

JANUARY 2011

NATIONAL GEOGRAPHIC

INTERACTIVE EDITION

POPULATION **7** BILLION

How your world will change

INTERACTIVE GRAPHIC
QUIETING A NOISY OCEAN



Telltale Scribes Of Timbuktu

Conquering a Vietnamese Cave

America's Lost City

NATIONAL GEOGRAPHIC

VOL. 219 • NO. 1

January 2011

Cover Story

Population 7 Billion

Find out why you shouldn't
panic—at least, not yet.

MORE >



January 2011 | Features

▲ **Phoenix Islands Rising**

Pacific reefs bounce back from disaster.

Telltale Scribes

E-EXTRA TEXT Timbuktu's writings





MORE 

Conquering a Cave

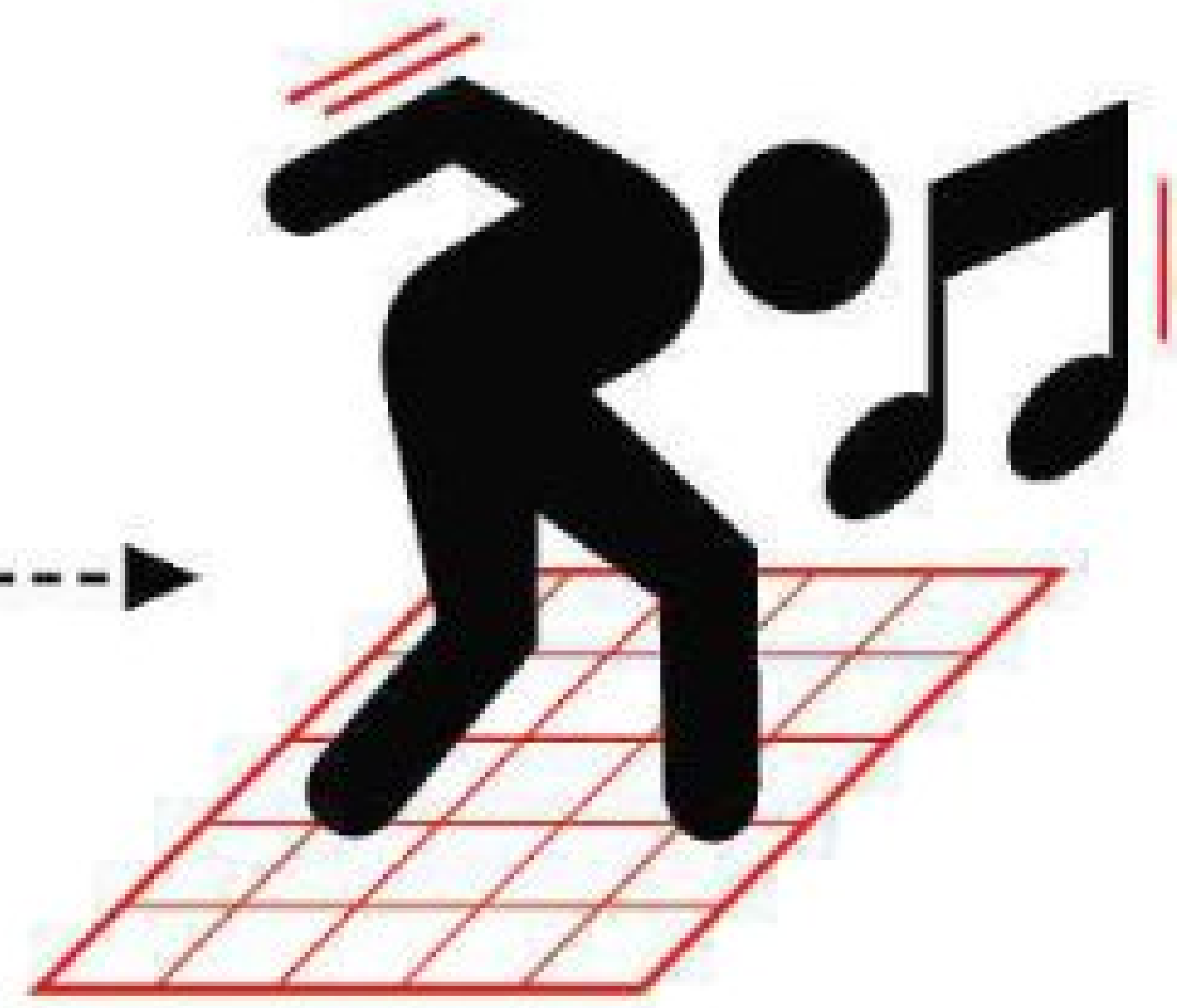
VIDEO Adventure in Vietnam



America's Lost City

Cahokia boomed—then went bust.





Editor's Note

Letters

Your Shot

SLIDE SHOW

Visions of Earth

Inside Geographic

Flashback

Next Month

On the Cover

Emblematic of our populous world, Shanghai has 14 million people, 2.3 million vehicles, and 9,320 miles of roads.

Photo by Peter Bialobrzeski, Laif/Redux

POPULATION

World's Biggest Guest List

How much space would be needed for a party for everyone on Earth?

VIDEO

ENVIRONMENT

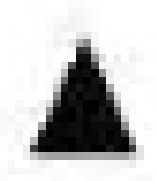
Eat a Ray, Save the Bay

Cownose rays are gobbling shellfish and roiling grass beds.

CULTURE

More Mature Mothers

The number of births for moms 35 and older has jumped.



WILD

How Butterflies Get Color

Microscopic 3-D structures can create brilliant greens.

ARCHAEOLOGY

Cave Secrets

Bones and manuscripts may shed light on Tibet's Bon religion.

THE BIG IDEA

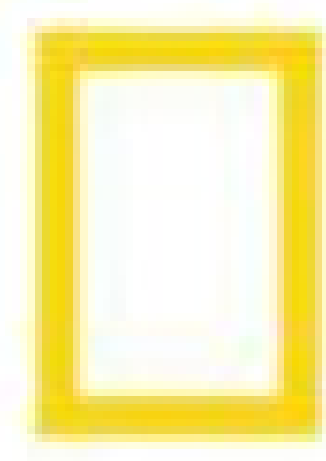
Noisy Ocean

The sounds of ships, from air guns to propellers, are disrupting the lives of marine dwellers.

INTERACTIVE GRAPHIC

StoreMags - Free Magazines Download in True PDF format

FOR SUBSCRIPTIONS AND GIFT MEMBERSHIPS, CONTACT CUSTOMER SERVICE AT NGMSERVICE.COM, OR CALL 1-800-NGS-LINE (647-5463). OUTSIDE THE U.S. AND CANADA PLEASE CALL +1-813-979-6845.

**NATIONAL GEOGRAPHIC** *Inspiring people to care about the planet*

NATIONAL GEOGRAPHIC MAGAZINE

EDITOR IN CHIEF **Chris Johns**

DEPUTY EDITOR Victoria Pope

CREATIVE DIRECTOR Bill Marr

EXECUTIVE EDITORS

Dennis R. Dimick (*Environment*), David Griffin (*E-Publishing*),Kurt Mutchler (*Photography*), Jamie Shreeve (*Science*)

MANAGING EDITOR Lesley B. Rogers

NGM.COM Rob Covey

TEXT **DEPUTY DIRECTOR:** Marc Silver. **STORY DEVELOPMENT EDITOR:** Barbara Paulsen**ARTICLES EDITOR:** Oliver Payne. **SENIOR EDITORS:** Lynn Addison (*Features*), Robert Kunzig (*Environment*), Peter Miller (*Expeditions*). **EDITOR AT LARGE:** Cathy Newman. **FEATURES EDITORS:** Glenn Oeland, Jane Vessels. **EDITOR, MISSION PROJECTS:** Hannah Bloch. **SENIOR WRITERS:** Jennifer S. Holland, Tom O'Neill, A. R. Williams. **WRITER:** Peter Gwin. **ADMINISTRATION:** Imad Aoun; Katia Andreassi, Nicholas Mott
CONTRIBUTING WRITERS: Caroline Alexander, Joel K. Bourne, Jr., Robert Draper, Cynthia Gorney, Peter Hessler, Mark Jenkins, David Quammen, Neil Shea**DEPARTMENTS DIRECTOR:** Margaret G. ZackowitzDEPUTY DIRECTOR: Luna Shyr. **EDITOR:** Jeremy Berlin. **ADMINISTRATION:** Catherine B. Zuckerman**COPYDESK DIRECTOR:** David Brindley. **SENIOR COPY EDITOR:** Mary Beth Oelkers-KeeganCOPY EDITOR: Kity Krause. **PRODUCTION:** Sandra Dane. **SCHEDULING DIRECTOR:** Carol L. Dumont**PHOTOGRAPHY** **DEPUTY DIRECTORS:** Ken Geiger, Susan A. Smith. **SENIOR EDITORS:** Bill Douthitt (*Special Editions*), Kathy Moran (*Natural History*), Susan Welchman (*Departments*). **EDITOR AT LARGE:** Michael Nichols
SENIOR PHOTO EDITORS: Todd James, Elizabeth Krist, Sarah Leen, Sadie Quarrier
RESEARCH EDITOR: Mary McPeak. **STAFF PHOTOGRAPHER:** Mark Thiessen. **STUDIO:** Rebecca Hale
DIGITAL IMAGING: Edward Samuel, Evan Wilder. **PHOTO ENGINEERING:** Walter Boggs, David Mathews, Kenji Yamaguchi. **RIGHTS MANAGER:** Elizabeth Grady. **ADMINISTRATION:** Whitney Hall; Sherry L. Brukbacher, Kate Napier, Elena Sheveiko, Cristen Wills**DESIGN / ART** **DESIGN DIRECTOR:** David C. Whitmore. **ART DIRECTOR:** Juan Velasco. **MAPS DIRECTOR:** William E. McNulty
DEPUTY ART DIRECTOR: Kaitlin M. Yarnall. **SENIOR DESIGN EDITORS:** John Baxter, Elaine H. Bradley
DESIGN EDITOR: Oliver R. Uberti. **SENIOR GRAPHICS EDITORS:** Fernando G. Baptista, Martin Gamache, Virginia W. Mason, Sean McNaughton, John Tomanio. **SENIOR CARTOGRAPHY EDITORS:** Marguerite B. Hunsiker, Gus Platis. **CARTOGRAPHY EDITOR:** Lisa R. Ritter. **ART RESEARCH EDITOR:** Amanda Hobbs
GRAPHICS SPECIALISTS: Jerome N. Cookson, Mariel Furlong, Lawson Parker, Sam Pepple
SENIOR DESIGNER: Betty Clayman-DeAtley. **DESIGNERS:** Molly Snowberger, Hannah Tak
ADMINISTRATION: Cinde Reichard**RESEARCH** **DIRECTOR:** Abigail A. Tipton. **RESEARCH EDITORS:** Alice S. Jones, Kathy B. Maher, Heidi Schultz, Elizabeth Snodgrass, Christy Ullrich, Barbara L. Wyckoff. **SENIOR RESEARCHERS:** Karen C. Font, Nora Gallagher, David A. Lande, Nancie Majkowski, Taryn Salinas, Brad Scriber. **ADMINISTRATION:** Jacqueline Rowe**E-PUBLISHING** DEPUTY DIRECTOR: Melissa Wiley. **SENIOR VIDEO PRODUCER:** Hans Weise. **ADMINISTRATION:** Trish Dorsey**NGM.COM** **SENIOR PRODUCERS:** Paul Heltzel, John Kondis. **ASSOCIATE PRODUCER:** William Barr**SENIOR PHOTO EDITOR:** Monica C. Corcoran. **ART DIRECTOR:** Shawn Greene**ADMINISTRATION** Karen Dufort Sligh (*Asst. to the Editor in Chief*), Valarie Cribb-Chapman (*Finance*); K. Ressler Evans, Nikisha Long. **COMMUNICATIONS** VICE PRESIDENTS: Beth Foster, Mary Jeanne Jacobsen; Barbara S. Moffet
IMAGE COLLECTION AND SALES VICE PRESIDENT: Maura A. Mulvihill; William D. Perry**LIBRARIES AND INFORMATION SERVICES** DIRECTOR: Barbara Penfold Ferry; Renee Braden**PRODUCTION SERVICES** **IMAGING** DIRECTOR: Thomas J. Craig; John Ballay, David J. Bulebush, Neal Edwards, James P. Fay, Steve Goldman, Arthur N. Hondros, Gregory Luce, Ann Marie Pelish, Bernard Quarrick, Stephen L. Robinson. **PRINTING:** Joseph M. Anderson. **QUALITY** DIRECTOR: Ronald E. Williamson; Clayton R. Burneston, Michael G. Lappin, William D. Reicherts. **DISTRIBUTION** DIRECTOR: Michael Swarr

Contributions to the National Geographic Society are tax deductible under Section 501(c)(3) of the U.S. tax code. Copyright © 2010 National Geographic Society. All rights reserved. National Geographic and Yellow Border: Registered Trademarks ® Marcas Registradas. National Geographic assumes no responsibility for unsolicited materials. Printed in U.S.A.

INTERNATIONAL EDITIONS

EDITORIAL DIRECTOR: Amy Kolczak. **DESIGN EDITOR:** Darren Smith. **TEXT EDITOR:** Justin Kavanagh
PHOTOGRAPHIC LIAISON: Laura L. Ford. **PRODUCTION:** Angela Botzer. **ADMINISTRATION:** William Shubert

EDITORS

ARABIC Mohamed Al Hammadi • **BRAZIL** Matthew Shirts • **BULGARIA** Krassimir Drumev • **CHINA** Ye Nan
CROATIA Hrvoje Prčić • **CZECHIA** Tomáš Tureček • **FRANCE** François Marot • **GERMANY** Erwin Brunner
GREECE Maria Atmatzidou • **HUNGARY** Tamás Schlosser • **INDONESIA** Yunas Santhani Azis
ISRAEL Daphne Raz • **ITALY** Guglielmo Pepe • **JAPAN** Hiroyuki Fujita • **KOREA** Sun-ok Nam
LATIN AMERICA Omar López • **LITHUANIA** Frederikas Jansonas • **NETHERLANDS/BELGIUM** Aart Aarsbergen
NORDIC COUNTRIES Karen Gunn • **POLAND** Martyna Wojciechowska • **PORTUGAL** Gonçalo Pereira
ROMANIA Cristian Lascu • **RUSSIA** Alexander Grek • **SERBIA** Igor Rill • **SLOVENIA** Marija Javornik
SPAIN Josep Cabello • **TAIWAN** Roger Pan • **THAILAND** Kowit Phadungruangkij • **TURKEY** Nesibe Bat

ADVERTISING

711 Fifth Avenue, New York, NY, 10022; Phone: 212-610-5500; Fax: 212-610-5505

EXECUTIVE VICE PRESIDENT AND WORLDWIDE PUBLISHER: Claudia Malley

NATIONAL ADVERTISING DIRECTOR: Robert Amberg. **VICE PRESIDENT MARKETING:** Jenifer Berman

VICE PRESIDENT BUSINESS AND OPERATIONS: Margaret Schmidt. **MANAGER:** Karen Sarris (*Detroit*)

INTERNATIONAL MANAGING DIRECTOR: Charlie Attenborough

DIRECTORS: Nadine Heggie (*International*), Rebecca Hill (*Marketing*), David Middis (*British Isles*)

CONSUMER MARKETING VICE PRESIDENT WORLDWIDE: Terrence Day. **DIRECTORS:** Christina C. Alberghini (*Member Services*), Anne Barker (*Renewals*), Richard Brown (*New Business*),

John MacKethan (*Financial Planning and Retail Sales*), John A. Seeley (*International*)

NATIONAL GEOGRAPHIC SOCIETY

CHAIRMAN AND CEO John M. Fahey, Jr.

PRESIDENT Timothy T. Kelly

EXECUTIVE VICE PRESIDENTS Terrence B.

Adamson. **PRESIDENT, ENTERPRISES:** Linda Berkeley

MISSION PROGRAMS: Terry D. Garcia

COMMUNICATIONS: Betty Hudson

CFO: Christopher A. Liedel

BOARD OF TRUSTEES Joan Abrahamson, Michael R. Bonsignore, Jean N. Case, Alexandra Grosvenor Eller, Roger A. Enrico, John M. Fahey, Jr., Daniel S. Goldin, Gilbert M. Grosvenor, Timothy T. Kelly, Maria E. Lagomasino, George Muñoz, Reg Murphy, Patrick F. Noonan, Peter H. Raven, William K. Reilly, Edward P. Roski, Jr., James R. Sasser, B. Francis Saul II, Gerd Schulte-Hillen, Ted Waitt, Tracy R. Wolstencroft

COUNCIL OF ADVISORS **CHAIRMAN:** Edward P. Roski, Jr. **DARLENE T. ANDERSON,** Lucy C. Billingsley, Michael R. Bonsignore, Howard G. Buffett, Virginia Busch, Jean N. Case, David Court, Roger A. Enrico, Juliet C. Folger, Robert B. Haas, David H. Koch, Lara Lee, Sven-Olof Lindblad, Bruce L. Ludwig, Claudia Madrazo de Hernández, David P. Margulies, Michael L. Matkins, Larry Mullen, Jr., Sally Engelhard Pingree, W. Russell Ramsey, Catherine B. Reynolds, Joseph E. Robert, Jr., Victoria P. Sant, B. Francis Saul II, Ted Waitt, Sam R. Walton, Garry A. Weber, Tracy R. Wolstencroft, William Wrigley, Jr.

RESEARCH AND EXPLORATION COMMITTEE

CHAIRMAN: Peter H. Raven. **VICE CHAIRMAN:** John M. Francis. Colin A. Chapman, Keith Clarke, Steven M. Colman, Philip Gingerich, Carol P. Harden, Nancy Knowlton, Jonathan B. Losos, Dan M. Martin, Scott E. Miller, Jan Nijman, Elsa M.

Redmond, Thomas B. Smith, Wirt H. Wills, Melinda A. Zeder

EXPLORERS-IN-RESIDENCE Robert Ballard, Wade Davis, Jared Diamond, Sylvia Earle, J. Michael Fay, Zahi Hawass, Beverly Joubert, Dereck Joubert, Louise Leakey, Meave Leakey, Johan Reinhard, Paul Sereno, Spencer Wells

MISSION PROGRAMS **VICE PRESIDENT, MEDIA OUTREACH:** Mark Bauman. **VICE PRESIDENT, EDUCATION:** Daniel Edelson. **VICE PRESIDENT, RCE GRANTS:** John M. Francis. **CHIEF OPERATING OFFICER:** Sarah Laskin. **VICE PRESIDENT, PUBLIC PROGRAMS:** Gregory A. McGruder. **VICE PRESIDENT, STRATEGIC INITIATIVES:** Alexander Moen. **SR. VICE PRESIDENT, GLOBAL PARTNERSHIPS:** Kristin Rechberger **PRESIDENT, JASON PROJECT:** Caleb Schutz **HUMAN RESOURCES** **SR. VICE PRESIDENT:** Thomas A. Sabló. **TREASURER** **SR. VICE PRESIDENT:** H. Gregory Platts. **DEVELOPMENT** **SR. VICE PRESIDENT:** Jacqueline M. Hollister. **CHIEF SUSTAINABILITY OFFICER:** Hans H. Wegner

NATIONAL GEOGRAPHIC GLOBAL MEDIA

PRESIDENT: Timothy T. Kelly

CHIEF OPERATING OFFICER: Edward M. Prince, Jr.

PUBLISHING **PRESIDENT:** Declan Moore

BOOK PUBLISHING **PRESIDENT:** Nina D. Hoffman

ENTERTAINMENT **PRESIDENT:** David Beal

DIGITAL MEDIA **PRESIDENT:** John Caldwell

TELEVISION **PRESIDENT:** Michael Rosenfeld

NATIONAL GEOGRAPHIC CHANNEL

PRESIDENT: David Haslingden

NATIONAL GEOGRAPHIC CHANNEL-U.S.

