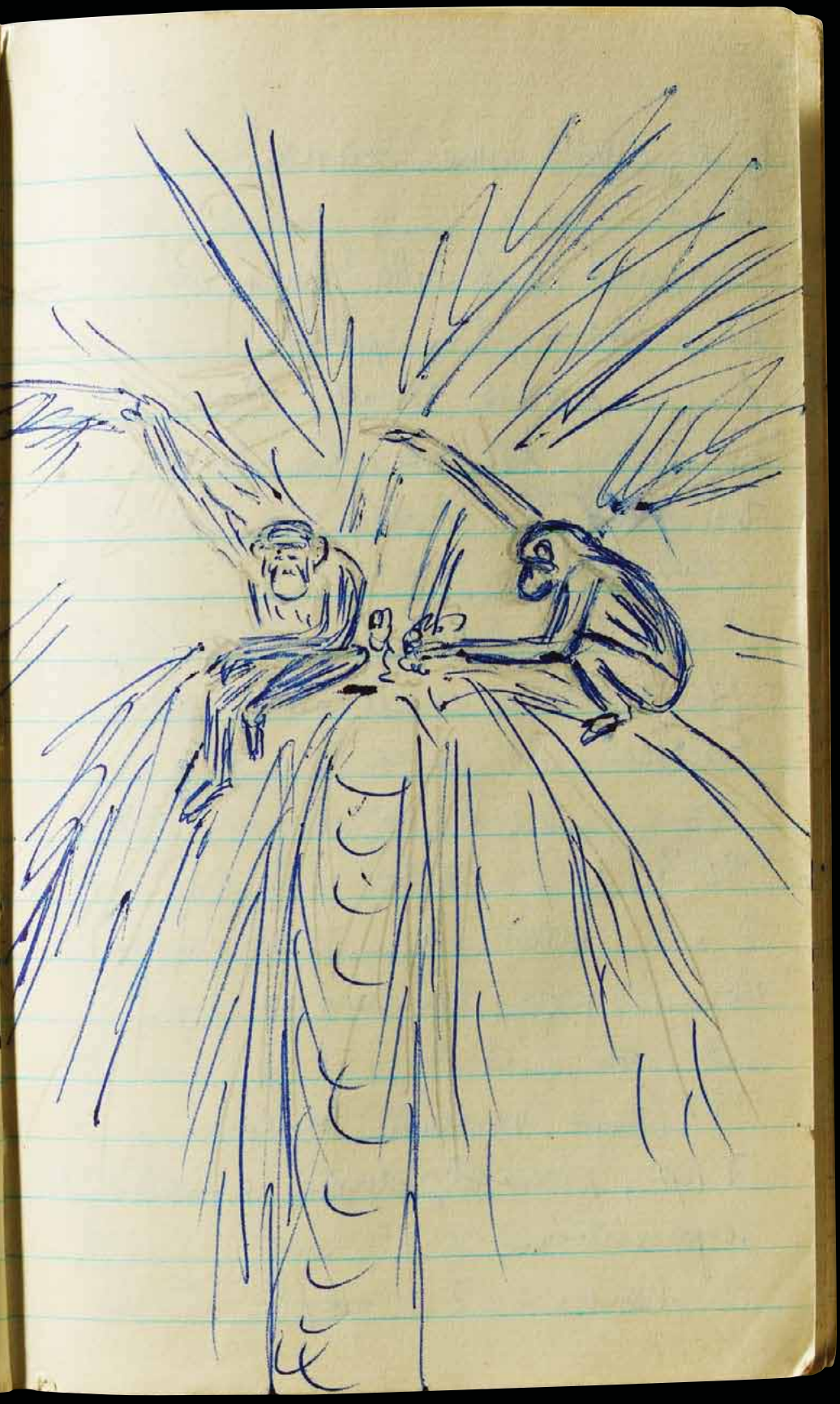
Contributing writer David Quammen's book on zoonotic diseases will be published next year by W. W. Norton.

Who's watching whom? Jane trades gazes with Fifi, one of her original study subjects. The wooden fence kept chimps from charging into camp and scattering provisions. Years later Fifi climbed to top matriarch, with seven of nine offspring surviving—the most of any female. She and her youngest disappeared in 2004, "a really sad time," Jane says.


21st September

Buffalo on path. Necessary to chase them away.
7.5. Horned fem rests in trees.
7.12. ♂ p. hoots loudly. Answered, p. calls, ♀, rest area.
7.20 p. calls ♀ group.
7.25 more calling. Glimpsed 3 in pigs this side.
7.35. In Bocket, loudly. ♀ Soft calls
7.40 ♂ p. hoots & higher calls, dull low tot.
Again - both lots.
See low bit up palm.
Calls ♀ bit - also 3rd?
7.5. Down & away. ♂♂ (Palm). still in pigs.
Per ans later more calling.
More calls.
♂ calls ; ♀, p. hoots.
Both.

