

NGM.COM MARCH 2011

# NATIONAL GEOGRAPHIC

## Designing the Perfect Pet

*Can a fox become man's best friend?*

A New Geologic Epoch:  
The Age of Man 60

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Pollinators: Birds, Bees...Lemurs? 114

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POSTER: *Who Is Earth's Most Typical Human?*





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# NATIONAL GEOGRAPHIC

VOL. 219 • NO. 3

## March 2011

**Cover Story**

### Taming the Wild

A dog isn't the only animal that can be man's best friend. All it takes is the right genes.

OFFICIAL JOURNAL OF THE  
NATIONAL GEOGRAPHIC SOCIETY



## Enter the Age of Man

We remove mountains, raise supercities, transform our planet.

## Ancient Swimmers

Fish that date to dinosaur days get rare human visitors.



## Kung Fu Kingdom

The changing world of martial arts.  
[VIDEO](#)



MORE



## Gold Dusters

Pollinators deserve a closer look.

VIDEO



## Alaska Trek

What makes a world-class hiker cry?  
Ask Andrew Skurka.



## March 2011 | Departments



### **Editor's Note**

### **Nat Geo Channel**

### **Letters**

### **Your Shot**

SLIDE SHOW

### **Visions of Earth**

---

### **Explorers Journal**

### **Inside Geographic**

### **Flashback**

### **Next Month**

### **On the Cover**

Wild foxes in Ontario's Algonquin Provincial Park are so used to people that they beg for food—and sometimes pose for a portrait.

*Photo by Greg Schneider*

### **POPULATION**

### **How Big Is Seven Billion?**

Figuring it out in other terms, from footsteps to text messages.

VIDEO

### **TECHNOLOGY**

### **Solar Magellan**

A European crew aims to sail around the world in a sun-powered ship.