PRESIDENT: Steve Schiffman

NATIONAL GEOGRAPHIC SCHOOL PUBLISHING GROUP **PRESIDENT AND CEO:** Alison Wagner

EDITOR'S NOTE



Crowds surge during the annual Rath Yatra Hindu festival in Puri, India.

PHOTO: RANDY OLSON

The world's population will reach seven billion this year. But you don't need to visit Delhi, India (population 22 million), or China (home to a fifth of the world's people) to grasp the consequences. When I return to Jackson County, Oregon, where I was born, the green fields where I used to cut hay, dig onions, and harvest pears are gone. They have been replaced by subdivisions and big-box stores. This is hardly a surprise given that the population of Jackson County has more than tripled in my lifetime. When I see the rapid development going on in my hometown, I can't help but wonder what the future holds for the rest of the world.

This month we begin exploring that future with a series of stories about population that will run throughout the year. Environment editor Robert Kunzig starts by sketching out a natural history of population. The issues associated with population growth seem endless: poverty, food and water supply, world health, climate change, deforestation, fertility rates, and more.

Kunzig writes, "There may be some comfort in knowing that people have long been alarmed about population." Some of the first papers on demography were written in the 17th century. It's more than 300 years later, and we are still grappling with the outcome of *People v. Planet*. We look forward to exploring the topic with you.





Bring amazing photography home!

Prints starting at just \$19.95





StoreMags - Free Magazines Download in True PDF format

**shop
now!**

**Get 15% off-Use code NG15
at checkout**

ENVIRONMENT

Eat a Ray, Save the Bay?

Cownose rays swarm the Chesapeake Bay each summer, taxing an already fragile ecosystem by gobbling shellfish and roiling grass beds. Shaped like kites, they taste like tuna—a meaty mouthfeel packed with lean protein. Now area officials see a potential win-win: Whet human appetites with a tasteful name (“Chesapeake ray”) and rebalance the bay.

Rays aren’t invasive newcomers here; in 1608 one stung explorer John Smith. But as predators like coastal sharks have declined, the observed spike in cownoses, though untallied, could be grounds for a carefully monitored fishery—and new revenue streams for watermen, retailers, and localities. Call it the new calamari?

—*Jeremy Berlin*



PHOTO: HENRY HORENSTEIN, GETTY IMAGES. NGM MAPS



With a three-foot wingspan, an adult *Rhinoptera bonasus* can weigh 40 pounds.

CULTURE

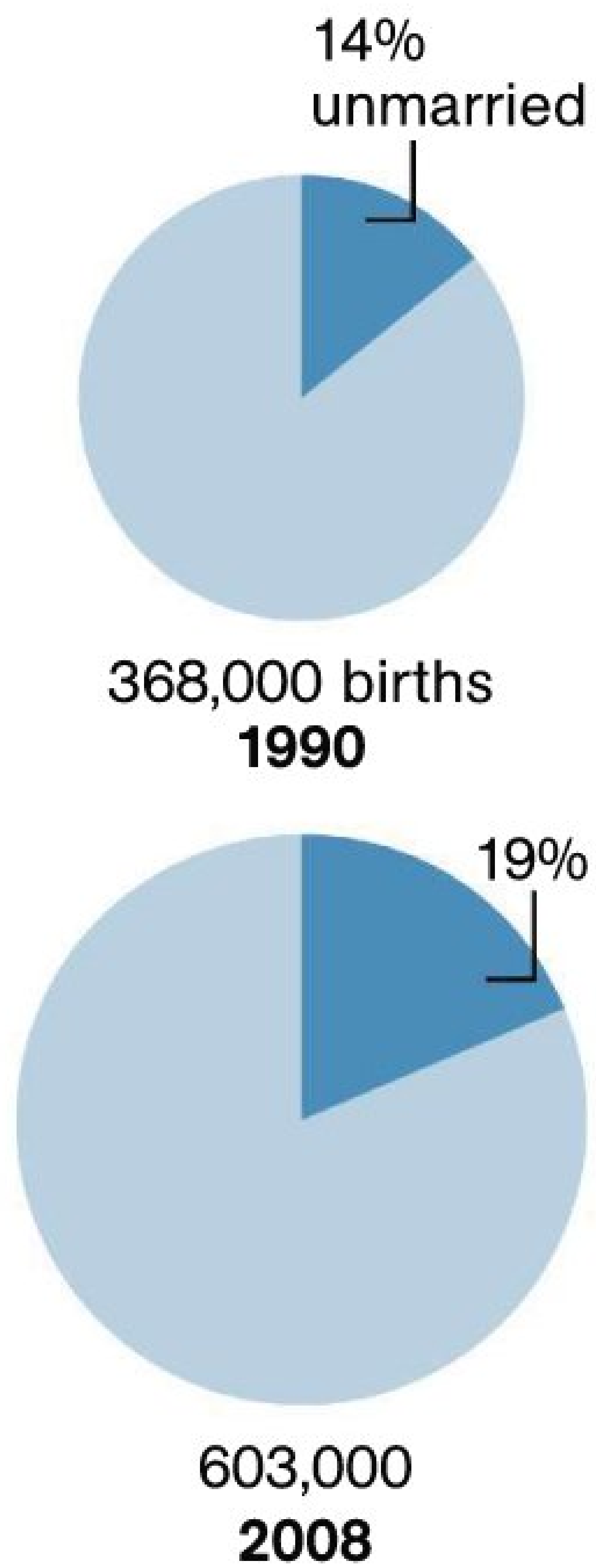
Modern Mothering More U.S. women are having children later in life, according to a new study from the Pew Research Center. Some possible reasons: higher education, fertility treatments, and changing attitudes toward marriage. While the overall birthrate in 2008 didn't vary much from 1990, the number of babies born to women 35 and older rose a staggering 64 percent.

Another factor, notes report co-author Gretchen Livingston, is that younger people were more likely than older ones to cite the economic downturn as a reason to delay pregnancy. Women in their late 30s to 40s "don't really have that choice."

The same Pew report found that a record 41 percent of 2008 births occurred outside of marriage, up from 28 percent in 1990. And though most were to women under 25, older mothers are also less likely to be married these days. Which is not to say these moms are going it alone. The trend "comes largely from births to women who are cohabiting with the child's father," says sociologist R. Kelly Raley. "It's clear that we think differently today than we did several decades ago." —*Cara Birnbaum*



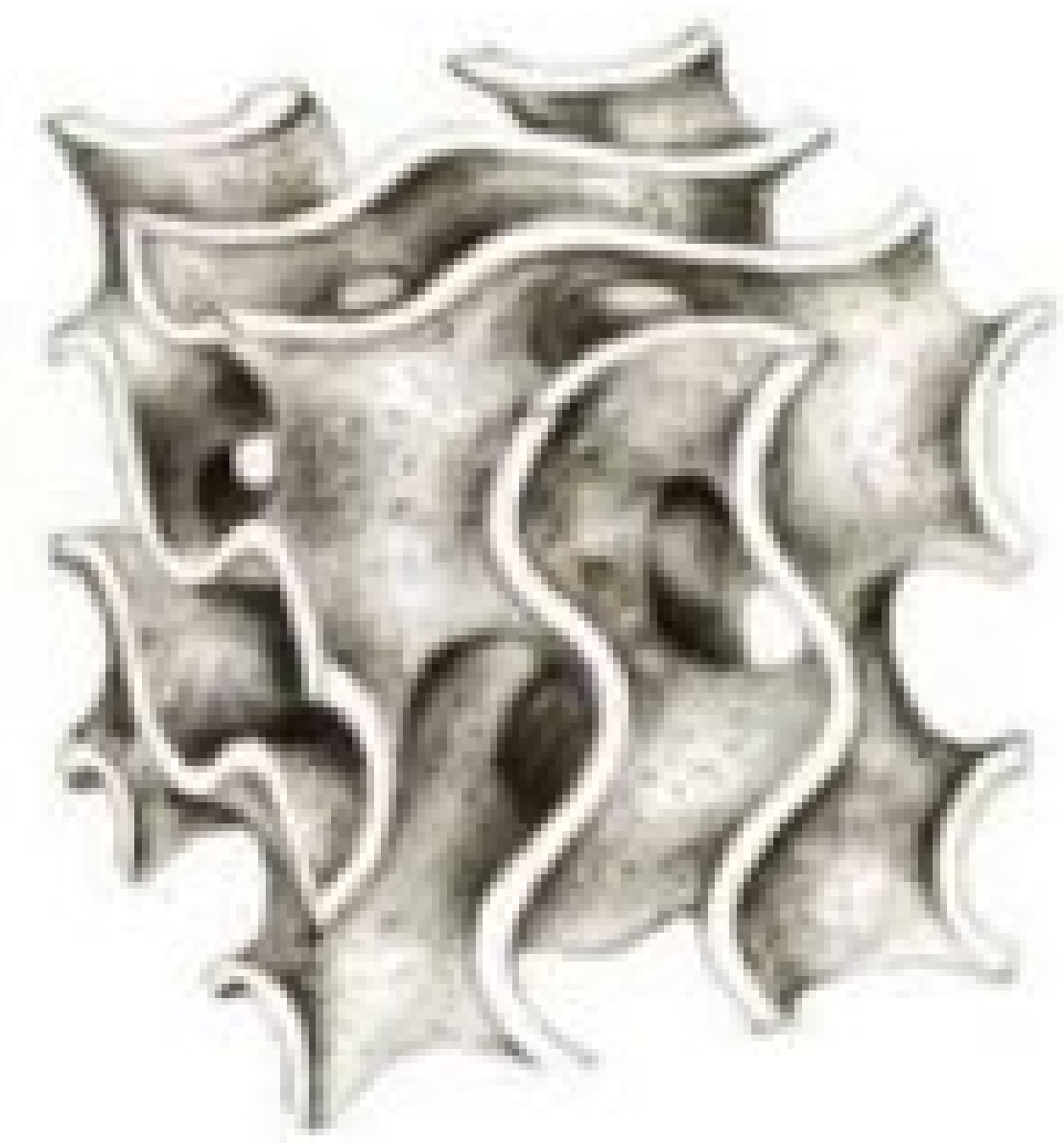
Births to U.S. women 35 and older



Today's mothers include more women who are older and, increasingly, unmarried.

WILD

Coloring by Structure For years scientists have known that pigments aren't the only way butterflies get their brilliant colors. Light can also bounce off structures and reflect hues through scattering or interference, as with



the blue of the sky or the iridescence of a soap bubble. Now a group at Yale University has identified one such structure in five butterfly species as a gyroid—a complex, three-dimensional form that is one of nature's most efficient ways of folding space (left).

In the butterflies studied, from the Papilionidae and Lycaenidae families, the microscopic gyroids consist of chitin—the same material found in insect exoskeletons—and air pockets interwoven in a repeating pattern that resembles a network of three-bladed boomerangs. The green color resulting from the interplay of scattered light helps warn off predators, says lead scientist Richard Prum. Gyroids have superior optical properties, and the ability to synthesize similar forms could aid in the development of solar cells and insulation for fiber-optic cables.

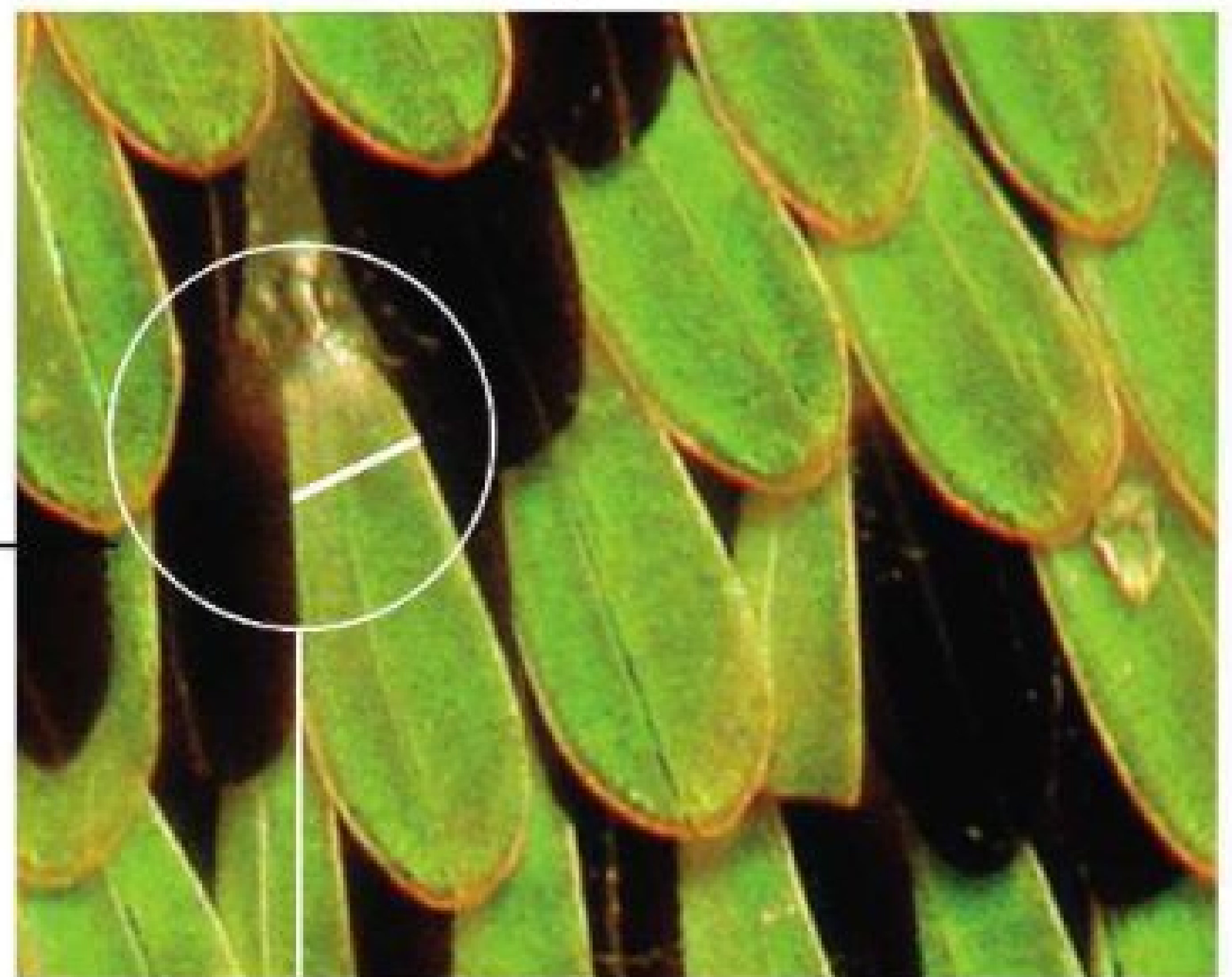
While the majority of butterfly colors are pigmentary—created when molecules absorb and reemit certain wavelengths of light—a variety of structural ones exist. So far green is the only known gyroid color, says Prum, “but I’m sure there are more.” —*Luna Shyr*

PHOTOS: MARTIN OEGGERLI, WITH MARCO CANTONI, ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE (RIGHT); MARTIN OEGGERLI (TOP RIGHT); RICHARD PRUM, YALE UNIVERSITY (TOP LEFT). ART: SHIZUKA AOKI

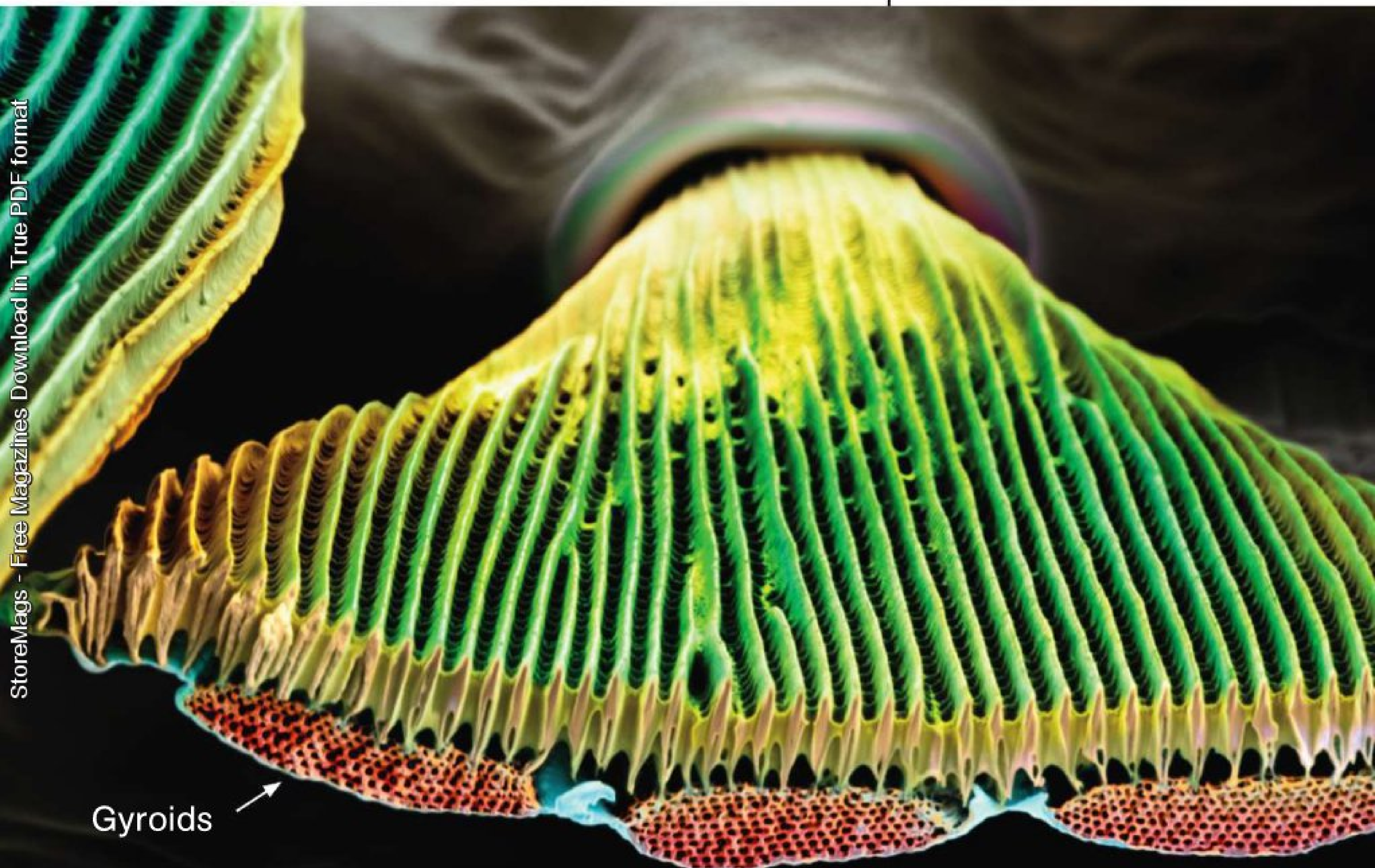
Parides sesostris



Scales on wing surface



Cross-section of a scale



Gyroids

Gyroids, seen here in a colorized electron microscope scan, produce this butterfly's green hues.



A Nepalese child
peers into a tent
sheltering remains as
old as 2,500 years.