Jane's entry in a 1961 field notebook

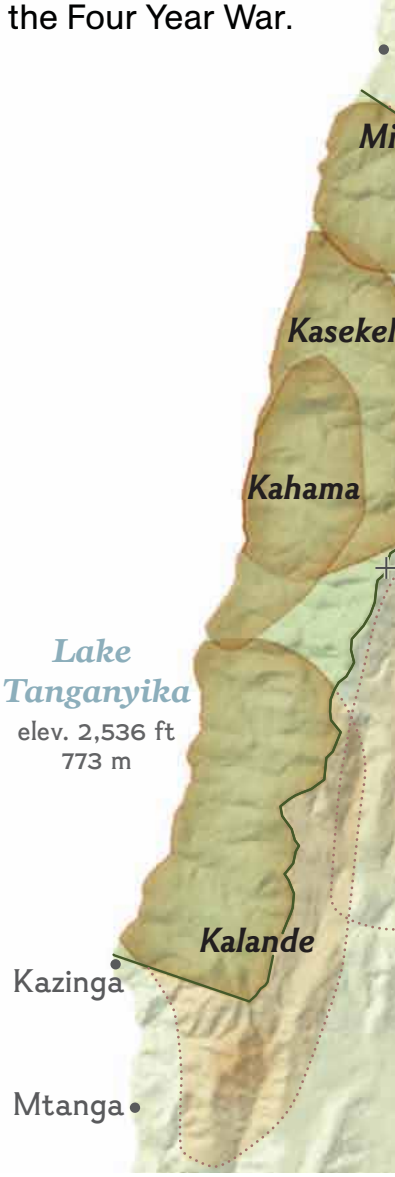


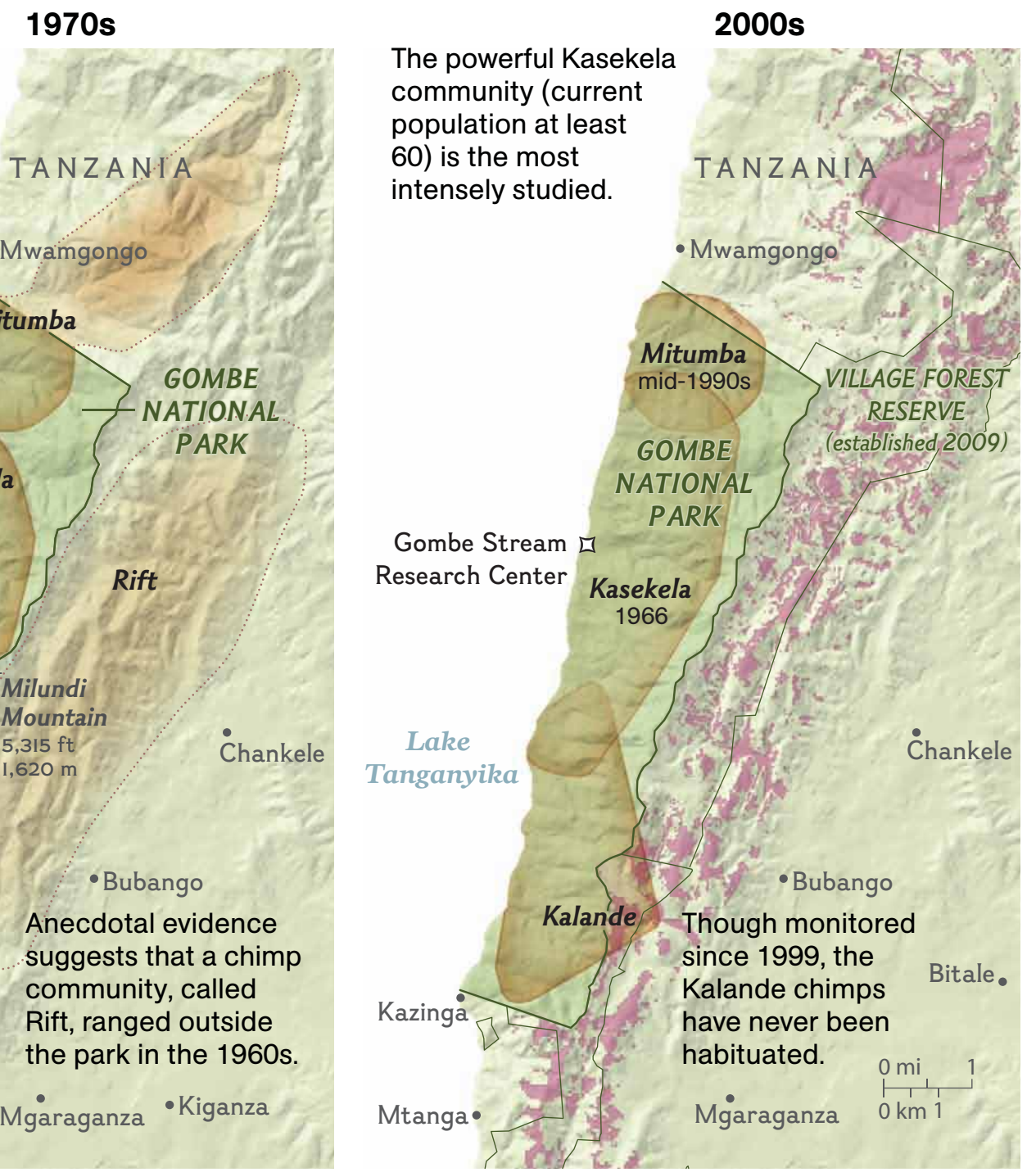
COURTESY JANE GOODALL

A Haven for Chimps

An area of 13.5 square miles seemed enough in 1968, when Gombe was named a national park. But studies have since shown that this primate population—about a hundred chimps—will need a larger foraging area to thrive in the long term. As farms and oil palm plantations have closed in on the park, chimp home ranges outside have shrunk, likely intensifying territorial conflicts. Disease has added to the toll. The Jane Goodall Institute is now promoting livelihoods that both benefit villagers and restore chimp habitat.

By 1977 the Kasekela community had killed or absorbed chimps of the Kahama group. Their conflict is called the Four Year War.

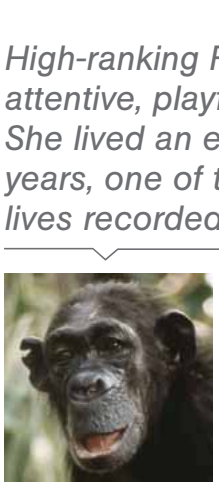




MAPS: MARTIN GAMACHE, NGM STAFF; INTERNATIONAL MAPPING ASSOCIATES
SOURCES: LILIAN PINTEA, JANE GOODALL INSTITUTE; ANNE PUSEY, DUKE UNIVERSITY; MIKE WILSON AND DEUS CYPRIAN, UNIVERSITY OF MINNESOTA

FAMILY TIES

Three matriarchs in the Kasekela community became key personalities in the study of chimp reproduction, nurturing, and social behavior. Family lines are traced through the mothers, since paternity was uncertain before DNA testing.



High-ranking Flo was an attentive, playful mother. She lived an estimated 53 years, one of the longest lives recorded at Gombe.