### **HISTORY**

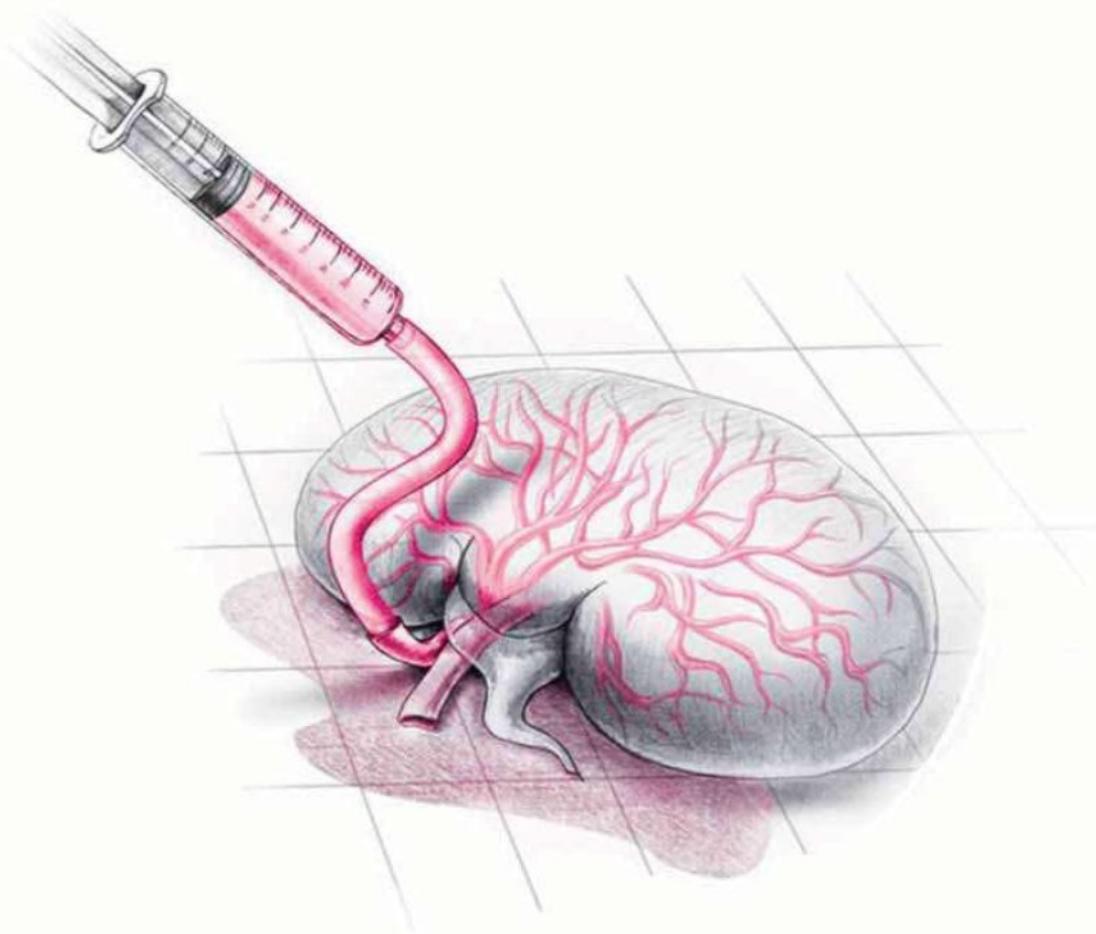
### **Peace Corps Rising**

On the service group's golden anniversary, enlistment is up.

### **SPACE**

### **Lunar Probe**

Bouncing laser beams have mapped the moon's pocked surface.



## **CONSERVATION** **In the Pink**

Bolivians save 20 trapped pink river dolphins.

## **CONSERVATION** **Elephants at Risk**

Trains are colliding with protected pachyderms in India.

## **THE BIG IDEA**

### **Grow Your Own Organs** -----

One day, people may send cells to a lab to order new body parts.

## **eEXTRAS**

### **Seven Billion Interactive Special Report: Egypt**

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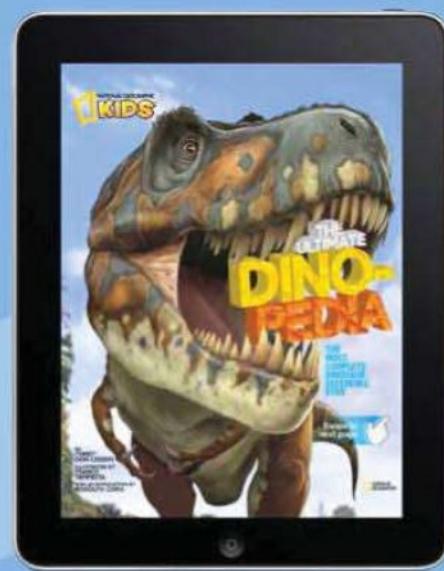


# On your next trip, don't forget to pack the dinosaurs.

## Introducing Ultimate Dinopedia for iPad

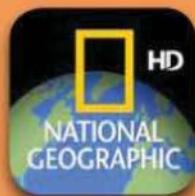
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Featuring more than 700 dinosaurs and loads of illustrations, size comparisons, pronunciations, 3-D video and cool interactive features, it's no surprise this app is a favorite of K-12 science teachers nationwide. It's sure to become a favorite of yours, as well!