StoreMags - Free Magazines Download in True PDF format



ARCHAEOLOGY

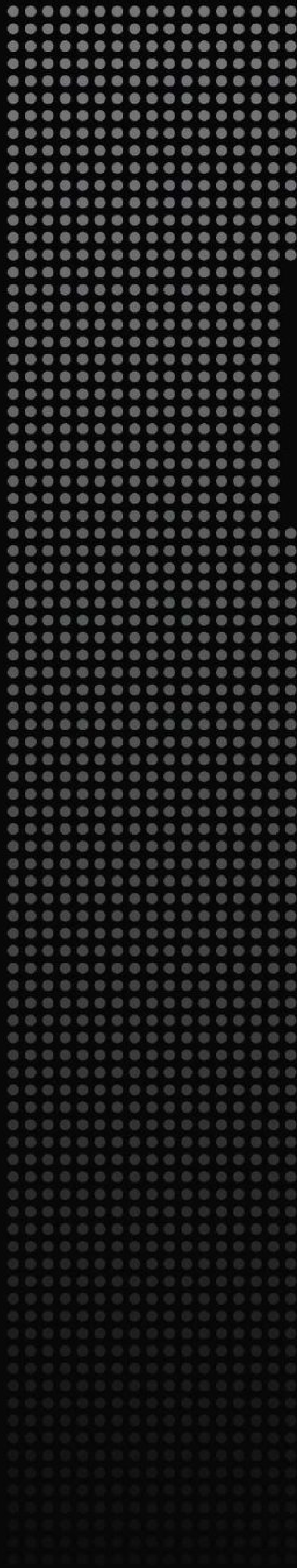
NG GRANTEE

Cliff Cave Secrets Archaeologist Mark Aldenderfer set out last year to explore remote cliffside caves in Nepal's Mustang district, aiming to find human remains near an ancient settlement high in the Himalaya. Almost at once, he came face-to-face with what he was seeking: Jutting out from the rock, he recalls, 13,000 feet up, "a skull was looking at me right as I was looking at it."

The skull, dating back perhaps 2,500 years, was among many human bones piled inside several burial caves. Aldenderfer and his team hope that DNA analysis will help pinpoint the origins of this isolated region's inhabitants, who may have migrated from the Tibetan Plateau or points south.

Nearby, Aldenderfer's colleagues in 2008 also found 8,000 manuscripts at least 500 years old, similar to one (below) found in 2010. Their contents are still being deciphered, but scholars say they will shed new light on Bon, the indigenous religion that predated Buddhism in ancient Tibet and still exists in a few pockets. "These caves," says Aldenderfer, "offer marvelous insights." —*Hannah Bloch*





There will soon be
seven billion people
on the planet.



PULSING WITH PEOPLE

INDIA Its steaming streets crammed with vendors, pedestrians, and iconic Ambassador taxis, Kolkata throbs with some 16 million people—and more pour in every day from small towns. In 1975 only three cities



StoreMags - Free Magazines Download in True PDF format

worldwide topped ten million. Today 21 such megacities exist, most in developing countries, where urban areas absorb much of the globe's rising population. RANDY OLSON



ENERGIZED LANDSCAPE

ENGLAND Glowing furnace bright at night, London became the world's largest city during the coal-powered industrial revolution, a tipping point for the steep rise of Earth's population. Wealthy countries use many times



more resources per capita than poorer nations, but as global incomes rise, increased consumption may stress the planet more than population growth. JASON HAWKES



StoreMags - Free Magazines Download in True PDF format

AGENTS OF CHANGE

SPAIN Immigrants like these Indians at a Sikh festival in Barcelona are bolstering Europe's stagnant population growth rate. Around the world, the childbearing decisions of young women will determine



whether global population stabilizes or not. Research shows that the more education a woman receives, the fewer children she is likely to have. RANDY OLSON

**By 2045 global
population is projected
to reach nine billion.
Can the planet take
the strain?**

As we reach the milestone of seven billion people this year, it's time to take stock. In the coming decades, despite falling birthrates, the population will continue to grow—mostly in poor countries. If the billions of people who want to boost themselves out of poverty follow the path blazed by those in wealthy countries, they too will step hard on the planet's resources. How big will the population actually grow? What will the planet look like in 2045? Throughout the year we'll offer an in-depth series exploring those questions. The answers will depend on the decisions each of us makes.

SOURCES: POPULATION REFERENCE BUREAU AND UNITED NATIONS

1
BILLION
1800

2
BILLION
1930

3
BILLION
1960

4
BILLION
1974

5
BILLION
1987

6
BILLION
1999

7
BILLION
2011

8
BILLION
2024

9
BILLION
2045

Projected



NEW AMERICANS

UNITED STATES Bundled newborns on September 1, 2010, are arranged for a portrait at Orlando's Winnie Palmer Hospital, the second busiest birth facility in the U.S. Unusual among industrial nations, the U.S. has



a comparatively high fertility rate, due in part to the significant rate of teenage pregnancies and a steady influx of immigrants. By 2050 America's population is expected to top 400 million. JOHN STANMEYER

How Population Booms

As living conditions improve, a country enters successive phases of a process called the demographic transition. The death rate falls, but there's a lag before the birthrate falls too. The result: Population soars. Each phase is marked by a redistribution of the population's age groups, as shown in the pyramids at bottom.

1. A wide base and narrow top characterize populations with a high birthrate and high death rate.
2. As conditions improve, the death rate declines, and the pyramid tiers for older ages begin to fill out.
3. A population with fewer children emerges as the birthrate falls; life expectancy increases.
4. Annual deaths may outnumber births, but immigration can ensure population growth.

PHASE 1: Preindustrial

Example: None since war-torn Rwanda in the 1990s

BIRTHRATE

High birthrate matches high death rate.



DEATH RATE

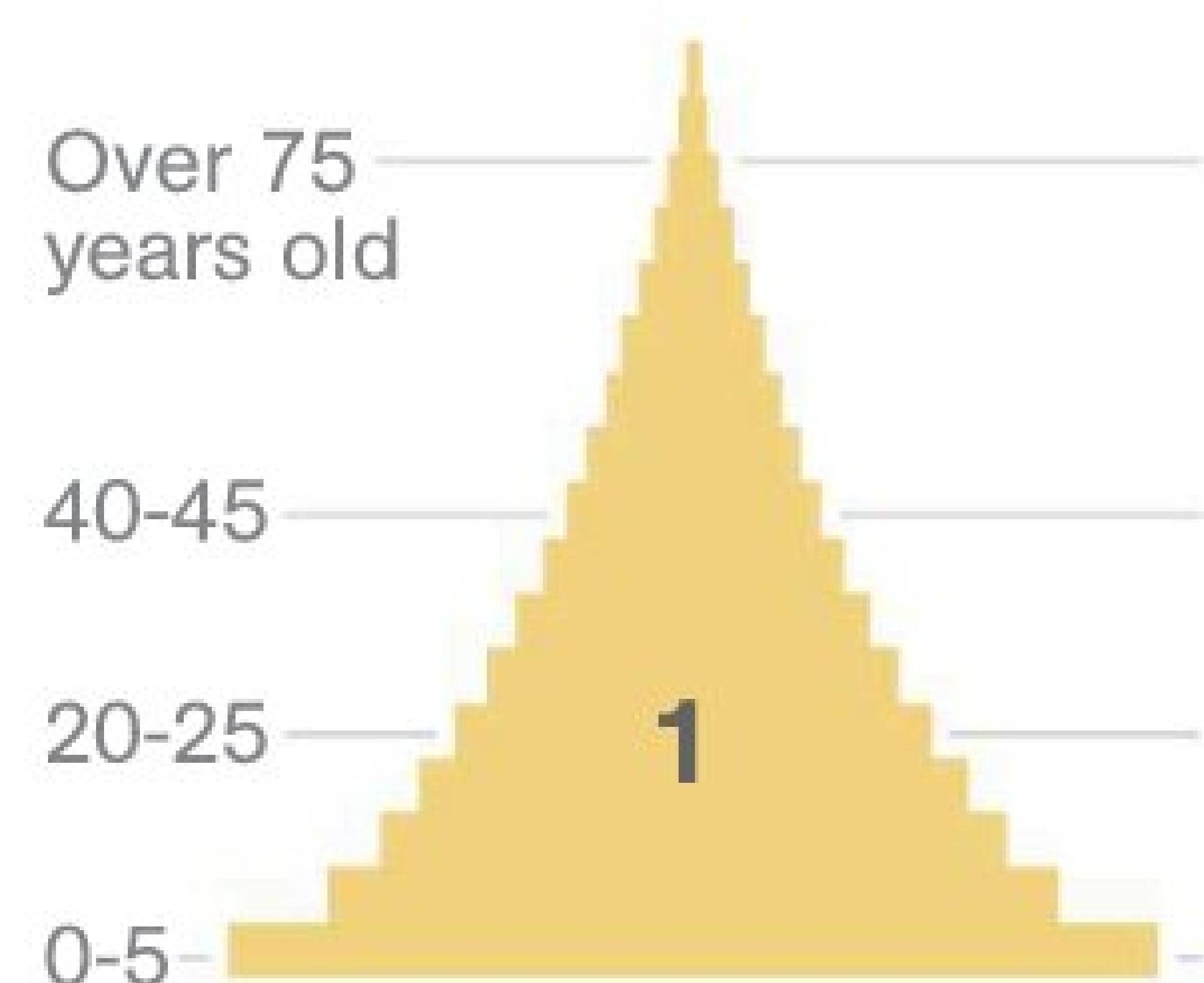
Disease, poor living conditions, and warfare lead to a high death rate that sometimes exceeds the birthrate.

POPULATION

A high birthrate and high death rate create a young population of fairly constant size.



POPULATION PYRAMIDS



PHASE 2: Boom Begins

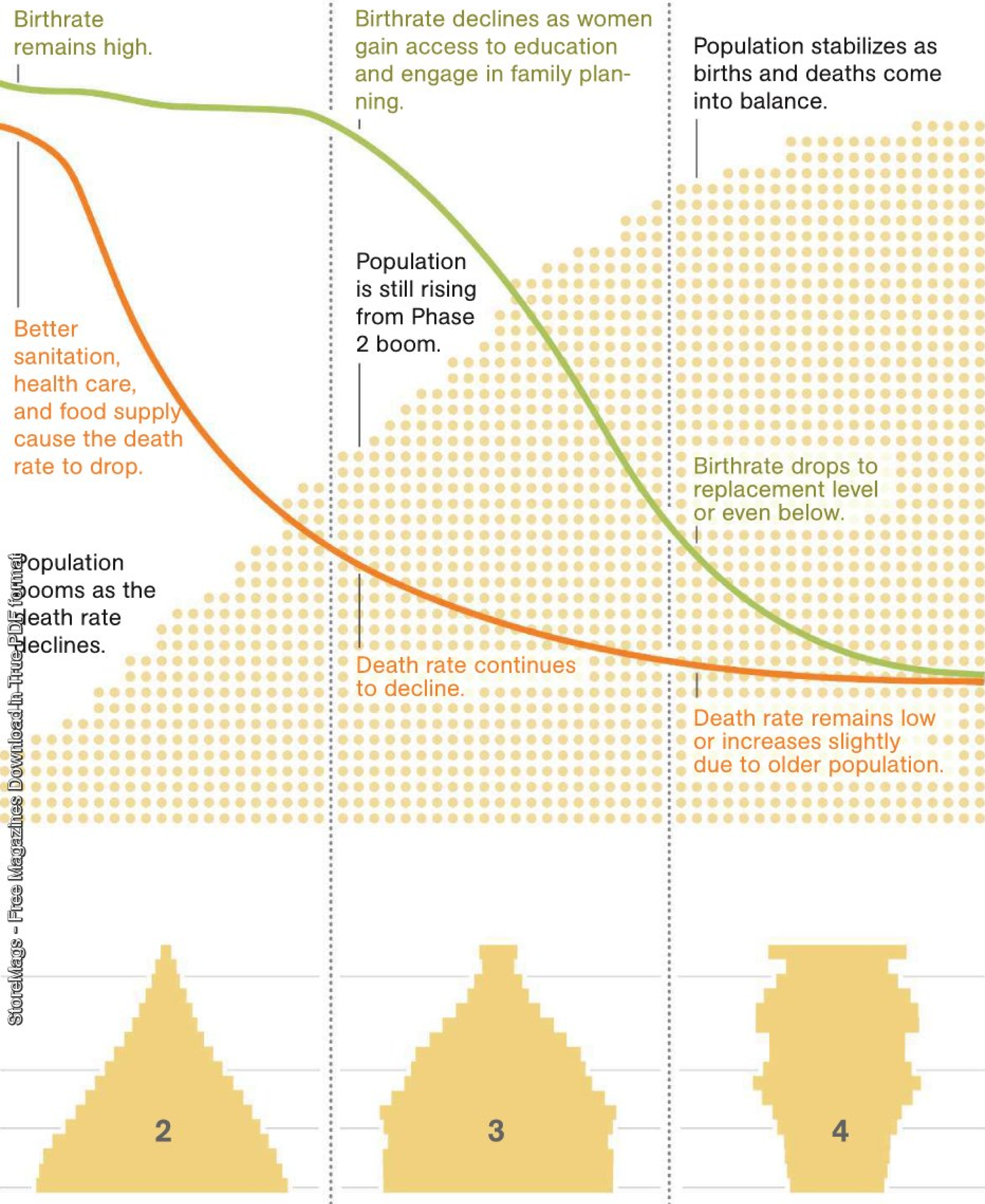
Uganda, Nigeria, Angola

PHASE 3: Still Rising

India, Brazil, Bangladesh, U.S.*

PHASE 4: Leveling Off

Japan, Russia, Italy, China

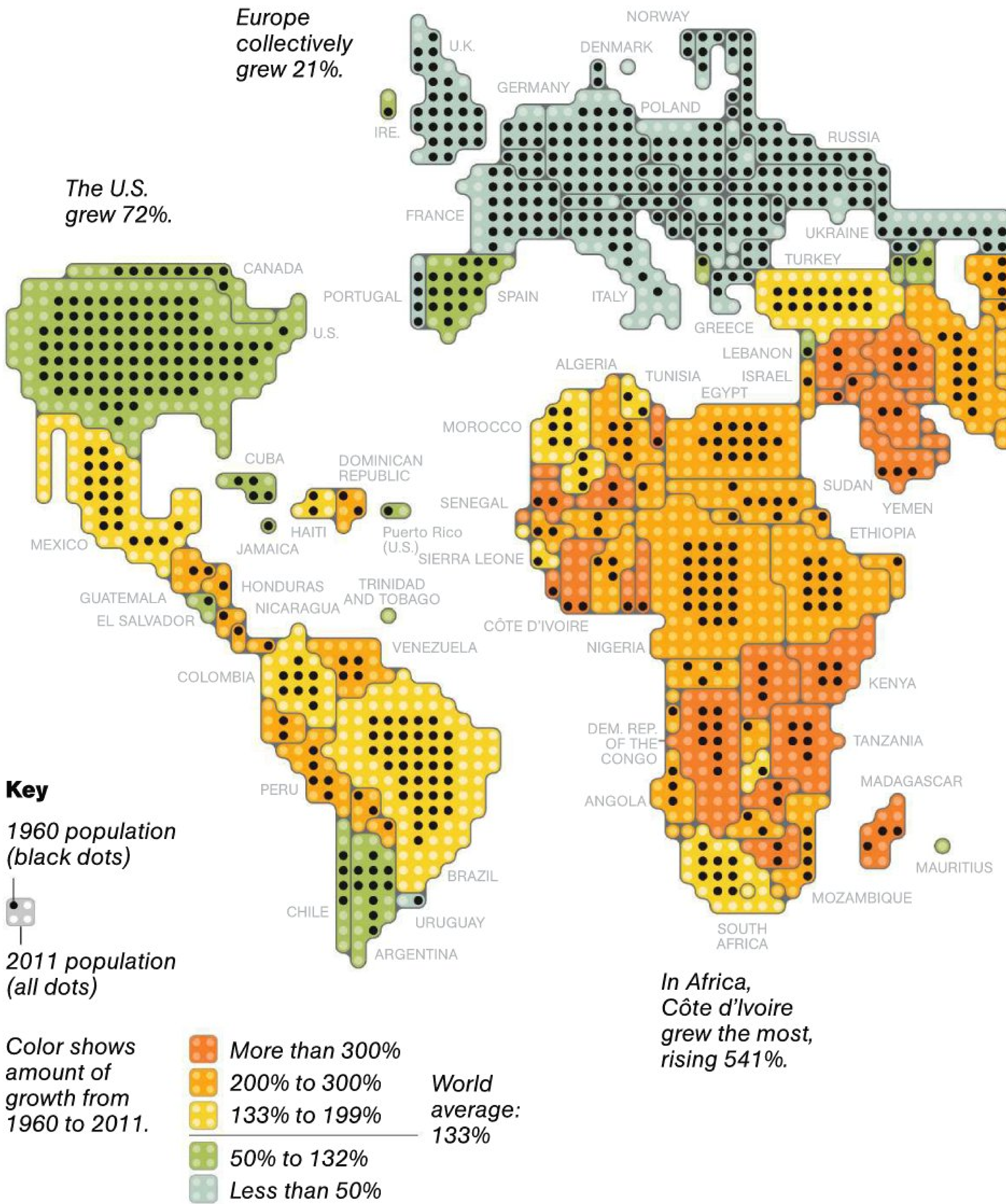


StoreMags - Free Magazines Download in True PDF format

*THE U.S. HAS CHARACTERISTICS OF PHASES 3 AND 4: A RELATIVELY HIGH BIRTHRATE AS WELL AS AN AGING POPULATION.

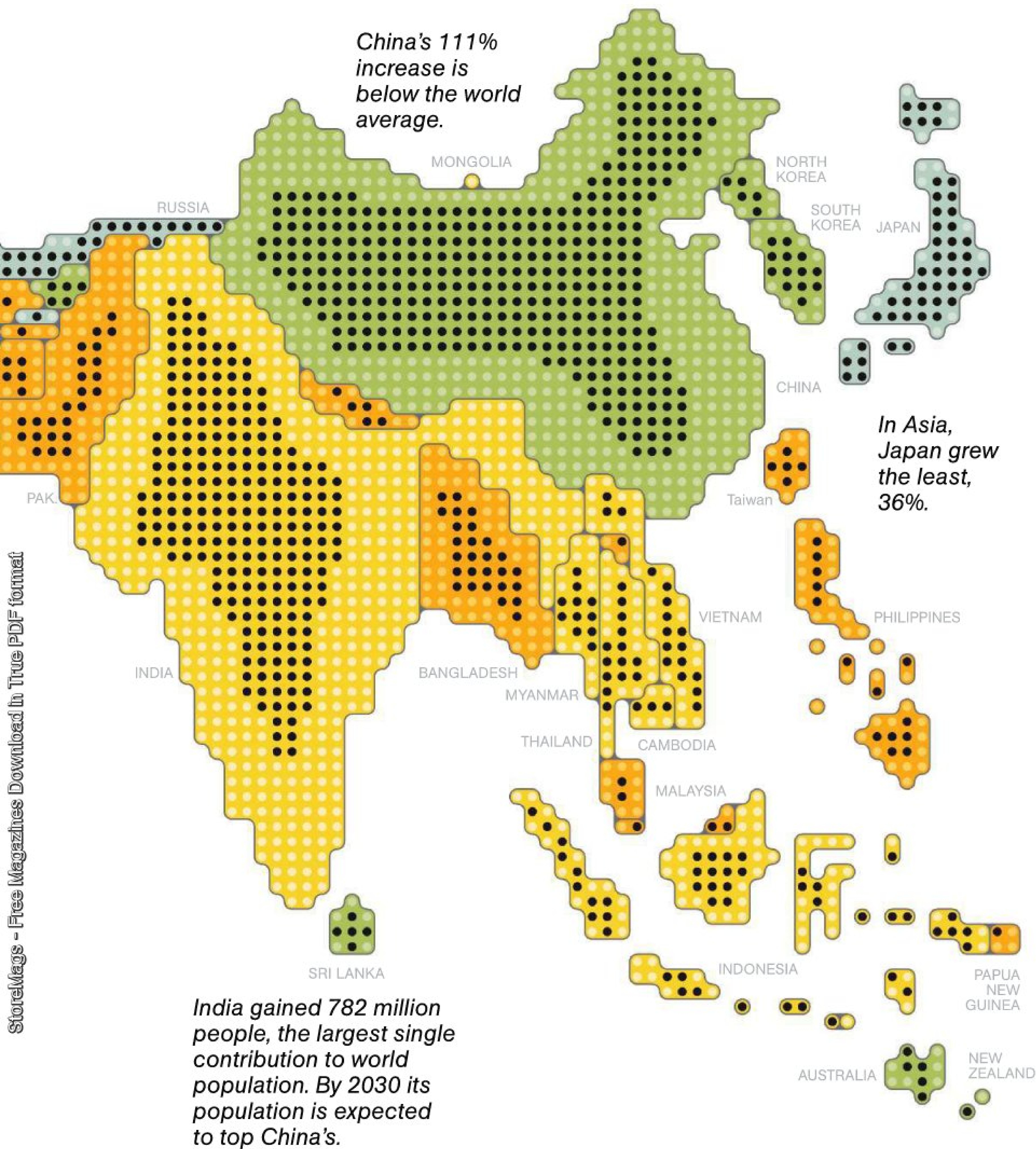
POPULATION

The Shape of Seven Billion



StoreMags - Free Magazines Download in True PDF format

Each country in this cartogram is sized according to its projected population in 2011. Black dots represent the country's population in 1960; light dots are population added since then. Each dot represents two million people. Colors indicate the amount of growth (detailed below). Nations with populations under 1.5 million are not shown.