1960

1970

Gombe's top matriarch, Fifi has the most offspring: seven of nine surviving.

Gombe's largest chim on record, 121-pound Frodo has sired the most offspring: eight.

Freud

Frodo

Faben

Figan

Fifi

Flint

Flame

Flo dies

Her son despon three w

*1919**

1947

1953

1958

Flo

A callous and indifferent mother, Passion's unusual behavior took a violent turn.

Pa

Infant

Pom

Prof

Pax

1949

Passion

Passion and her daughter, Pom, killed and ate at least four infants.

Strong relationships with her children helped Melissa maintain her social ranking.

Eaten by Passi Pom, and Prof.

Stillborn infant

Genie

Goblin

Gremlin

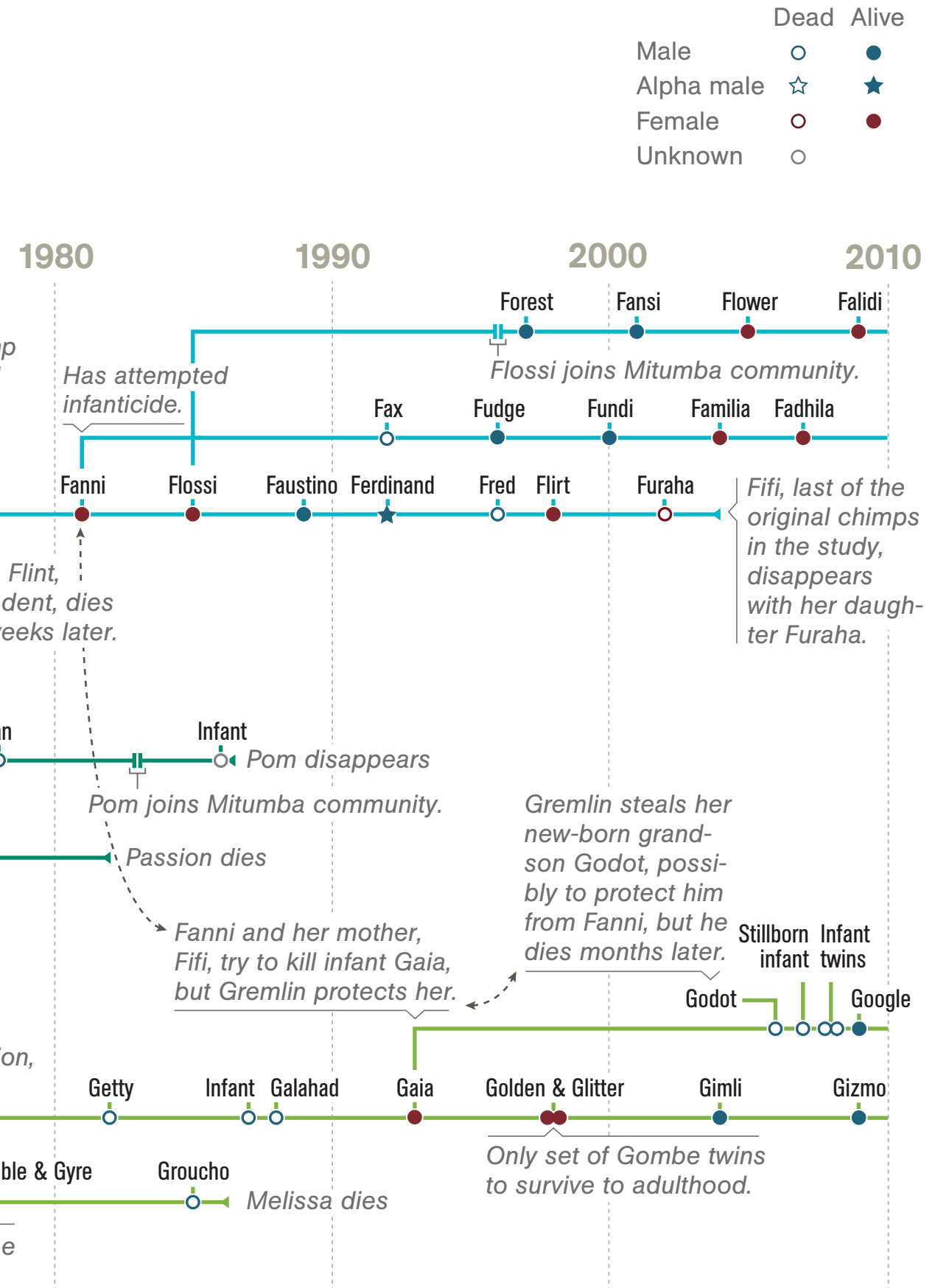
Infant

Gim

1949

Melissa

Goblin became an alpha male, one of 11 th Kasekela community has had since 1960.



GRAPHIC: LAWSON PARKER, NGM STAFF

GRAPHIC SOURCE: JOANN C. SCHUMACHER-STANKEY. PHOTOS: COURTESY JANE GOODALL INSTITUTE

to "fish" for termites. Until recentl
stood nearly eight years, was that "ma
evolution when the creature begins to

Since the chimpanzees are making
even though these tools are primitive,
natives, either they accept chimpanzee
must redefine "man"

March 21, 1963

From: LOUIS LEAKEY

Correspondence to National Geographic executive Melvin Payne

In a memo, Leakey—Jane's mentor—credited her with a discovery that helped redefine what it means to be human: Chimps make tools. Three years earlier Jane had observed chimps fishing for termites with plant stems. This chimp, photographed in 2005, displays humanlike concen-tration as he snags a termite snack.

INGO ARNDT, MINDEN PICTURES (RIGHT); NATIONAL GEOGRAPHIC ARCHIVES & SPECIAL COLLECTIONS

y the definition of man, which has
n starts at the stage of primate
make tools to a set and regular patter

tools to a "set and regular pattern,"
scientists are faced with two alter-
s as man, by definition, or else they

“You cannot share your life with any animal
and not realize that animals have personal

with a well-developed brain
ities.” *—Jane Goodall*

Bananas gave Jane an edge. A steady supply lured chimps and enabled her to gain their trust. David Greybeard (left), who once ate about 50 bananas in a sitting, was the first Gombe chimp to lose his fear of human contact. When he let Jane groom him, it was, she wrote, “a proud moment.” It is now known that chimps lack immunity to some human diseases, so Gombe researchers must keep at least 25 feet away.