StoreMags - Free Magazines Download in True PDF format

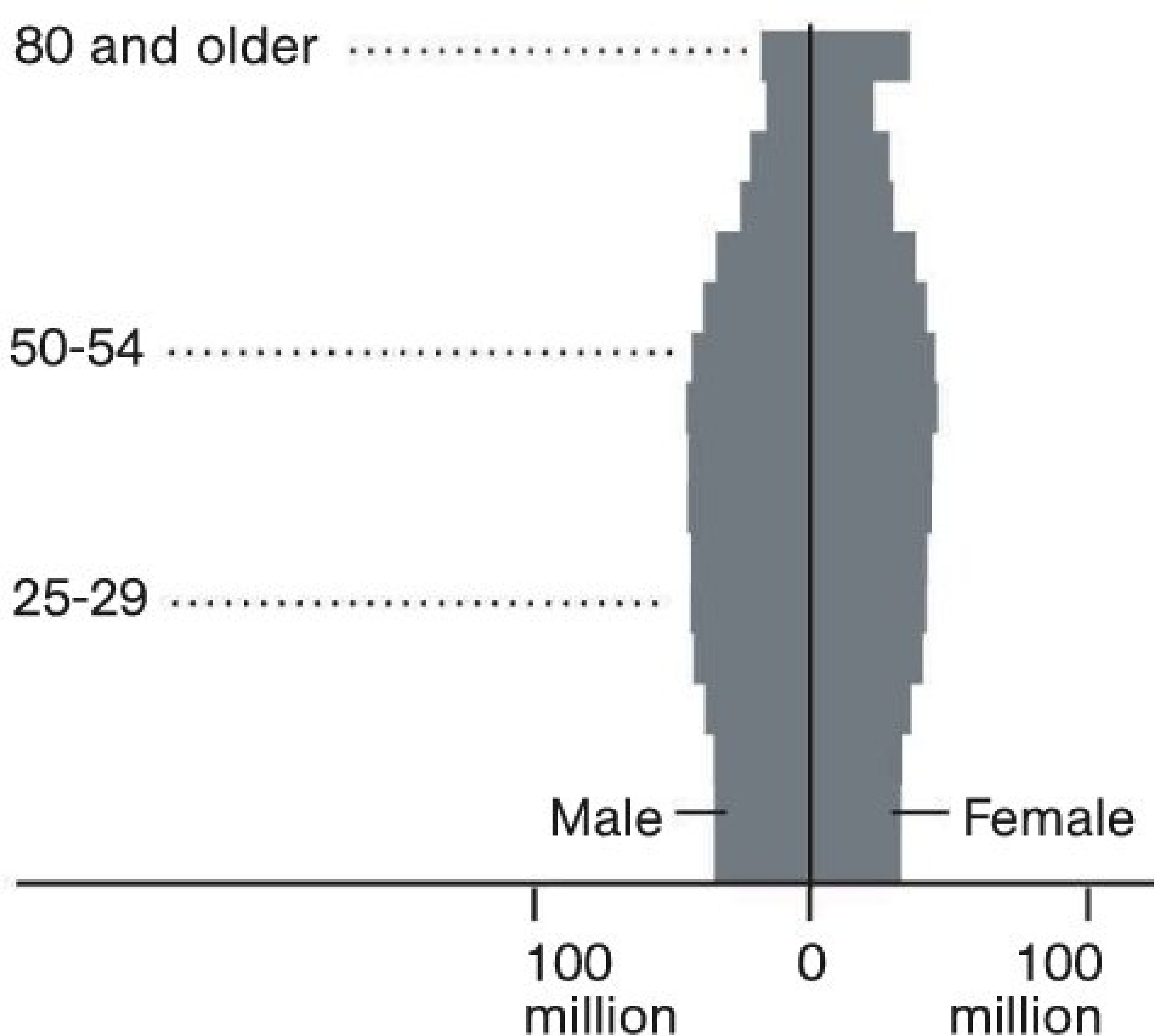
POPULATION

The less developed world will account for more than 95 percent of future population growth.

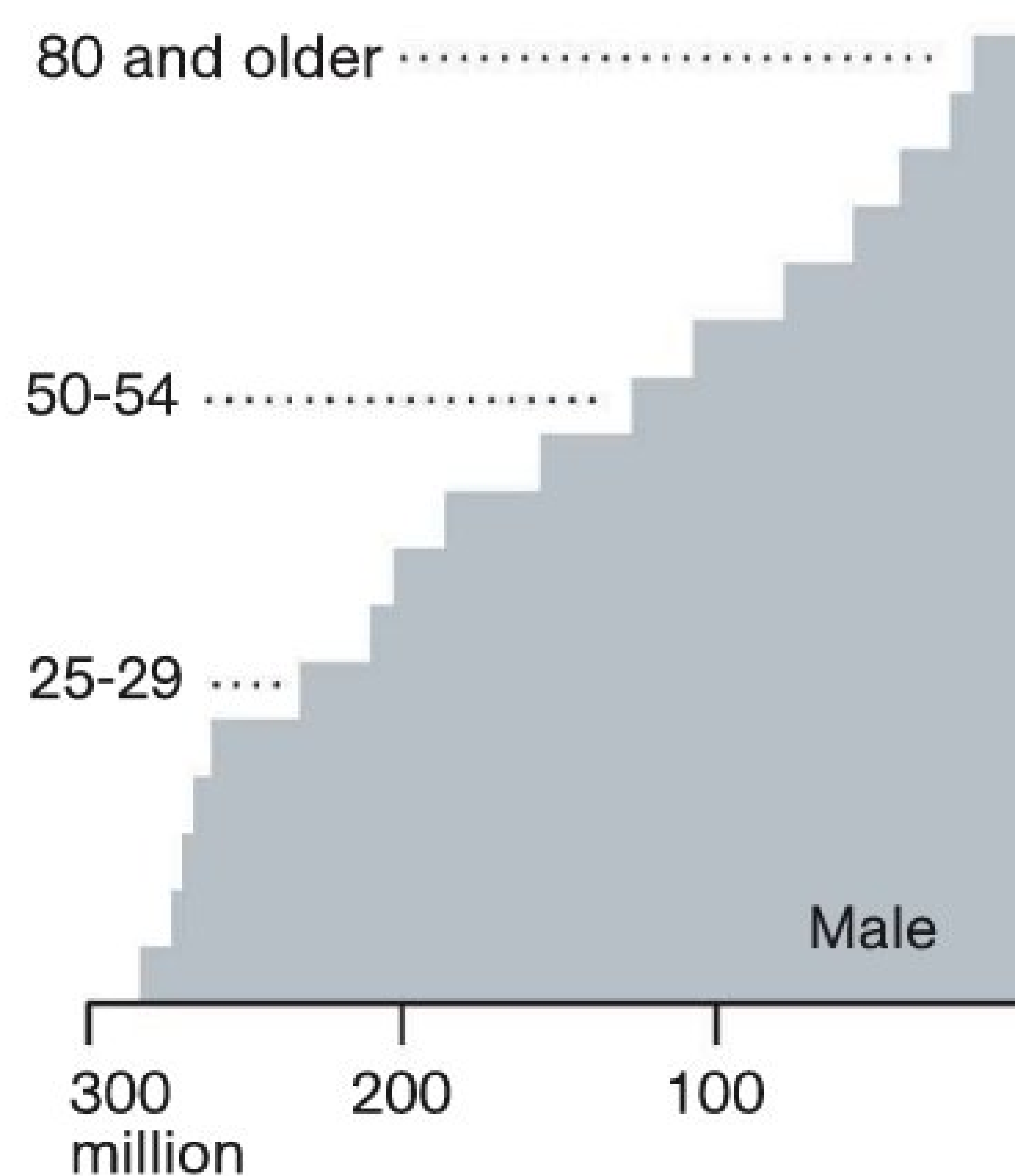
Youthful momentum

Age-distribution pyramids (below) show why the overwhelmingly young populations of developing countries will produce almost all the future population increase. Even with falling birthrates, the world's population is still growing by about 80 million people a year.

More developed world,* 2010



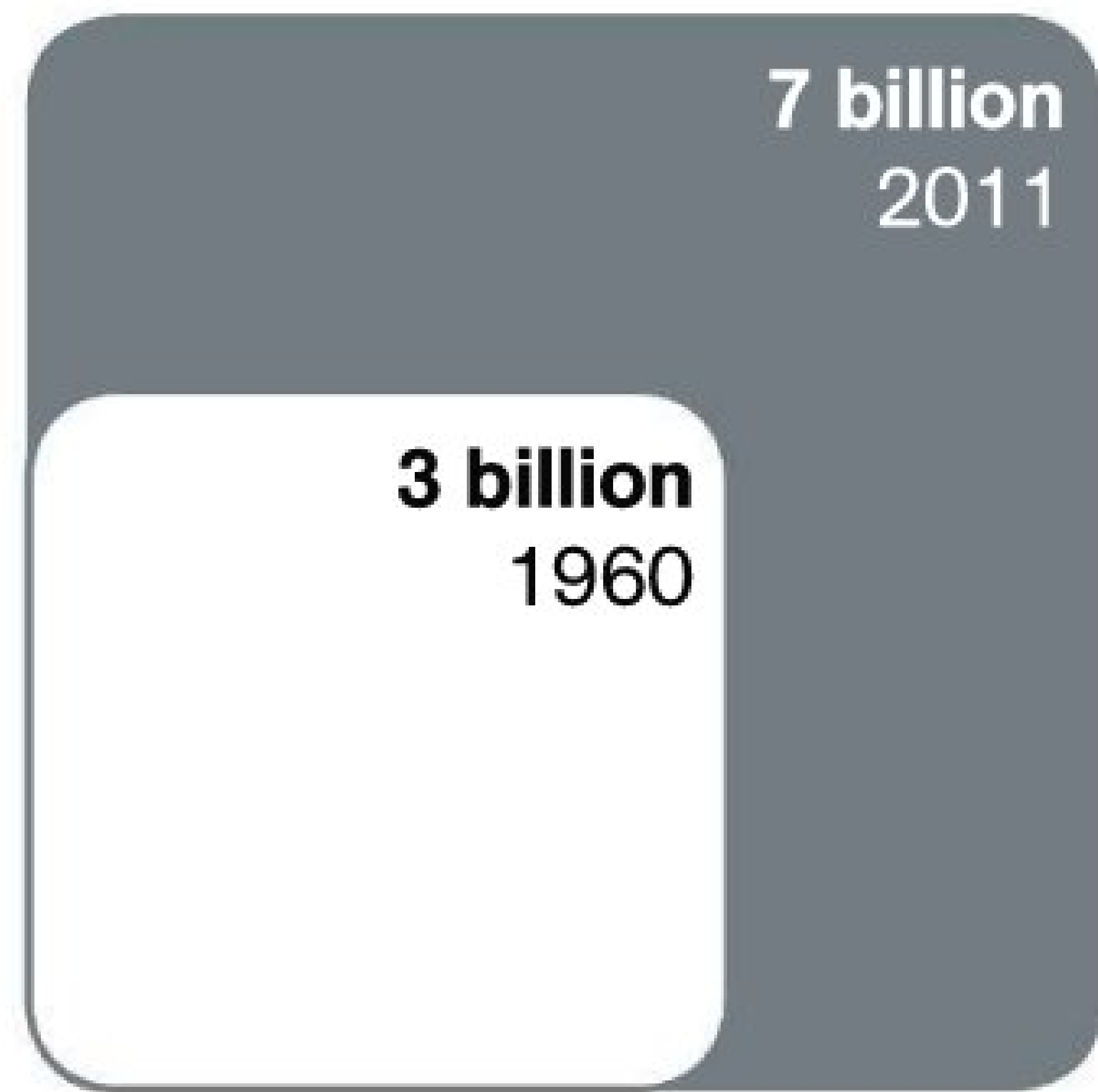
Less developed world, 2010



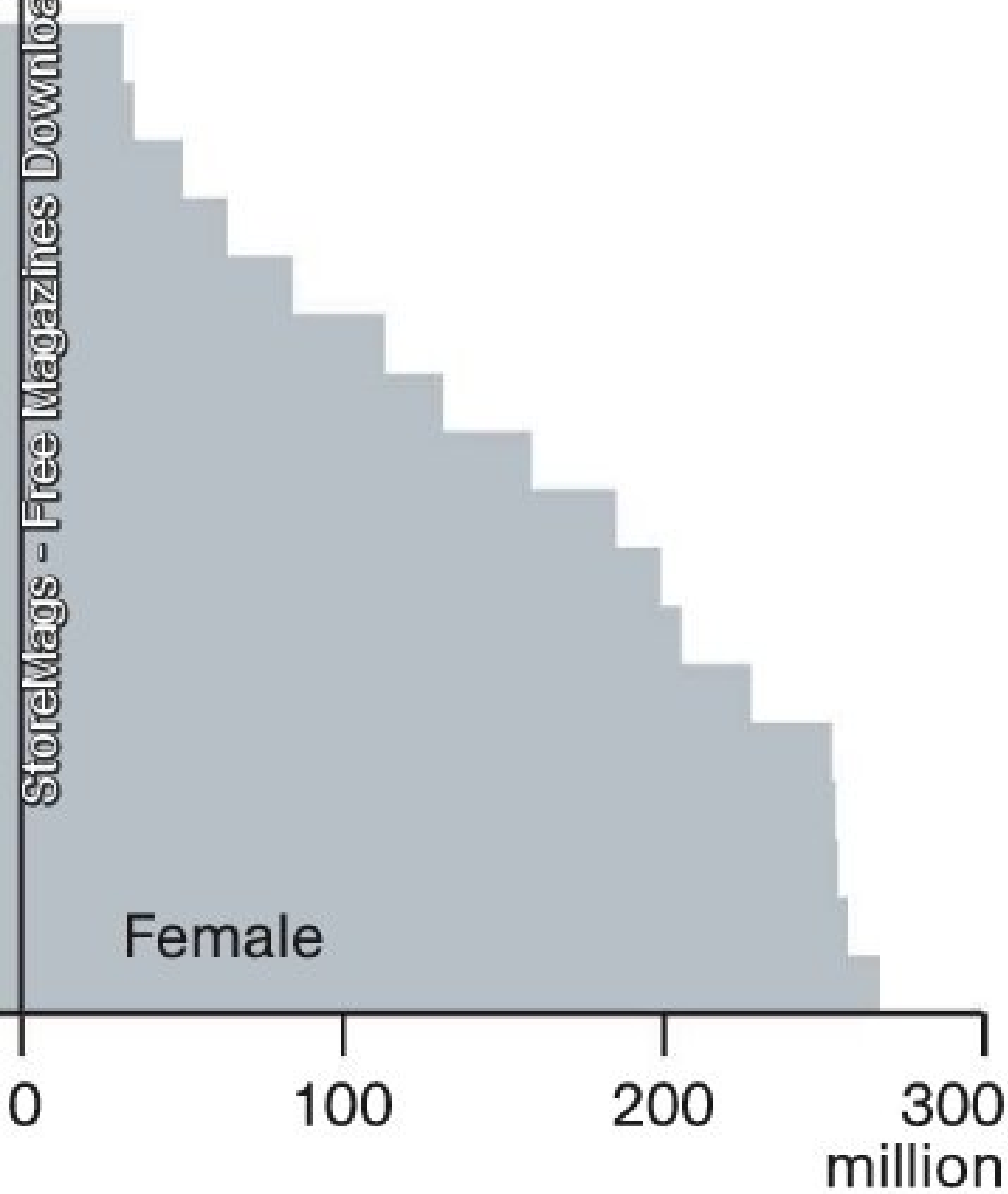
There are more than twice as many people on the planet today as there were in 1960.

World population has never doubled this quickly before, but it is unlikely to double again. The era of explosive growth is expected to end by 2050, at more than 9 billion people, with an estimated range of 8 to 10.5 billion people.

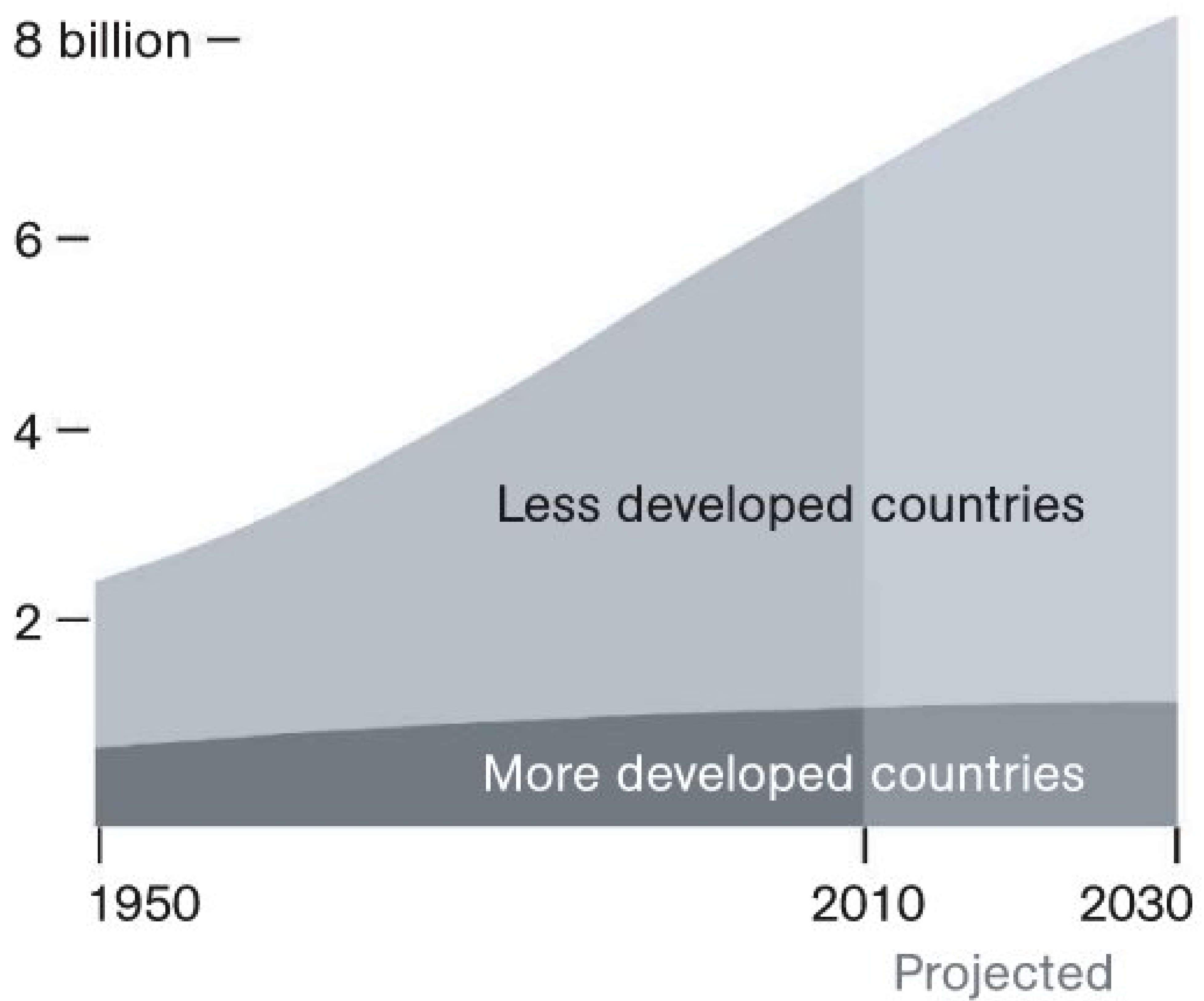
World population



StoreMags - Free Magazines Download in True PDF format



World population, 1950-2030



*"MORE DEVELOPED" IS DEFINED IN THESE UN STATISTICS AS THE U.S., CANADA, EUROPE, JAPAN, AUSTRALIA, AND NEW ZEALAND. JOHN TOMANIO, NGM STAFF. SOURCE: UN

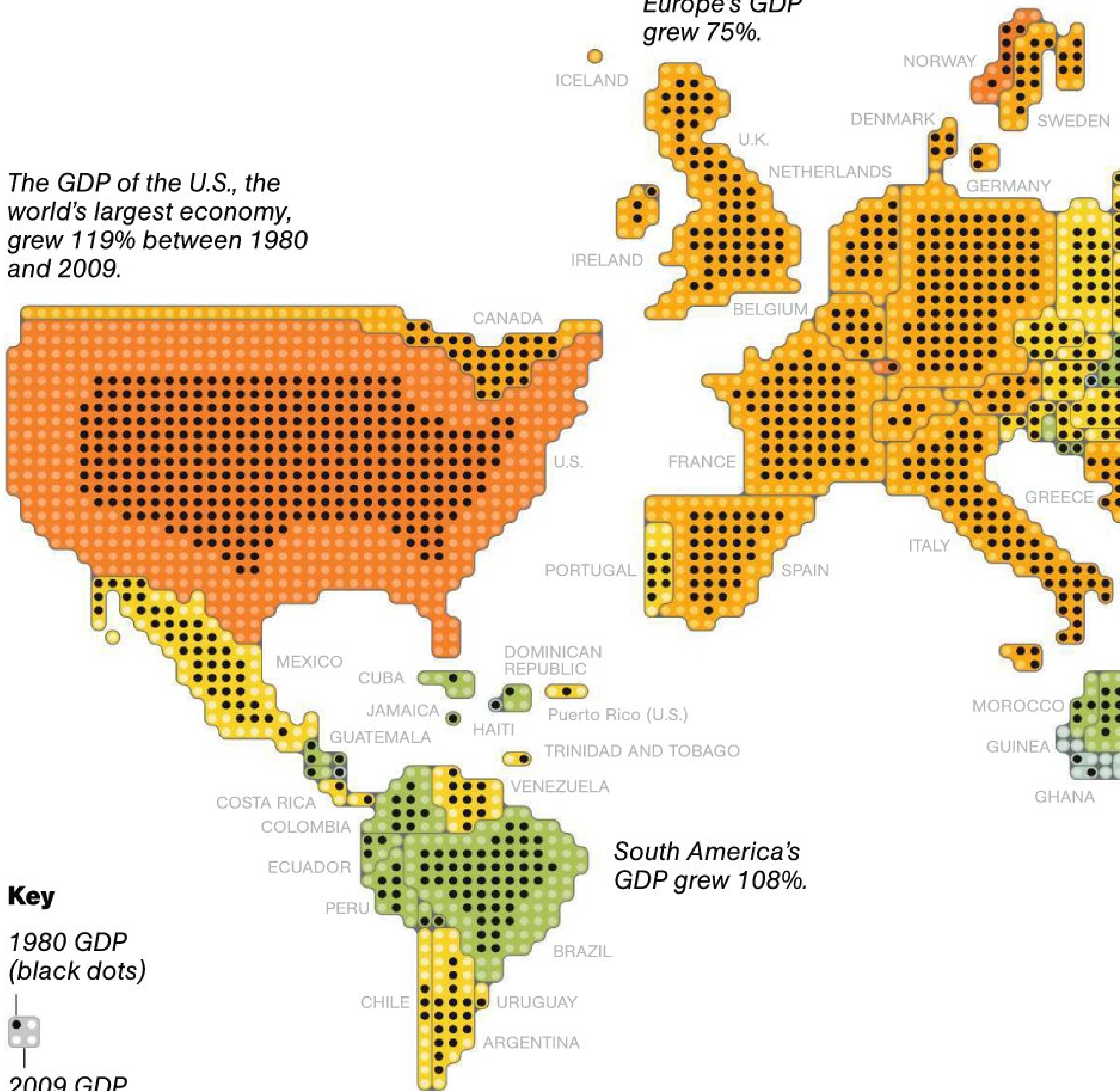
CONSUMPTION

Appetites of the Seven Billion

The GDP of the U.S., the world's largest economy, grew 119% between 1980 and 2009.

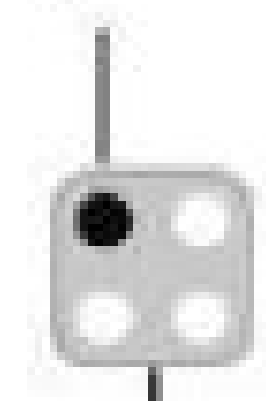
Europe's GDP grew 75%.

South America's GDP grew 108%.



Key

1980 GDP
(black dots)

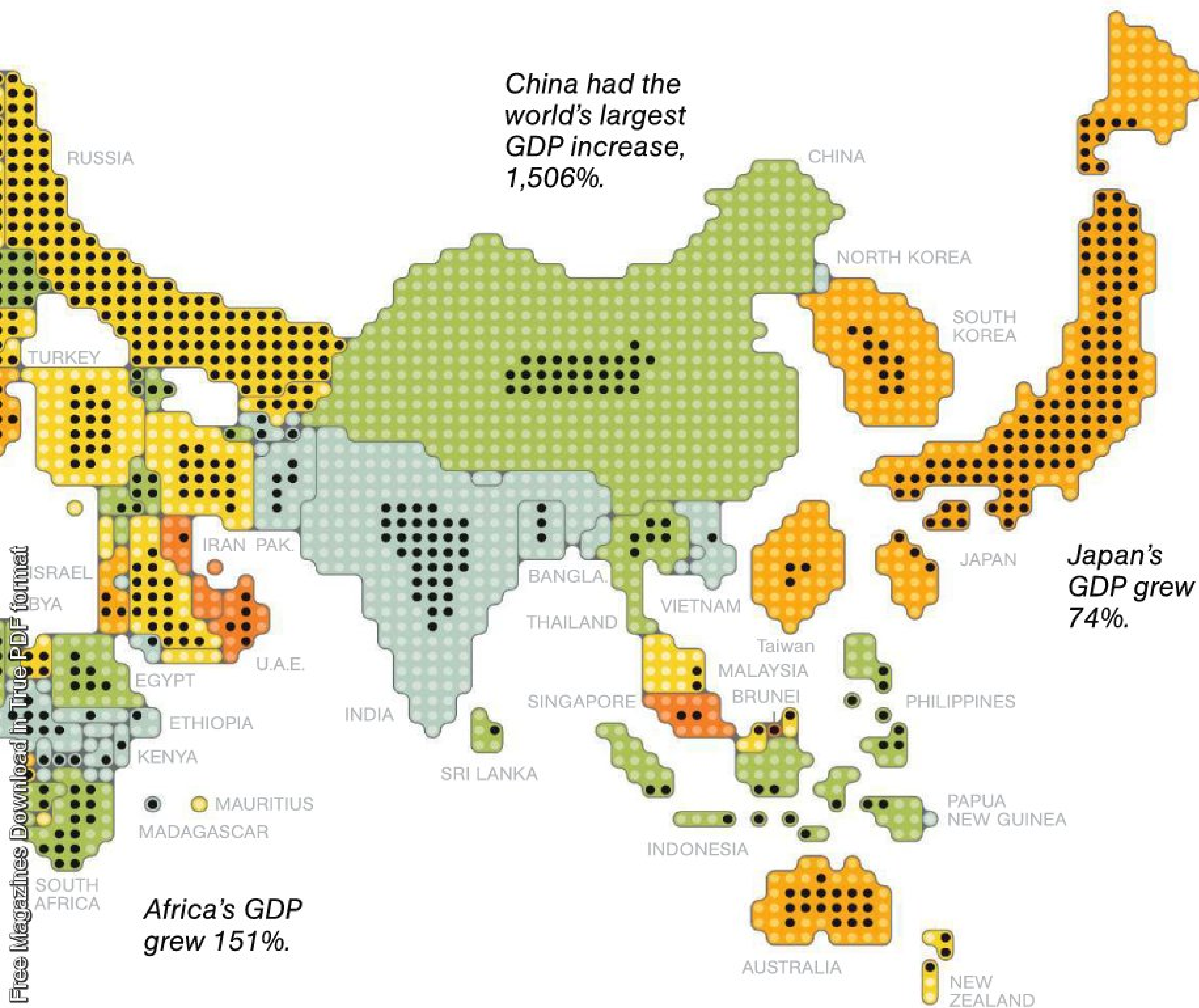


2009 GDP
(all dots)

Color indicates gross domestic product per person (2009).

- More than \$40,000
 - \$25,000 to \$40,000
 - \$9,514 to \$24,999
 - \$3,000 to \$9,513
 - Less than \$3,000
- World average: \$9,514

How much impact does each country have on Earth's resources? One way to approximate a nation's consumption is to look at its gross domestic product (GDP)—the total production of goods and services in a year by its residents, firms, and government. In this cartogram, countries are sized according to their GDP for 2009. Black dots show GDP in 1980, or latest year available; light dots show growth since then. Each dot represents \$20 billion.* A country's color indicates its GDP per person (detailed in the key below).



*TO COMPARE THE GROSS DOMESTIC PRODUCT OF THE COUNTRIES ON THIS MAP, GDP WAS CONVERTED TO CONSTANT INTERNATIONAL DOLLARS USING PURCHASING POWER PARITY RATES. IN THIS CONVERSION AN INTERNATIONAL DOLLAR HAS THE SAME PURCHASING POWER THAT A U.S. DOLLAR HAS IN THE UNITED STATES.

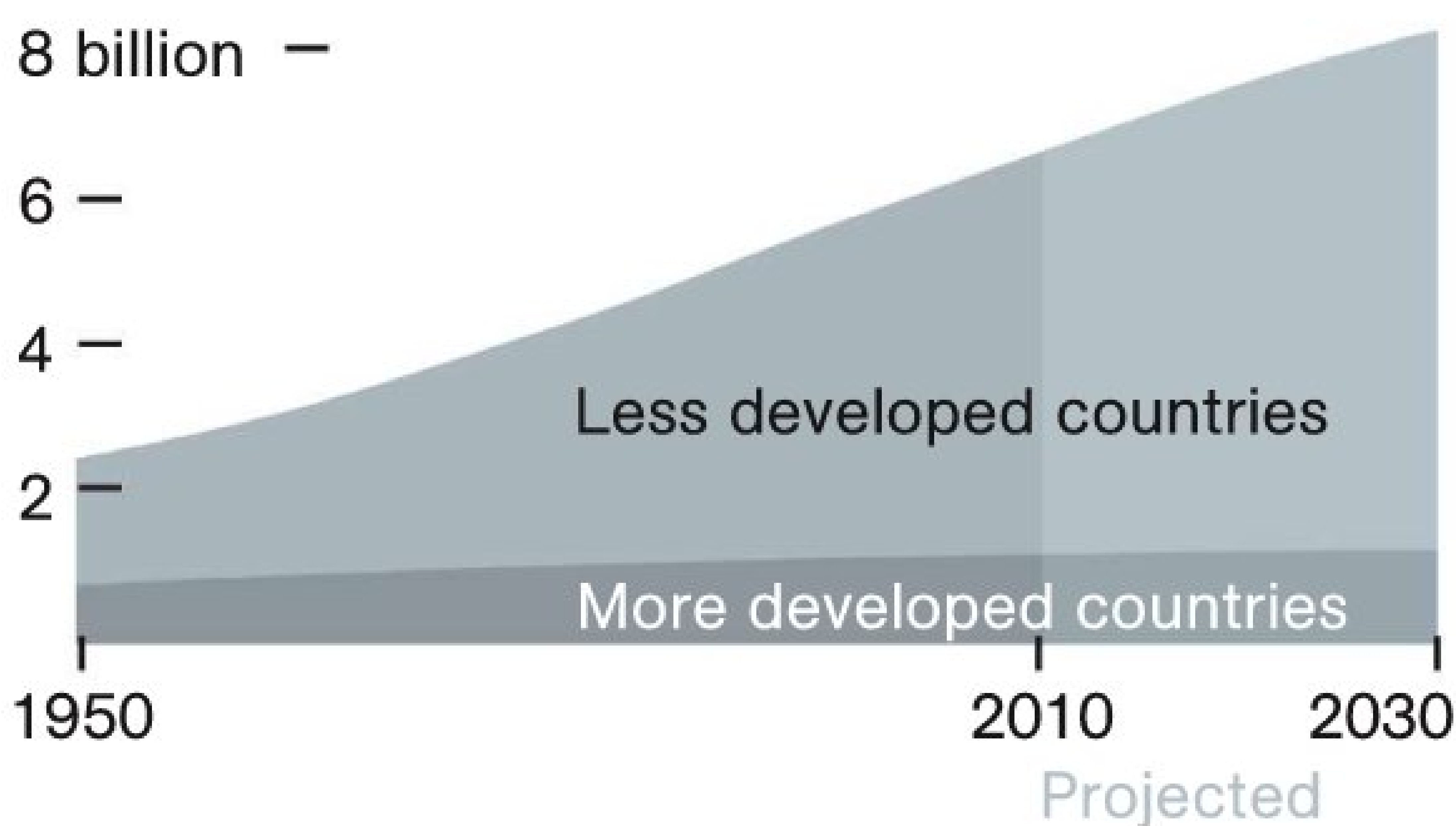
CONSUMPTION

Wealthy nations use the most resources now, but emerging economies are catching up fast.

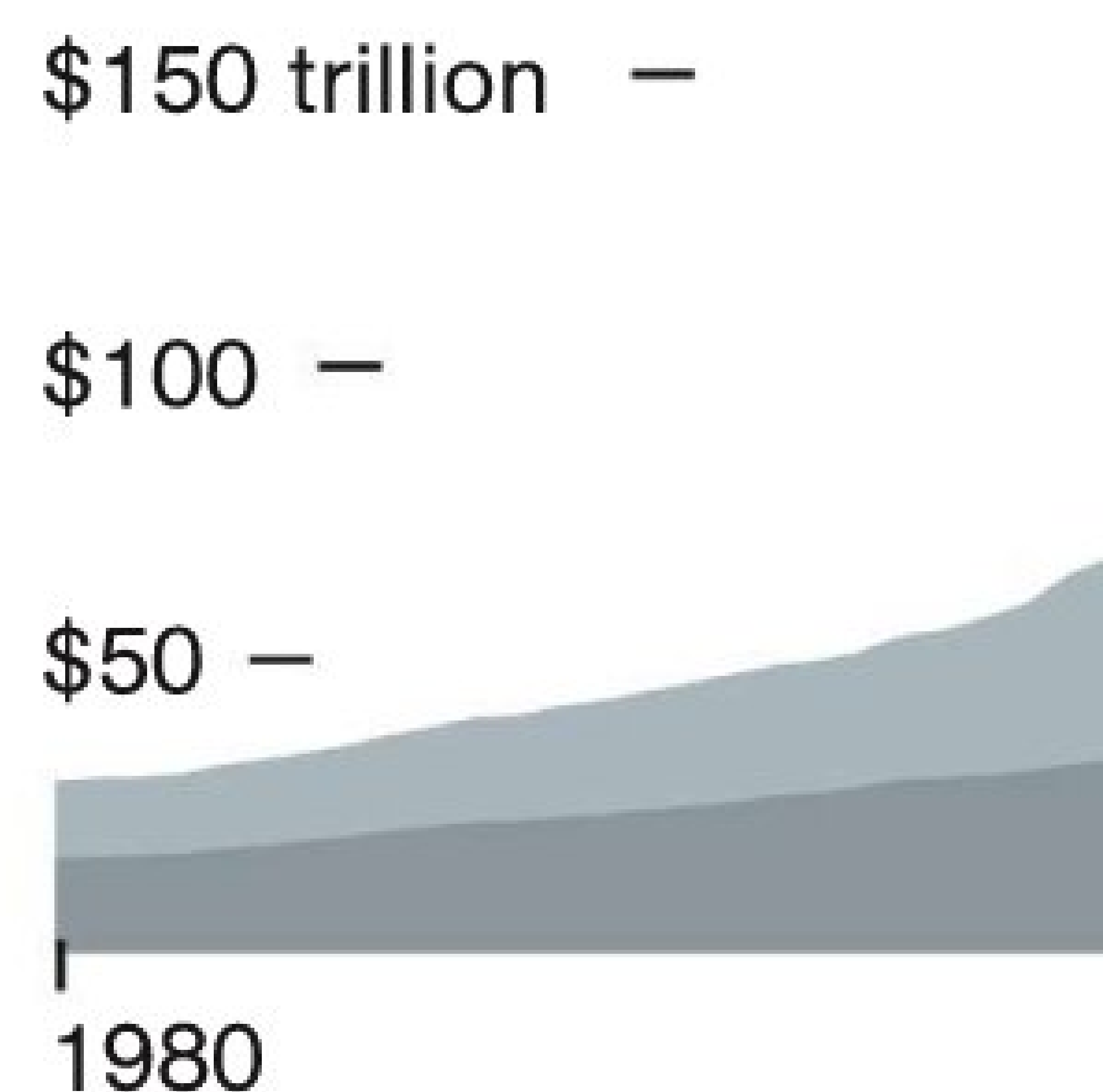
Demand on natural resources will continue to increase.

Earth's finite resources will be stressed both by rising prosperity and sheer numbers of people (graphs, below). The consumption of resources now enjoyed in the wealthiest nations will be difficult to sustain worldwide.