HUGO VAN LAWICK

1962: David Greybeard earns a banana

GOMBE SCRAPBOOK

For the past 50 years, Gombe has had two families—the chimps who live in the park and the scores of researchers who've watched them. Led by Jane, they've camped out for months, crouched in the woods, and spent countless hours observing our closest kin. Tanzanian helpers became trackers and data collectors in the 1970s; now they are largely in charge. "It's a really vibrant place for research," Jane says. With today's mapping and DNA technologies, "the capabilities are vaster than anything I could have imagined as I sat with my notebook and slide rule."

HIGHLIGHTS OF 50 YEARS OF GOMBE RESEARCH

CHIMPANZEES HUNT MAMMALS AS FOOD

Published in 1963

Jane's first key finding ended the long-held assumption that chimps were vegetarians. Meat is relished and shared.

CHIMPANZEES MAKE AND USE TOOLS

Published in 1963

Young chimps learn by watching others probe termite mounds with plant stems, for instance, or use leaves as sponges.

1962: Jane and partner show the flag

MORE

CHIMPANZEES HAVE RICH SOCIAL LIVES AND FAMILY TIES

Published in 1965

Complex social interactions among chimps include robust maternal bonds that last into adulthood.

FEMALE CHIMPANZEES SEEK MULTIPLE MATES

Published in 1971

Females often mate with all males in a community. Some males try to monopolize a female or take her away on a consortship.

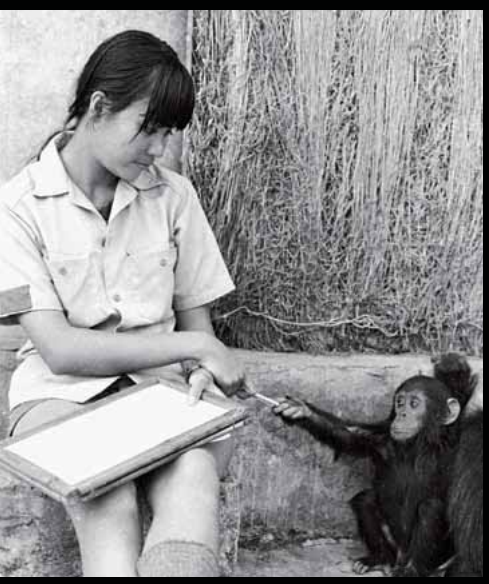
HUGO VAN LAWICK (BOTH)

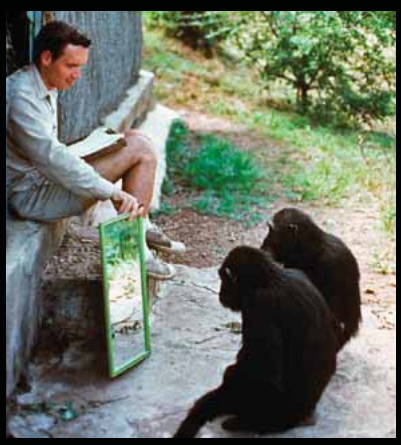
1970: Lori Baldwin retrieves a pen from Atlas

1971: Staff document chimps with prey

1970: Chimps peer in a mirror

1971: Anne





FEMALE CHIMPANZEES COMMIT INFANTICIDE

Published in 1977

Competition among females for good feeding areas may include the killing of other females' infants.

CHIMPANZEES AGGRESSIVELY COMPETE FOR LAND

Published in 1979

Neighboring chimpanzee communities live in a permanent state of hostility; battles can be deadly.

1973: News of a grant moves Jane and colleagues to dance

1974: Juma Mkukwe and Yassini Selemani with Figan

Shouldice ducks Mustard

MORE

CHIMPANZEES MATURE SLOWLY AND REMAIN FERTILE LATE IN LIFE

Published in 1979

Many aspects of chimp aging mirror those of humans, but female chimps do not experience menopause.

MALE CHIMPANZEES STAY IN NATAL GROUP; FEMALES LEAVE

Published in 1979

Males stay in and defend their birth community for life. Females often join a new group before breeding. Transfer reduces inbreeding.

CLOCKWISE: COURTESY DAVID BYGOTT (3); EMILIE VAN ZINNICQ BERGMANN-RISS; CAROLINE VAN ZINNICQ BERGMANN; COURTESY DAVID BYGOTT

1995: Jane with researcher Hilali Matama **2006:** Scanning habitat edge

2003: Watching Gremlin and family

FEMALE CHIMPANZEES HAVE THEIR OWN HIERARCHIES

Published in 1997

Males dominate, but female rank matters: High rank is associated with improved infant survival, shorter birth intervals, and faster maturing daughters.

CHIMPANZEES GET INFECTED BY A SIMIAN FORM OF AIDS

Published in 2009

Chimpanzees are natural hosts for the precursor to HIV-1. Some develop AIDS-like symptoms and die early.

2008: Methodi Vyampi observes Zeus

2010: Jane with Gombe staff

CLOCKWISE: MICHAEL NICHOLS, NGM STAFF; ELIZABETH LONSDORF, LINCOLN PARK ZOO; COURTESY MICHAEL L. WILSON; ROBERT O'MALLEY (2)

Since 1986 Jane has lived as an advocate,
to improve the plight of chimpanzees both

driven by a sense of mission captive and wild.

Back in the forest in 1995 for “spiritual refreshment,” Jane enjoys the company of Pax, arm raised for grooming by his brother, Prof. “When I’m on my own at Gombe now, I can easily recapture how I felt at 26, when all the world was new,” she says. “There’s still a spiritual power there. I can breathe it in.”