World population, 1950-2030



World GDP, 1980-2030

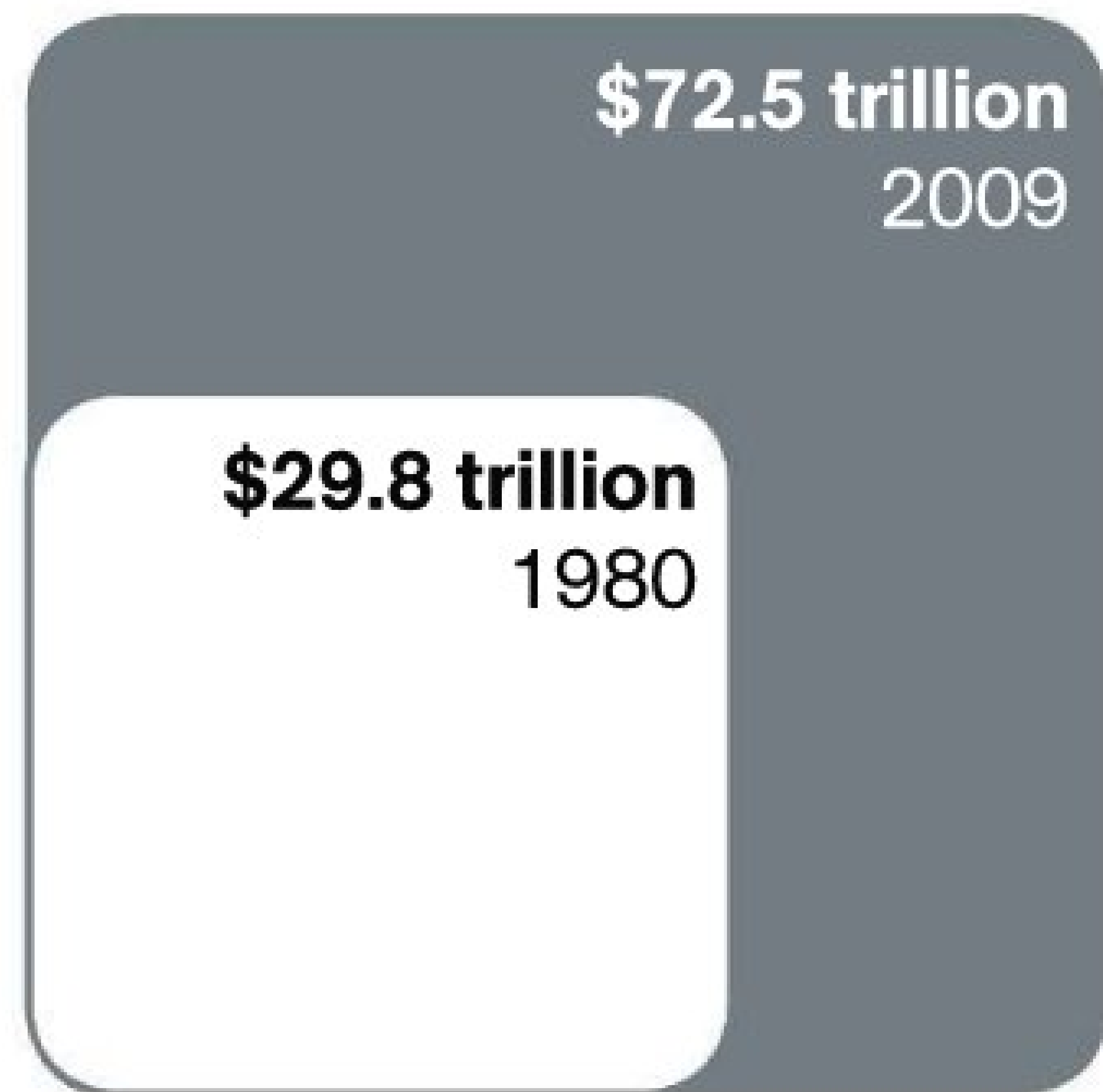


"MORE DEVELOPED" IS DEFINED IN THESE UN STATISTICS AS THE U.S., CANADA, EUROPE, JAPAN, AUSTRALIA, AND NEW ZEALAND.

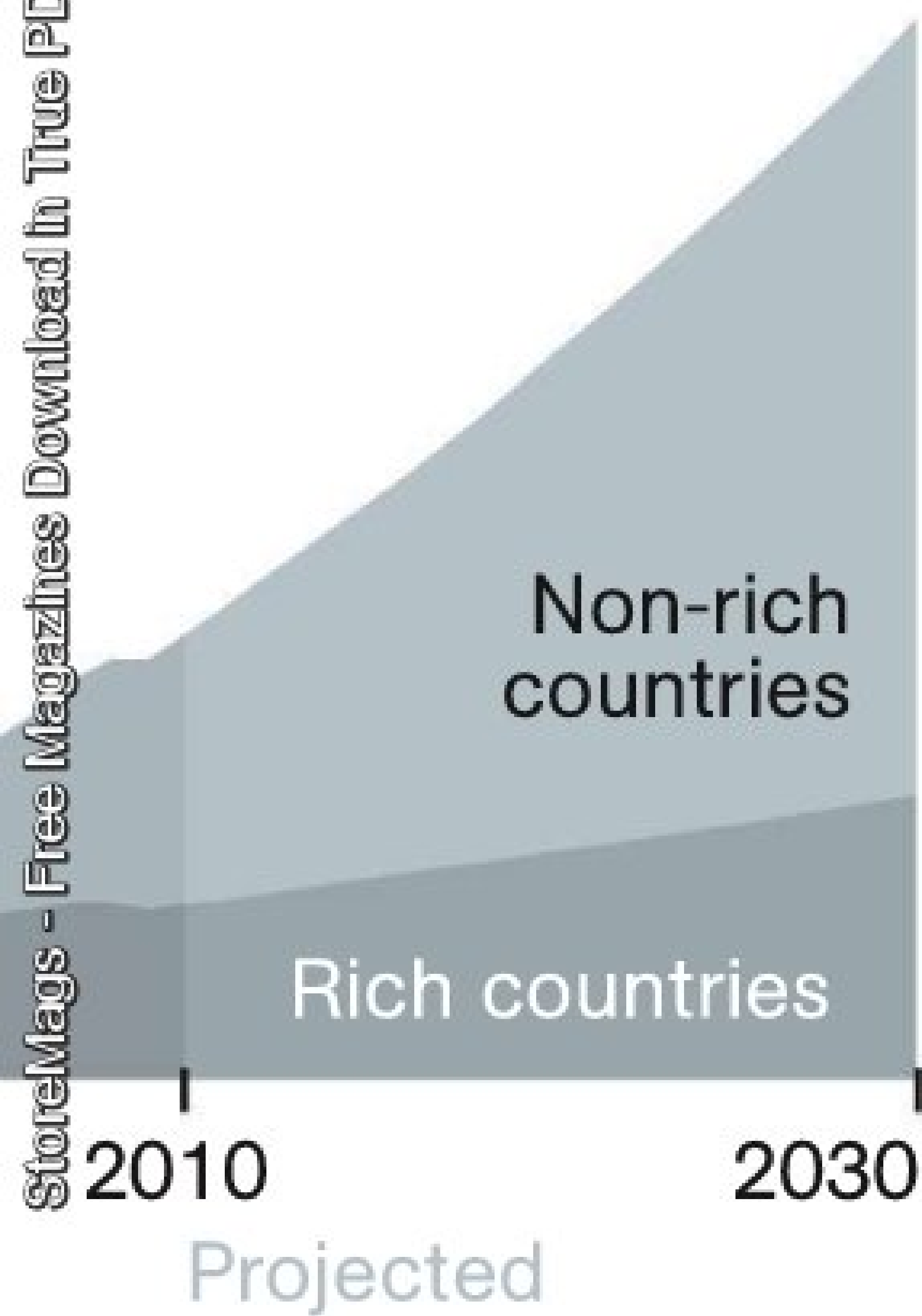
The world's gross domestic product more than doubled from 1980 to 2009.

Economic development in China and India accounts for much of the recent rise and will continue to drive it. Global economic growth, and the improved standard of living it offers, means that resources are being consumed at record levels.

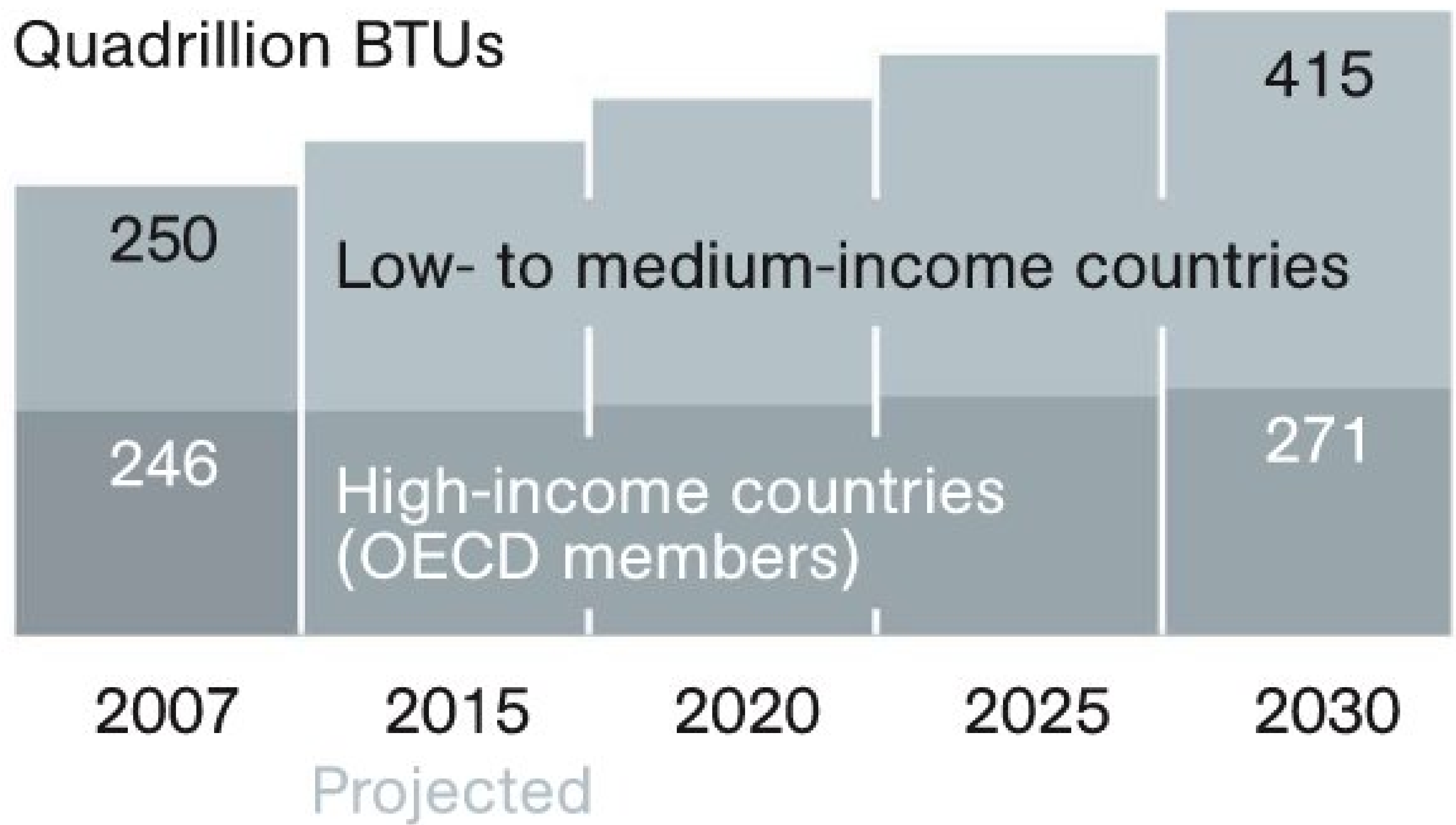
World GDP



StoreMaggs - Free Magazines Download in True PDF format



World energy consumption, 2007-2030



“RICH” INCLUDES THE UN'S MORE DEVELOPED COUNTRIES PLUS CYPRUS, HONG KONG, ISRAEL, SINGAPORE, SOUTH KOREA, AND TAIWAN.

OECD MEMBERS ARE THE UN'S MORE DEVELOPED COUNTRIES PLUS CHILE, ISRAEL, MEXICO, SOUTH KOREA, AND TURKEY.



FAMILY OF MANY

KENYA In a Nairobi slum Mary Wanza, a single mother earning three dollars a day, makes porridge for ten children, some hers, others grand-kids and orphans. Wanza, 41, gave birth to the first of seven at age 15.



StoreMags - Free Magazines Download in True PDF format

Fertility rates remain high in sub-Saharan Africa; Kenya's rate fell from eight to five births per woman between 1960 and 2000 but has since declined only to 4.6. The global average is 2.5. DOMINIC NAHR



StoreMags - Free Magazines Download in True PDF format

FEEDING A HUNGRY PLANET

CHINA Using every fertile inch, farmers harvest rice in the hills of Yunnan Province. High-yield seeds and ample fertilizer allow China to feed its billion-plus people on less than 10 percent of the Earth's arable land.



Producing enough food as global population grows is possible, but doing so without exhausting finite resources, especially water, will be a challenge. JIM RICHARDSON, NATIONAL GEOGRAPHIC STOCK



HIGH-TECH CAREGIVERS

JAPAN A talking robot helps 69-year-old Nabeshima Akiko shop in a test conducted by researchers from Keihanna Science City near Kyoto. Making up 23 percent of the population, the 29 million elderly



StoreMags - Free Magazines Download in True PDF format

in Japan far outnumber the young, an unprecedented situation that raises concerns about who—or what—will support the old in the years ahead. RANDY OLSON



EMPTIED COUNTRYSIDE

RUSSIA Traffic is light—a horse cart with grain, a puppy in pursuit—on a road passing an abandoned granary and church in Novotischevye, one of thousands of Russian villages depopulating as people move to





cities and have fewer kids. To combat a low birthrate, the government has promised to pay \$11,500 to women who have a second child. RANDY OLSON



LAYING OUT THE AMERICAN DREAM

UNITED STATES A new house went up every 20 minutes during the 2004 building boom that seized Las Vegas and its sprawling suburbs, like Henderson. The American lifestyle—characterized by gas-thirsty



StoreMags - Free Magazines Download in True PDF format

cars and big houses using lots of electricity—contributes to the country's energy appetite; its carbon emissions are four times higher than the global average. YANN ARTHUS-BERTHRAND, ALTITUDE



LURE OF THE CITY

VENEZUELA Sharing a hillside with high-rise apartment dwellers, children dance at a shop in one of the squatter communities that ring Caracas, a city of three million. One in seven people on Earth



StoreMags - Free Magazines Download in True PDF format

lives in slums today. Providing them with better housing and education will be one of the great challenges facing a world of seven billion people and counting. JONAS BENDIKSEN, MAGNUM PHOTOS


PHOENIX RISING

After a rare bleaching disaster, the reefs
of the Phoenix Islands bounce back.

A green turtle glides over a wasteland of dead coral near Kanton island in the central Pacific. Before water temperatures spiked here in 2002-03, this reef was brimming with life.





A school of yellowfin surgeonfish swimming in clear blue water. The fish are densely packed, with some in the foreground and others receding into the background. The water is a vibrant blue, and the fish have a silvery body with a prominent yellow stripe along their side. The scene is captured from an underwater perspective, showing the fish in motion.

On a mission to feed, yellowfin surgeonfish crowd the water at Nikumaroro. Although the atoll lost many corals, it kept an abundance of grazing fish that help reefs recover by keeping them clean.



StoreMags - Free Magazines Download in True PDF format



Healthy new plate coral in the lagoon on Kanton island is a sign of hope. Since the waters here were hit by a severe bleaching episode, the coral has grown to a diameter of more than four feet.

A school of Pacific steephead parrotfish graze on dead coral at Kanton island. "You can hear them going crunch, crunch, crunch," says Greg Stone, a diver and marine scientist. By grazing on algae, these and other herbivores keep reefs free of seaweed, enabling pink coralline algae to take hold and form a substrate for new coral.



A four-saddle grouper in the Kanton island lagoon passes over the candy-pink coralline algae on which new coral will grow.

StoreMags - Free Magazines Download in True PDF format

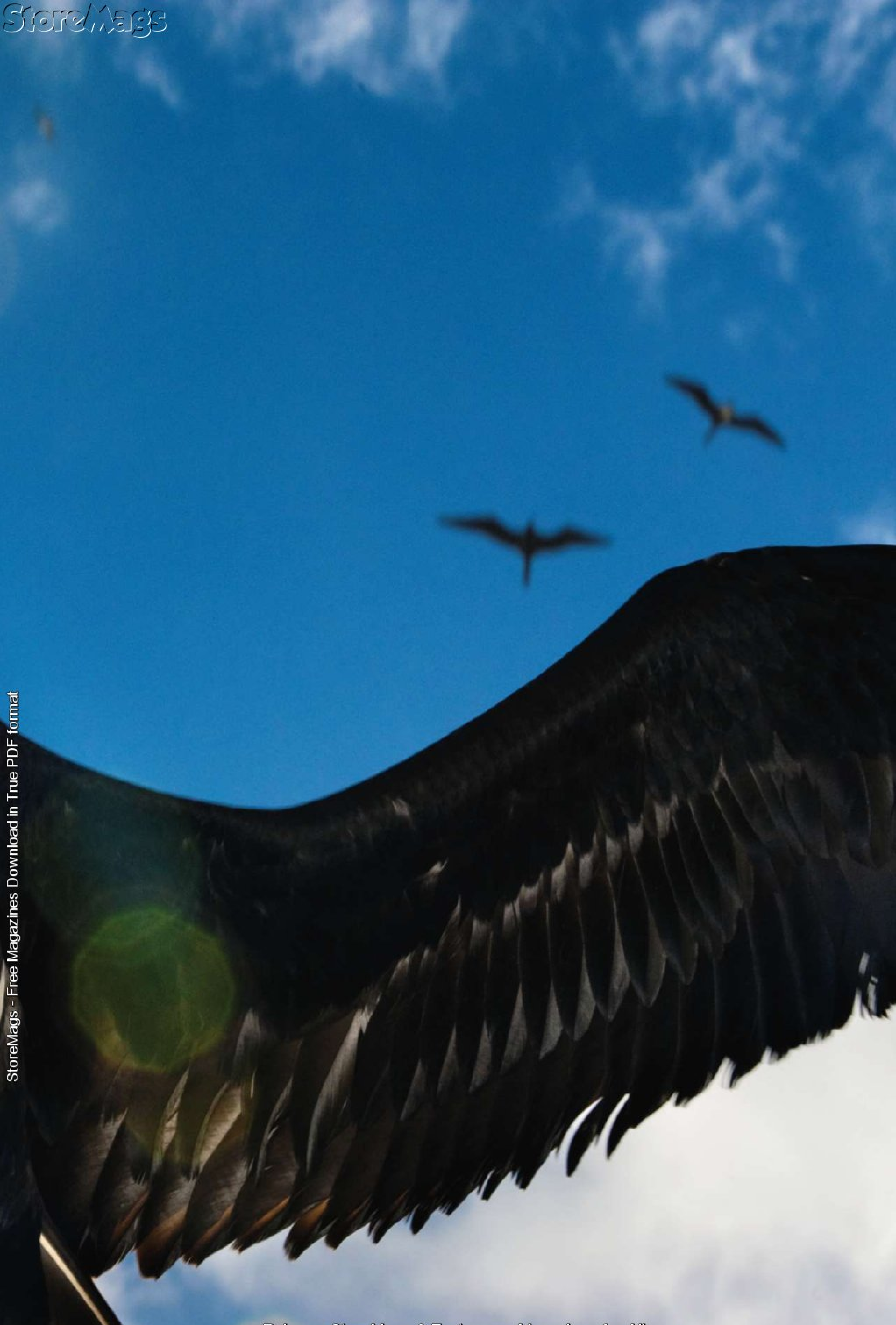




Hovering briefly over the photographer, feet tucked up beneath its belly, a frigatebird comes in for a landing on Rawaki. Hundreds of thousands of birds lay their eggs on the island.