MICHAEL NICHOLS, NGM STAFF

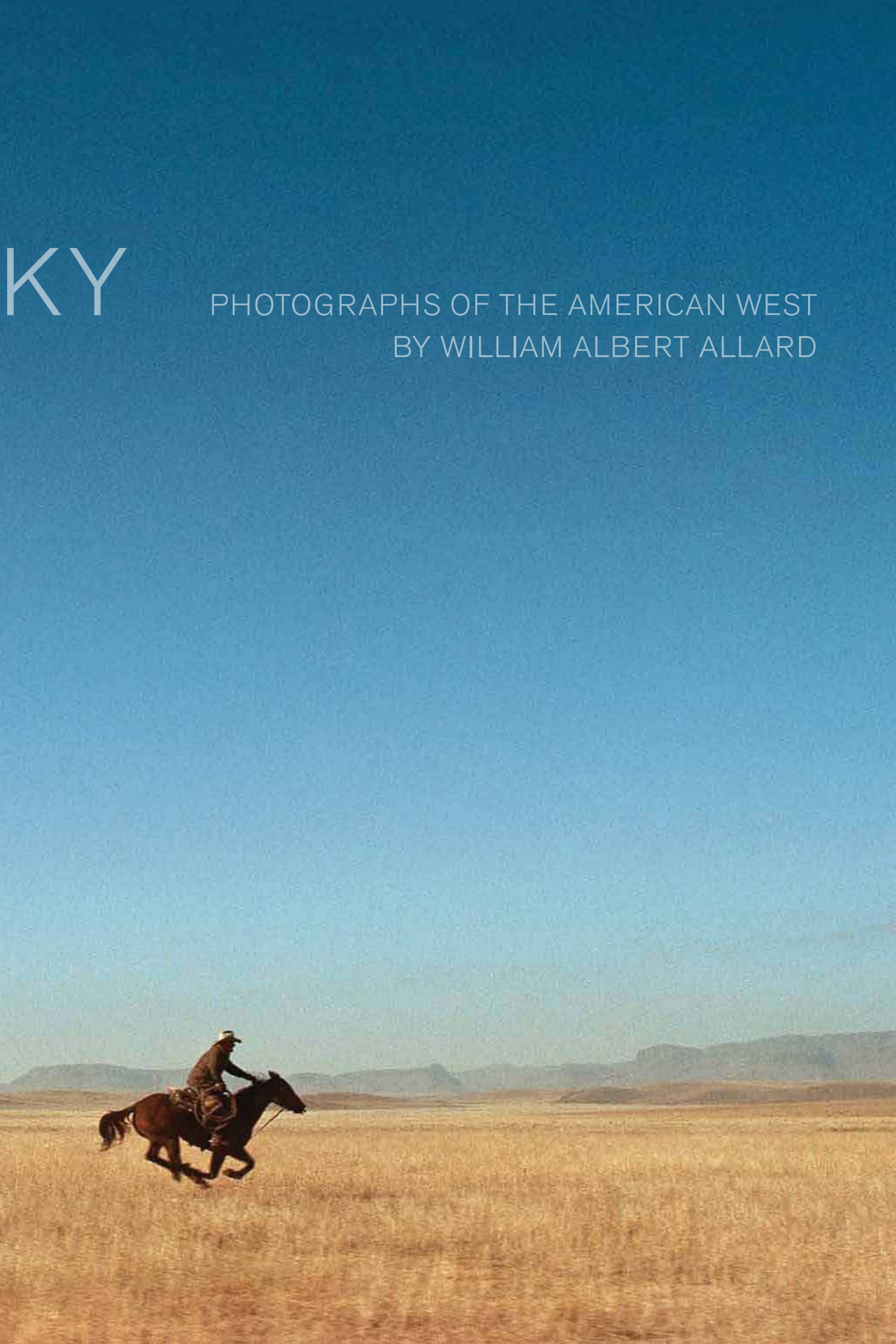
UNDER THE BIG S

LONE RIDER, TEXAS, 1974

If there is an image of mine that captures the wide-open West that has so enraptured me, it is this one of a West Texas cowboy at full gallop.

KY

PHOTOGRAPHS OF THE AMERICAN WEST
BY WILLIAM ALBERT ALLARD



"DO YOU EVER FEEL LIK

It was a summer day in 1969. There had been no rain for weeks. The 17-year-old boy from a Hutterite religious community in Stanford, Montana, said you can tell it's really dry when a single rider can kick up a dust trail. We stopped with our horses at a stream. The water was cool and tasted of the earth. We drank carelessly, splashing our faces until our shirtfronts hung wet.

"You know—do you ever feel like leaving the colony?"

"No," the boy said. "It must be a pretty rough life on the outside, all alone, trying to make a living. Don't you think?"

We let the horses drink, and then rode on.

"Yes," I told him. "It can be all of that."

Since that innocent exchange, I've spent much of my life traveling the world. I've seen a lot of wonderful places. But it was the American West that never left me. It kept drawing me back.

Raised in Minneapolis, I didn't get my first look at the

A RETROSPECTIVE LOOK

William Albert Allard is a 46-year-long contributor. National Geographic Books will publish *William Albert Allard: Five Decades,* in mid-October. A companion exhibition will open December 2 at Steven Kasher Gallery in New York City.

E GOING AWAY?" I asked.

West until the mid-1960s while on my first assignments for *National Geographic* magazine. I can still remember one early morning in Wyoming and the first light on high mountain meadows, the wisps of clouds within my reach. That look demanded another, and another, until I found myself seeking any excuse, any story idea that would lead me back from the East, where I had moved, to that grand expanse. Now I live half the year in western Montana.

I once knew an old Montana cowhand, now dead, who used to muse about times when the country was more open, with fewer fences and gates to slow a man down—restrictions in the land of the free. I suppose we all feel more restricted today. There seem to be gates in our lives that we never get open. But if we're lucky, we find a place special to us. Even though it may change with time, if we love it deeply enough, there is a part of it within us to the end. That's how I feel about the West. □

Allard talks about the cover photo of his new book.

T. J. SYMONDS, NEVADA, 1979

T. J. was 17 when I met him in a cow camp. He hadn't been doing too well at school and couldn't stay out of trouble, so his dad sent him to the IL Ranch in Nevada to be a buckaroo. Here he's got two slabs of camp-made bread slathered with peanut butter and pancake syrup.