StoreMags - Free Magazines Download in True PDF format



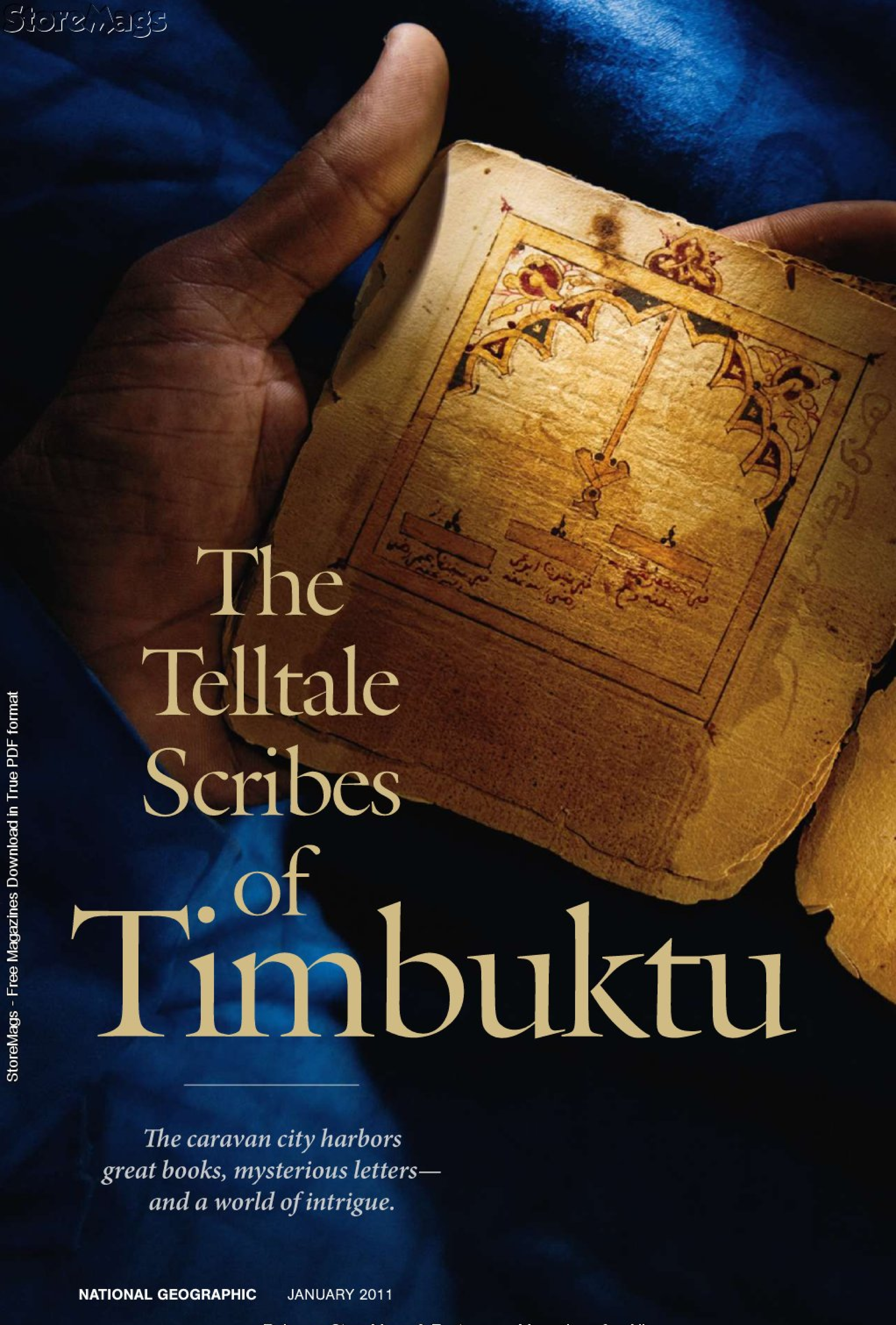


Even without counting the vast open ocean and largely unexplored deep-sea regions in the reserve, the Phoenix Island Protected Area shelters more than 800 fish, bird, and coral species, including 120 species of hard corals, such as this leafy formation at Enderbury Island.



A shy and elusive fish, a Napoleon wrasse at Orona island is a good omen for the marine reserve. The abundance of this species, often fished out early when reefs are targeted, means that the reef system here is still relatively intact. “The Phoenix Islands are what the oceans were like a thousand years ago,” scientist Stone says, “and what they can be like a thousand years from now.”





The Telltale Scribes of Timbuktu

*The caravan city harbors
great books, mysterious letters—
and a world of intrigue.*

A diagram of the Prophet's Mosque in Medina is one of the treasures found among thousands of ancient manuscripts.







Imam Chafi inspects his family's manuscripts, some over 400 years old, after rains collapsed his roof. Dozens of Timbuktu families receive aid to preserve their libraries, covering expenses such as roof repairs.



StoreMags - Free Magazines Download in True PDF format



A death in a prominent family draws a crowd of mourners. Their ranks include members of Timbuktu's three major ethnic groups: the Tuareg, Songhai, and Arabs. Each group has ruled the city during its long history.



StoreMags - Free Magazines Download in True PDF format



At its peak Timbuktu boasted 50,000 residents and streets swollen with arriving camel trains that stretched for miles. Today the city's population is about the same, but the caravans are almost extinct.



StoreMags - Free Magazines Download in True PDF format



With quills cut from desert shrubs, Boubacar Sadeck (in white) teaches calligraphy on the roof of his studio. The city once supported a flourishing industry of scribes who copied texts brought by traders and scholars.





Soldiers celebrate Malian independence day, September 22, but their revelry belies tensions beyond the city limits. Groups allied with al Qaeda hold hostages in the desert, crippling Timbuktu's tourism trade.



StoreMags - Free Magazines Download in True PDF format



High heels and high hopes have become vogue among teenage girls at Timbuktu's lone high school. A rise in female pupils, aided by scholarships, marks a national effort to cut Mali's 74 percent illiteracy rate.



والمنشور كتابه يتنوع الله على المؤمنين
 بحمد الله غفوراً رحيماً
 طور ابيه مطبوعة
 طر الرحي

والاير سلكوه
 العلم السخبا
 لاهم عناب

صرا
 طام
 باويه
 باويه

العلم السخبا
 طام
 باويه
 باويه



A selection of manuscripts from a small family library includes a text with astrology diagrams (center). Timbuktu's libraries contain over 100,000 manuscripts, and experts believe many thousands remain undiscovered.

There's a jungle inside Vietnam's mammoth cavern. A skyscraper could fit too. And the end is out of sight.

CONQUERING AN INFINITE CAVE



A giant cave column swagged in flowstone towers over explorers swimming through the depths of Hang Ken, one of 20 new caves discovered last year in Vietnam.





A jungle inside a cave? A roof collapse long ago in Hang Son Doong let in light; plants thickly followed. As “Sweeny” Sewell climbs to the surface, hikers struggle through the wryly named Garden of Edam.





A half-mile block of 40-story buildings could fit inside this lit stretch of Hang Son Doong, which may be the world's biggest subterranean passage.





Moss-slick boulders and a 30-foot drop test author Mark Jenkins at the forest-shrouded entrance to Hang Son Doong. “Even though these caves are huge, they’re practically invisible until you’re right in front of them,” Jenkins says. Hunters have found caves by spotting winds gusting from underground openings.



StoreMags - Free Magazines Download in True PDF format

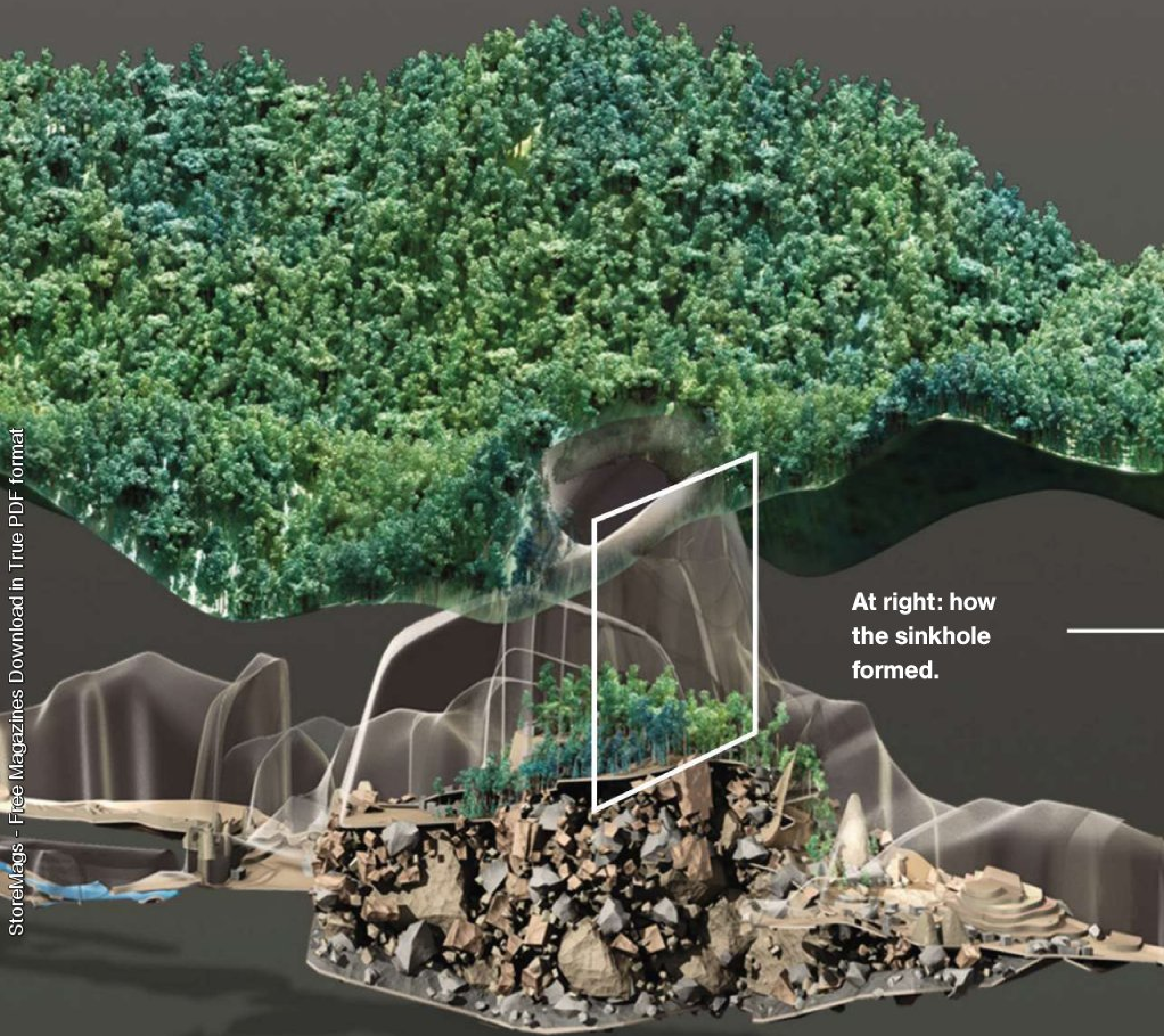


StoreMags - Free Magazines Download in True PDF format

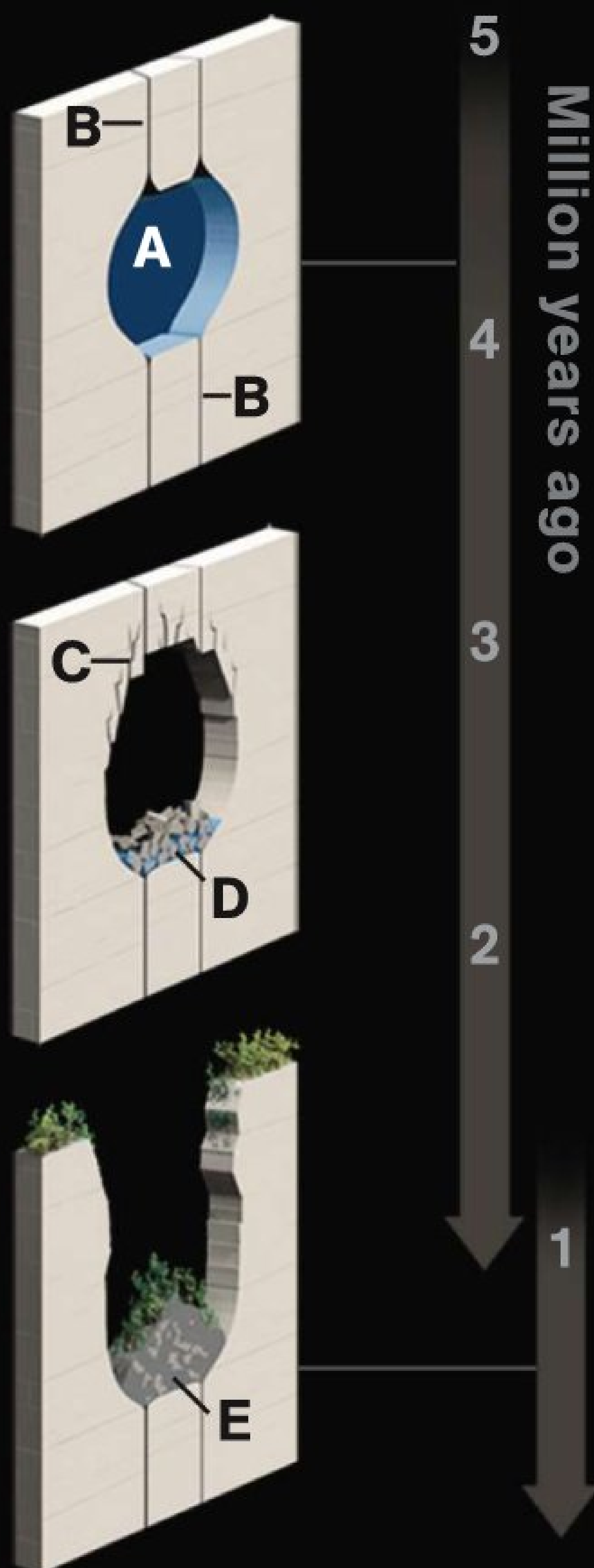
Dubbed the Great Wall of Vietnam, a 200-foot cliff halted the advance of the first team to enter Hang Son Doong, in 2009. When explorers returned, Sewell drilled bolts for climbers to scale the obstacle with ropes. A white streak below, to his right, marks how high water rises during the wet season.

A Mega-Sinkhole Opens

The cave's Garden of Edam sinkhole owes its size to its location: Another passage entered the main cave here. When the ceiling collapsed at this junction, it opened a pit 1,500 feet deep, with a 650-foot-wide opening.



At right: how
the sinkhole
formed.



Dissolving

2 million to 5 million years ago

A subterranean chamber (A) forms as water flowing along fracture lines (B) dissolves the limestone.

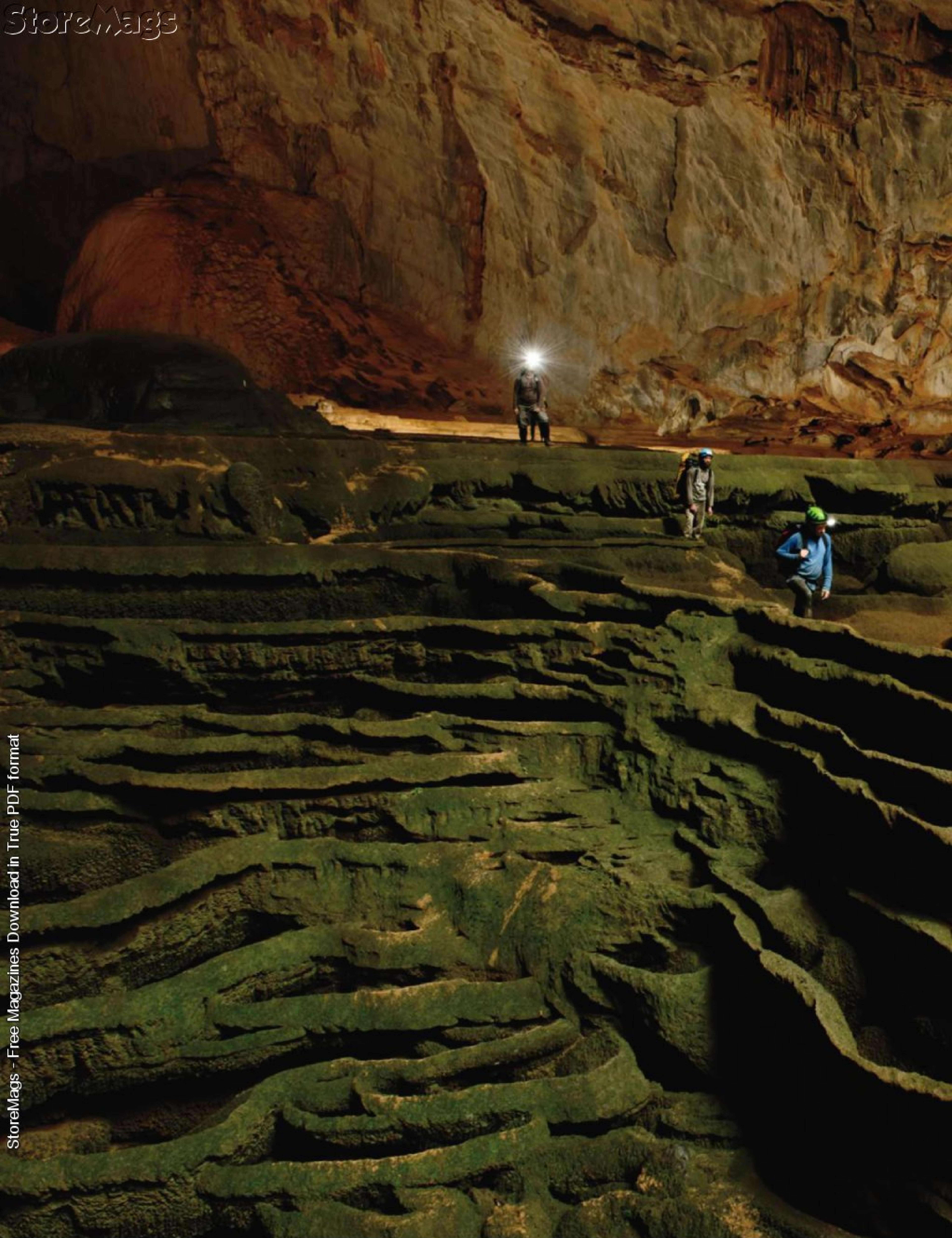
Expanding

With continued erosion and collapse (C), debris accumulates faster than it can be removed by the flowing water (D).

Collapse and colonization

Within the past million years

The chamber's roof collapses, opening the cave to the sky. Ferns and trees colonize the exposed debris cone (E).



StoreMags - Free Magazines Download in True PDF format



StoreMags - Free Magazines Download in True PDF format

Navigating an algae-skinned maze, expedition organizers Deb and Howard Limbert lead the way across a sculpted cavescape in Hang Son Doong. Ribs form as calcite-rich water overflows pools.





StoreMags - Free Magazines Download in True PDF format

Rare cave pearls, most of them dime-size here, fill dried-out terrace pools near the Garden of Edam in Hang Son Doong. This unusually large collection of stone spheres formed drip by drip over the centuries as calcite crystals left behind by water layered themselves around grains of sand, enlarging over time.

A climber ascends a shaft of light in Loong Con, where humidity rises into cool air and forms clouds inside the cave.







In the dry season, from November to April, a caver can safely explore Hang Ken, with its shallow pools. Come the monsoon, the underground river swells and floods the passages, making the cave impassable.





Headroom shrinks in the middle of Hang En as cavers pass beneath a ceiling scalloped by eons of floodwater rushing past. The river shortly reemerges onto the surface, then burrows into Hang Son Doong after a few miles.

Like a castle on a knoll, a rock formation shines beneath a skylight in Hang Son Doong. A storm had just filled the pool, signaling that exploring season was coming to an end.







Spirits and shamans loomed large in Cahokia and other mound-building communities, as revealed by a ceremonial mask (above) and a stone tablet (left). The shell beads surrounding the tablet were found in a burial mound containing human sacrifices.

ABOVE: CEDAR MASK, NATIONAL MUSEUM OF THE AMERICAN INDIAN; PHOTO BY ERNEST AMOROSO. LEFT: BIRDMAN TABLET, COURTESY ILLINOIS STATE MUSEUM; PHOTO BY IRA BLOCK



A few miles from Cahokia in St. Louis, residents saw the city's many mounds as little more than handy sources of soil. The largest, Big Mound, stood some 30 feet high and 300 feet long and took years to level. Oblivious to its historical value, workers needing fill dirt for a railroad bed carted off the last of it in 1869.

THOMAS M. EASTERLY, MISSOURI HISTORY MUSEUM





StoreMags - Free Magazines Download in True PDF format



StoreMags - Free Magazines Download in True PDF format

A ten-story behemoth known as Monks Mound is the centerpiece of the 2,200-acre Cahokia Mounds State Historic Site. Eighty surviving mounds dot this cultural World Heritage site; some were used as building platforms, some for burials.

IRA BLOCK

At its peak in the mid-12th century, Cahokia was by far the largest native community in North America. Smaller settlements shared similar features, including platform mounds, large plazas, and protective stockades.

ART: GREG HARLIN. SOURCES: BILL ISEMINGER AND MARK ESAREY, CAHOKIA MOUNDS STATE HISTORIC SITE; JOHN KELLY, WASHINGTON UNIVERSITY IN ST. LOUIS



Woodhenge

Borrow pit Area where earth was extracted to build the mounds

Mound 72

DISTANCE FROM MONKS MOUND TO MOUND 72 IS ABOUT A HALF MILE (0.8 KILOMETERS)



Cahokia
Creek

North
Plaza

Canteen
Creek

Monks
Mound

Grand Plaza

StoreMags - Free Magazines Download in True PDF format

Stockade



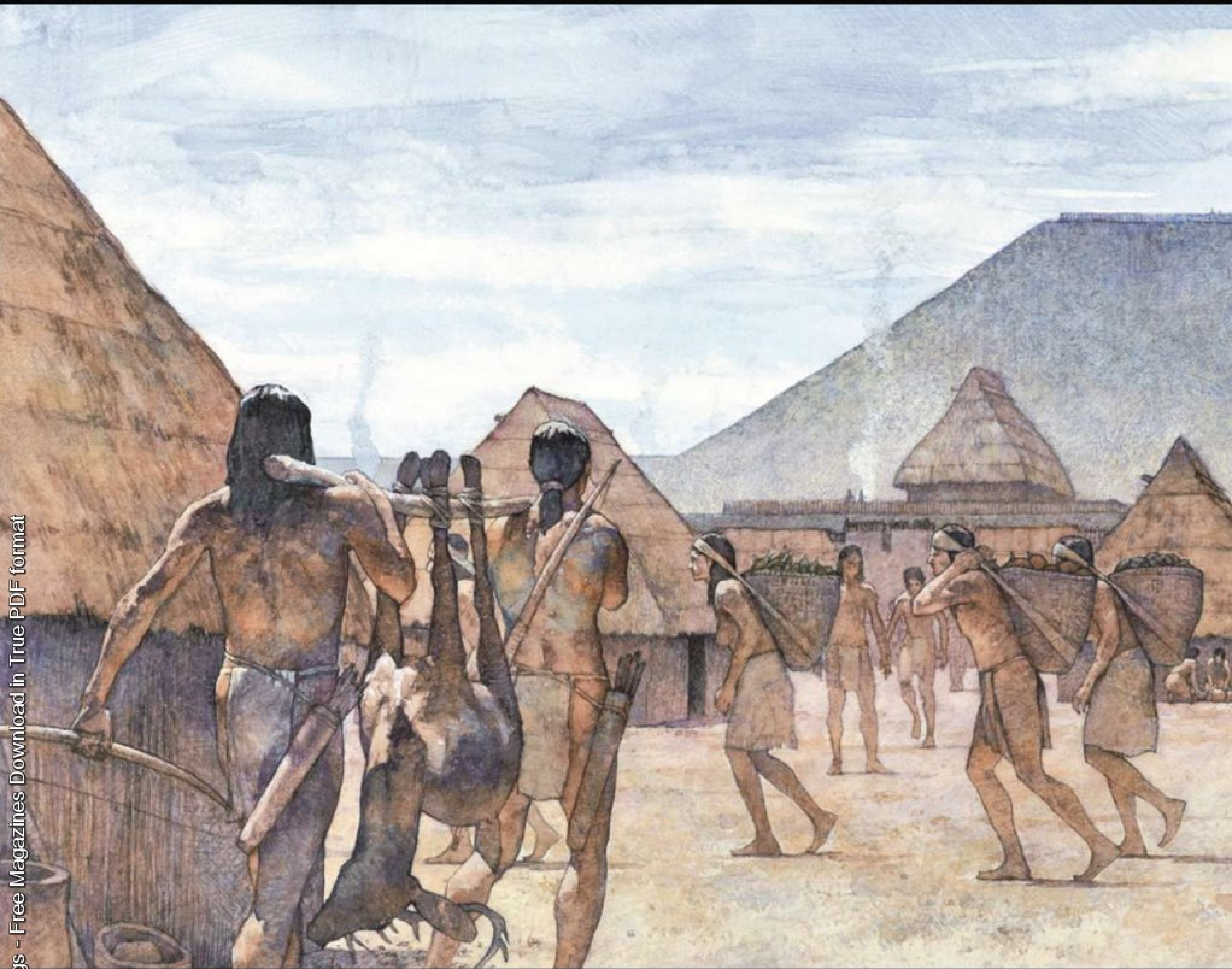
Placid in the morning mist, the plazas surrounding Monks Mound teemed with thousands during construction, which required 15 million baskets of soil. A large temple or palace was built on top, perhaps serving as center stage for religious ceremonies.

DON BURMEISTER



The Life and Death of a City

With abundant wildlife and fertile soil for corn and other crops, Cahokia's location was key to its success. A stable food supply allowed Cahokians to devote time and energy to ambitious building projects, specialized crafts, and ceremonies. So why did they abandon their city? One theory: The rain stopped falling.







Archaeologists digging at Cahokia in the 1960s discovered remnants of what they dubbed Woodhenge, a circular arrangement of wooden posts that functioned as a solar calendar. The discovery revealed an astronomical sophistication that put Cahokia on par with other ancient civilizations.

DON BURMEISTER



Chunkey, a sport using disc-shaped stones (right), was popular throughout the Mississippian region. A player (below) rolled his stone along the ground while opponents hurled spears to mark where it would stop.

BELOW: CHUNKEY PLAYER EFFIGY PIPE, ST. LOUIS SCIENCE CENTER. RIGHT: CHUNKEY STONES, COURTESY ILLINOIS STATE MUSEUM. PHOTOS BY IRA BLOCK





Cahokia was a ghost town by the time Columbus landed. Its demise is an even greater mystery than its emergence.

Unearthed by a farmer plowing a field, a plaque depicting a birdman figure is made of copper from the Great Lakes region, evidence that Cahokia and other communities were part of a far-reaching trade network.

REPOUSSE PLAQUE, MILDRED LANE KEMPER ART MUSEUM, WASHINGTON UNIVERSITY IN ST. LOUIS. GIFT OF J. MAX WULFING; PHOTO BY IRA BLOCK







Scenes of life presented in works of art range from the tender—a mother nursing her baby (below)—to the brutal: a warrior (left) holds a club in one hand and an enemy's head in the other.

MOTHER EFFIGY BOTTLE, ST. LOUIS SCIENCE CENTER; PHOTO BY IRA BLOCK.
SHELL GORGET, NATIONAL MUSEUM OF THE AMERICAN INDIAN, PHOTO BY ERNEST AMOROSO



A stockade similar to this reconstruction, but measuring some two miles long, protected Cahokia's core area from attack. The structure was rebuilt several times over a 200-year period, perhaps signalling an increase in warfare brought on by drought-induced food shortages.

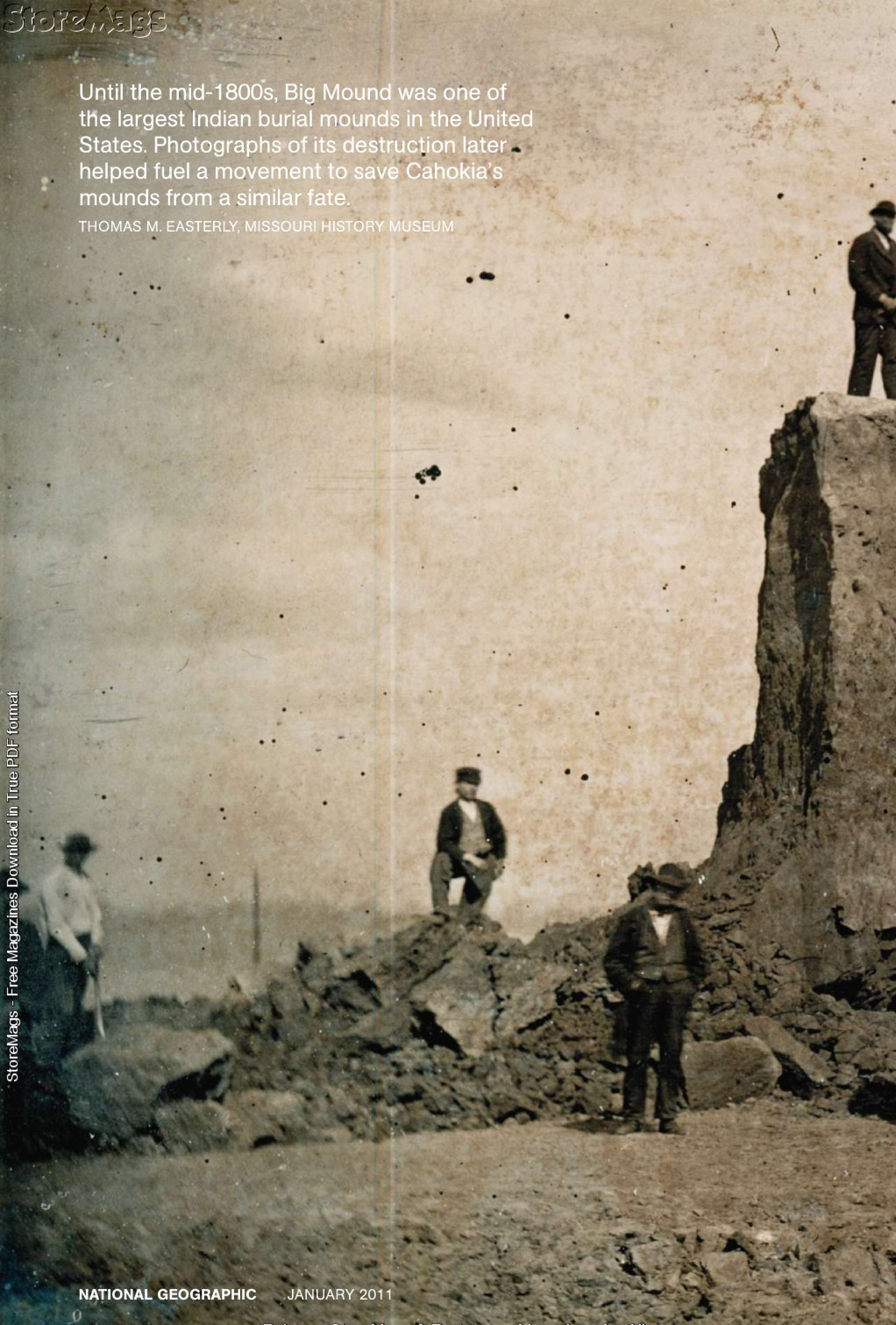
DON BURMEISTER





Until the mid-1800s, Big Mound was one of the largest Indian burial mounds in the United States. Photographs of its destruction later helped fuel a movement to save Cahokia's mounds from a similar fate.

THOMAS M. EASTERLY, MISSOURI HISTORY MUSEUM





A cobblestone marker in north St. Louis is all that's left of Big Mound. Souvenir hunters made off with the mound's burial goods, and whatever they might have revealed about the culture of Cahokia and its sister settlements was lost.

DON BURMEISTER

StoreMags - Free Magazines Download in True PDF format







The last Indian mound in St. Louis finally has a guardian. After a year on the market, Sugar Loaf Mound was bought by the Osage, one of several tribes who claim Cahokians as ancestors. Their plan: Remove the house and restore a memory.

DON BURMEISTER



INSIDE GEOGRAPHIC

ON ASSIGNMENT

Getting the Hang of It Shooting in Vietnam's massive Hang Son Doong posed some problems for photographer Carsten Peter. Climbing up ropes from the cold of the cave floor into the warmer, more humid layers of air above caused condensation to form on his cameras. "The only thing you can do is wait," he says, for the equipment to warm and the moisture to dissipate. But waiting for hours while dangling from a rope is problematic as well. "You lose the circulation in your legs, so you have to do a little moving around and stretching on the rope. This gear is not really made to be comfortable." Learn more about the Hang Son Doong expedition by tuning in to *World's Biggest Cave* on the Nat Geo Channel. Check local listings.





Carsten Peter climbs in Hang Son Doong.

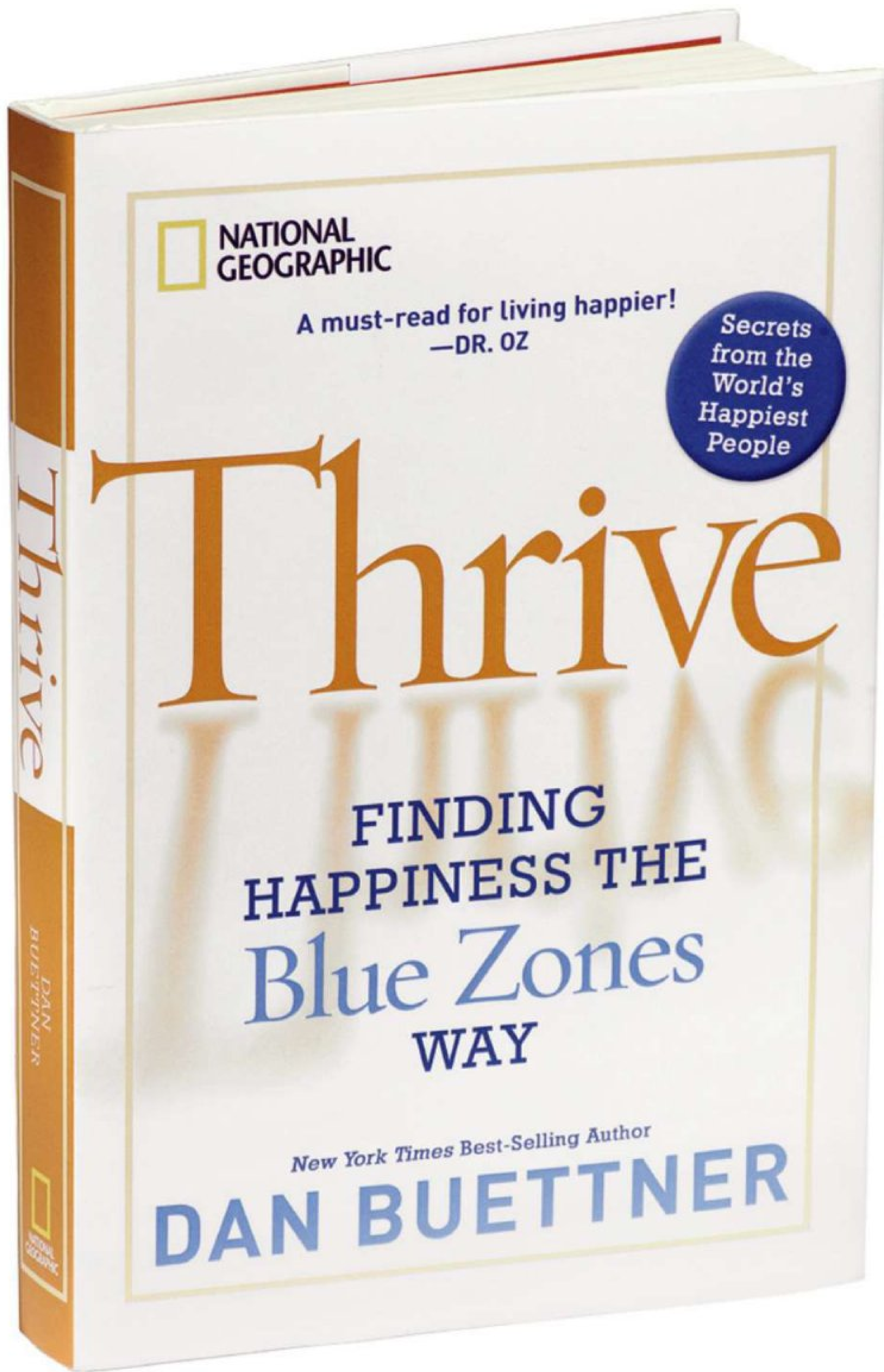
INSIDE GEOGRAPHIC

NG BOOKS

Thrive Best-selling author Dan Buettner knows a thing or two about the world's happiest, healthiest people. He has written about them and their longevity for *National Geographic* and also in his 2008 book, *The Blue Zones*. Now Buettner deepens his exploration into the human emotional condition in *Thrive: Finding Happiness the Blue Zones Way*, which takes a look at demographically derived “happiness hot spots” around the globe. Look for it in bookstores now (\$26).

NAT GEO FILMS

The Way Back—a new film directed by six-time Academy Award nominee Peter Weir—tells the story of a daring escape from a Russian gulag. Based on Slavomir Rawicz's book, *The Long Walk: A True Story of a Trek to Freedom*, the film stars Ed Harris, Colin Farrell, Jim Sturgess, and Saoirse Ronan. The movie opens in U.S. theaters on January 21.



NATIONAL GEOGRAPHIC

A must-read for living happier!
—DR. OZ

Secrets from the World's Happiest People

Thrive

FINDING
HAPPINESS THE
Blue Zones
WAY

New York Times Best-Selling Author

DAN BUETTNER

Thrive

DAN BUETTNER

NATIONAL GEOGRAPHIC

FLASHBACK

The Big Dip Every 12 years or so—according to the local astrological calendar—hundreds of thousands of people flock to the town of Kumbakonam, in India’s Tamil Nadu state, to wash away their sins. They seek a soaking in the Mahamaham tank, a 6.2-acre step-sided pool said to contain waters from many of India’s most sacred rivers. “Bathing is intimately connected with the religious life of the Hindu,” noted the caption to this photo in the December 1913 *National Geographic*. “The picture shows the great tank filled with pilgrims waiting for the auspicious moment to bathe.” The next Mahamaham festival is scheduled for 2016. —Margaret G. Zackowitz





StoreMaggs - Free Magazines Download in True PDF format

NEXT MONTH

The City of Light spreads out over a vast and surprising underground.

PHOTO: STEPHEN ALVAREZ

February 2011

Under Paris

You'll find bones, stones, and legal—as well as illegal—tourism.

Evolution of Feathers

Their origin may have had nothing to do with flight.

Opium Wars

A key step toward Afghan peace is to wipe out poppies.

From Relics to Reefs

Fish can't resist a subway car, tank, or ship.

China's Snub-Nosed Monkey

Its odd face may be one reason it weathers the cold.