HENRY GRAY, ARIZONA, 1970

Henry ran cattle for 50 years on the Organ Pipe Cactus National Monument desert country. He was 72. The government wanted his cattle off the land. As we moved about the house, Henry paused, lost in his thoughts, behind him a 48-star flag.

SURPRISE CREEK COLONY, MONTANA, 2005

Suspended momentarily under a vast gray sky, these children of my lifelong Hutterite friends find joy in simple pleasures. On this communal ranch the older children play ball on a makeshift field, the fenceless outfield stretching out forever.

CLOUD 9 BAR, NEVADA, 1979

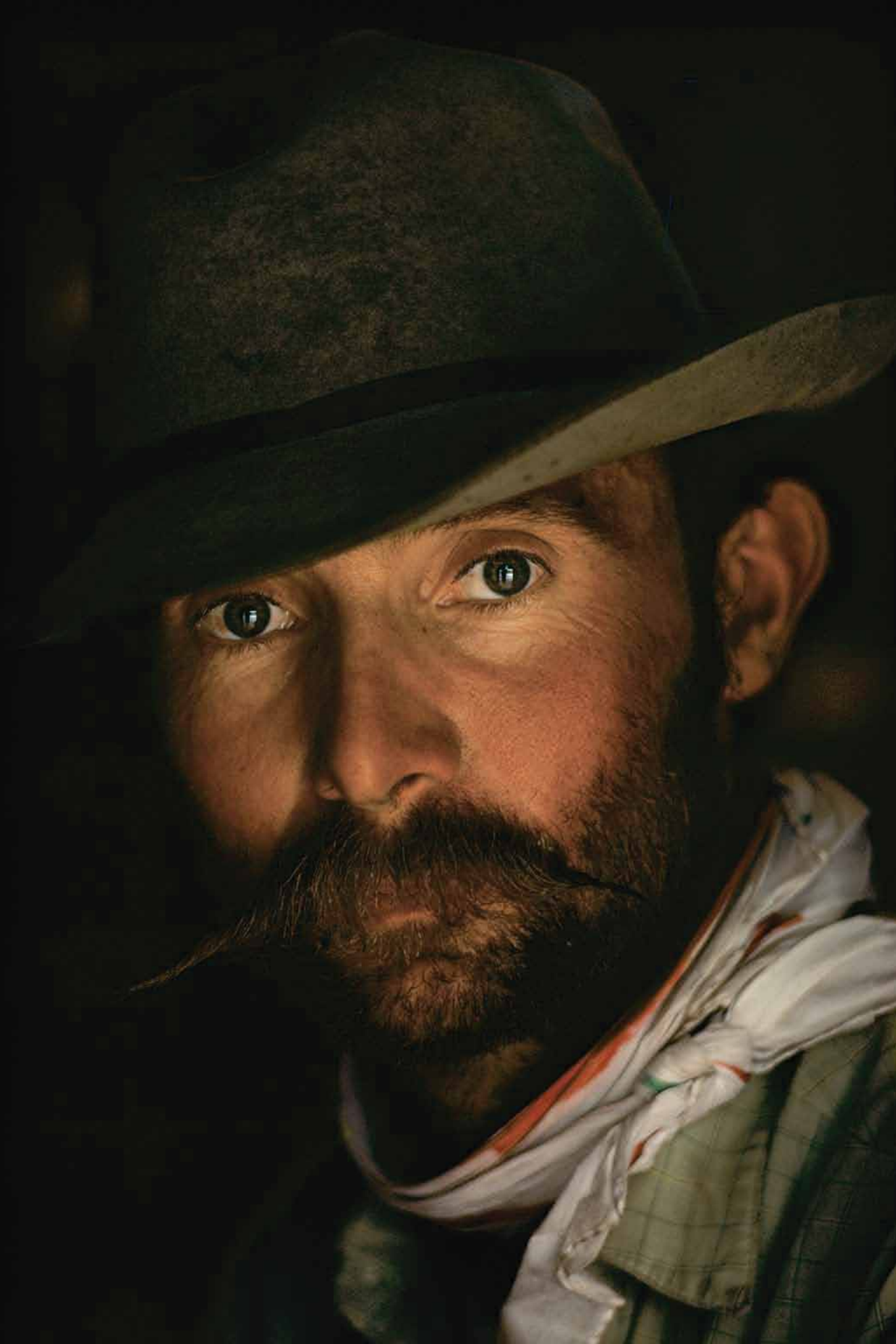
I’ve always liked bars. The glowing, jelly-colored lights and dreamlike name reflected at night beckoned me in Elko, a favorite cow town of mine.

STAN KENDALL, NEVADA, 1979

In Mountain City, a buckaroo had that leaving look and did so the next morning.

KATHY WALTER, MONTANA, 1969 (ABOVE); BRIAN MORRIS, NEVADA, 1970 (RIGHT)

One day at Spring Creek Colony, a young Hutterite girl allowed me to photograph as she braided her hair in a golden painterly light. Brian Morris and crew from the Circle A Ranch had just come in from a rain-scoured cattle drive when I made a portrait in a Paradise Valley bar.



STEPHANIE STAHL, MONTANA, 2005

The look on 14-year-old Stephanie Stahl's face during a baseball game at Surprise Creek has always intrigued me. What was on her mind? I took the picture a few years after one of her sisters ran away from the colony because she "wanted to be different."

IN MEMORIAM

Wes C. Skiles

Longtime *National Geographic* contributor Wes Skiles passed away on July 21 while diving off the Florida coast. He was 52. A husband, father, and inspiration to many, Skiles was an accomplished underwater explorer, photographer, and filmmaker. Born in Jacksonville, Florida, Skiles had mapped 200 miles of passages in underground springs by young adulthood. He skipped college to pursue his passion for the underwater universe and his dream of protecting it. “Wes had dedication, drive, and boyish enthusiasm,” says *Geographic* Senior Photo Editor Sadie Quarrier. Assignments took him from Antarctica to Mexico and—most recently—to the Caribbean, where he photographed “Bahamas Blue Holes,” our August cover story. “Floating over nearly bottomless voids raises the hairs on your neck more than the tight places,” he observed. Skiles’s love for his work was unrelenting, remembers friend and colleague Jill Heinerth: “Wes chased his imagination around the world.”

Wes Skiles prepares for a film shoot in the Bahamas.

PHOTO: LUIS LAMAR

Society Updates

GLOBAL ACTION ATLAS

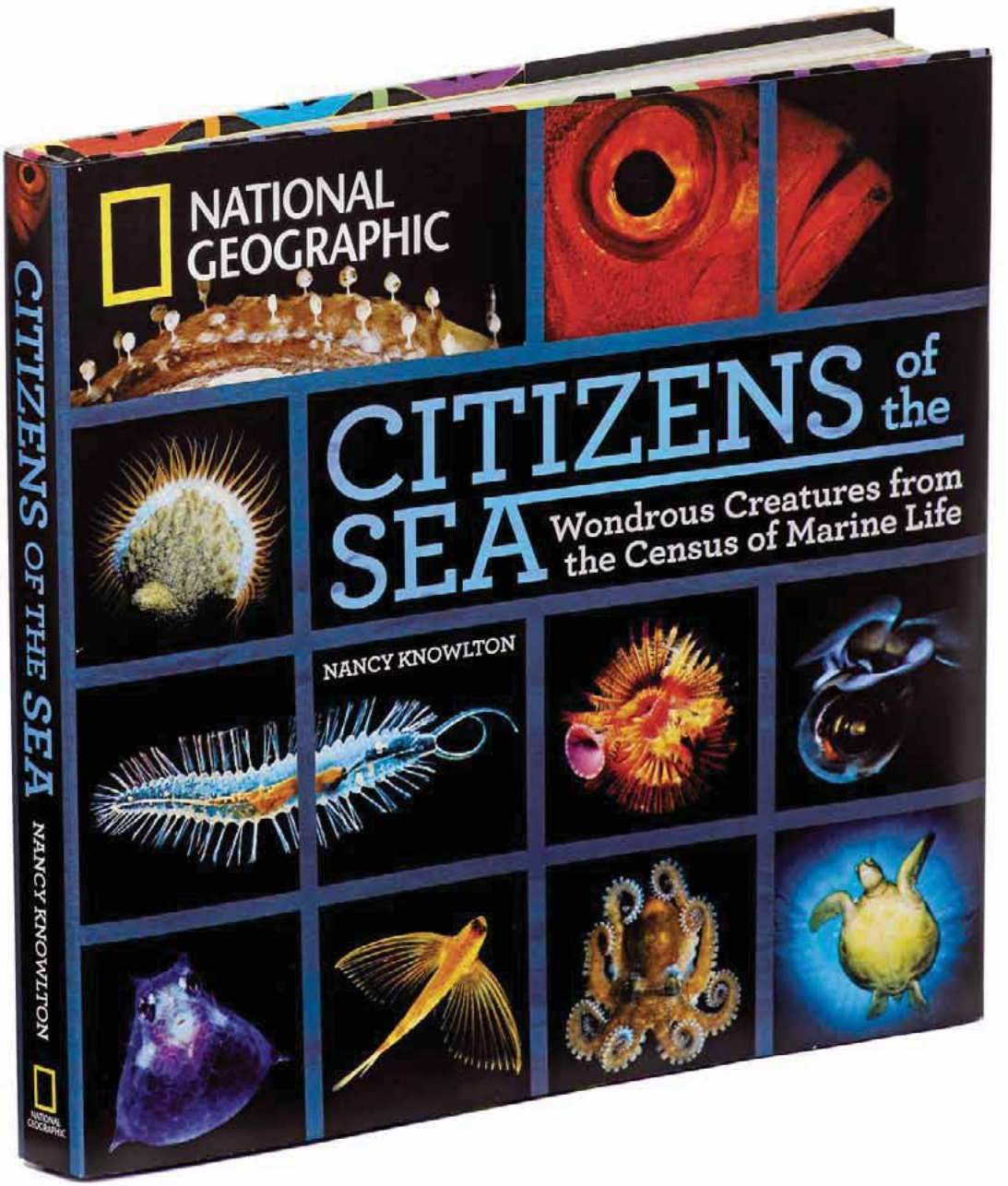
The new National Geographic *Global Action Atlas* website features hundreds of cause-related projects around the world—and ways to get involved. These efforts, including several specifically focused on the Gulf oil spill, are all working toward goals of reducing human suffering and preserving wildlife and ecosystems. Go to *actionatlas.org/oilspill* to explore, support, volunteer, and donate.

NAT GEO CHANNEL

This November the National Geographic Channel proudly debuts *Great Migrations*, an unprecedented, seven-part, global programming event.

NG BOOKS

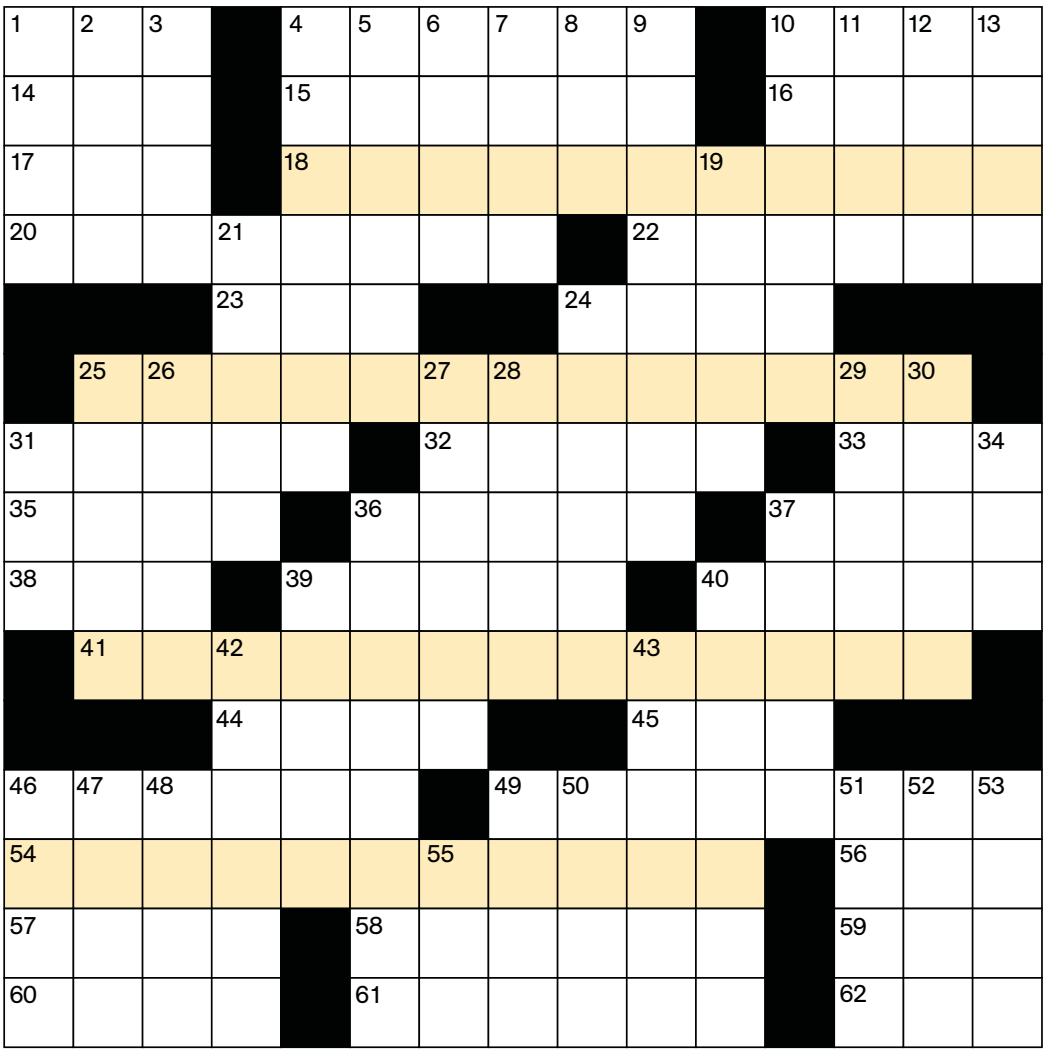
With its stunning marine life photography, engaging text, and fun trivia, *Citizens of the Sea* will entice readers of all ages. Find it in stores September 14 ($26).


NATIONAL GEOGRAPHIC
CITIZENS of the SEA
Wondrous Creatures from the Census of Marine Life
NANCY KNOWLTON
CITIZENS OF THE SEA
NANCY KNOWLTON

Boing "Some kangaroos can cover 30 feet in a single bound, and may outstrip a horse for a short distance," notes the caption to this photo in the December 1936 *Geographic* story "Beyond Australia's Cities." While driving across a sheep station, writer W. Robert Moore found himself in a race: "Propelling themselves with only their powerful hind legs, with their tiny undeveloped front legs held high, their running seems uncanny. But as our speedometer touched 45 miles an hour, one old kangaroo kept pace beside the car." *—Margaret G. Zackowitz*

PHOTO: WIDE WORLD PHOTOS/NATIONAL GEOGRAPHIC STOCK

GEOPUZZLE



ACROSS

1 Wellness resort
4 Flat dweller
10 Goya subject, naked and clothed
14 Panama, e.g.
15 Camden Yards ballplayer
16 Track shape
17 Before now
18 Physician-sourced nutritional supplement?
20 Like some fish populations
22 With uniformity
23 Righteous Babe Records creator DiFranco
24 French Polynesia components
25 It's among a cannibal's family recipes, literally?

LOA

31 Shafts between wheels
32 Get hitched
33 Ring bearer?
35 Bass parts
36 Hemingway and Haydn, nicknamewise
37 Contributed
38 Genetic messenger
39 Wong of book and film titles
40 Ran on TV
41 Willy's *Death of a Salesman* kin given the third degree?
44 Canasta objective
45 *Saving Fish From Drowning* author Amy
46 How freelancers may work
49 Peter and Paul, but not Mary
54 Steak shared by a couple with the same summer sign?
56 Bowl over
57 Privy to
58 Entertain abundantly
59 Male that mews
60 __ off (offended)
61 Male mallards
62 Emulate Bode and Lindsey

DOWN

1 Its roe are a delicacy
2 Summons with a beeper
3 Straddling
4 Gophers' group
5 Like the *Kama Sutra*
6 "Well played!"
7 Betrayed a secret
8 Collegian in the Whiffenpoofs
9 Merrymakers
10 To a greater extent
11 The Bard's river
12 Big house
13 One on your side
19 Each's partner
21 Some have gutters
24 The Mossad's country
25 Letting go
26 Of a forearm bone
27 Bowled over
28 Flavorful
29 Find out
30 Icicle sites, often
31 Cameroon's cont.
34 Word with snapper or herring
36 Dangling ceiling-fan part
37 Leviathan
39 Wintry weather woe
40 Stockpiles
42 Loom
43 Burton's *Becket* co-star
46 For the heck __
47 Muse count
48 Berry of the blackthorn
49 Bottom bit of the seafood chain
50 Pikes, e.g.
51 Back muscles, briefly
52 Furry Jedi friend
53 Tractor-trailer combo
55 Slangy ending for two or go

NEXT MONTH

Bison roam a South Dakota plain. PHOTO: JOEL SARTORE

November 2010

Great Migrations
Birds, butterflies, and beasts cover thousands of miles.

Lost Herds
They survived Sudan's civil war yet still need protection.

Southern Sudan
The scars and hopes of a boy named Logocho mirror his land.

Japan's Seas
The waters host arctic crabs, temperate squid, tropical sharks.

Unburying the Aztec
Dig uncovers eagles, fur-wrapped knives, but no emperor's tomb.

LOADING