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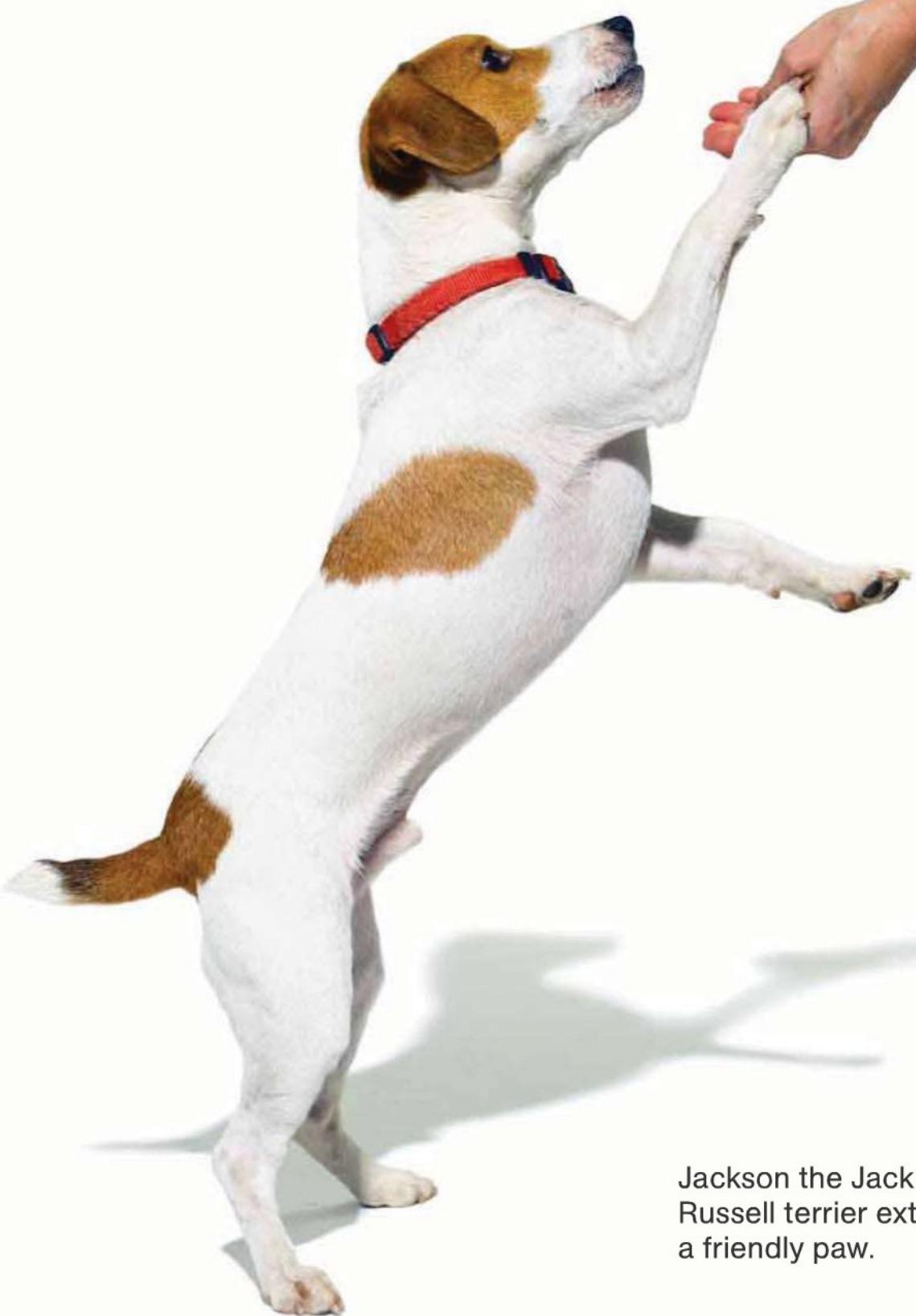
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## EDITOR'S NOTE

**In Jackson's mind** there is no such thing as a good person or a bad person. There are only people he desperately wants to meet. Jackson, I should explain, is my Jack Russell terrier. When he meets someone, his short tail wags at warp speed, sending a vibration through his piebald body right up to his floppy ears. He is exuberant, playful, affectionate—everything a dog lover could wish for. He fits the description of an animal domesticated through years of selective breeding.

In this month's issue we explore animal domestication, which began more than 15,000 years ago with dogs. As humans bred wolves to be our hunting companions and friends, changes in appearance occurred along with changes in behavior. Traits that might otherwise have been weeded out in the wild survived because they were, well, cute. Jackson, with his piebald coloring and floppy ears, is a classic example. But I think there is more to it than that. When my family went shopping for a dog, Jackson confidently trotted over and made it clear he liked us. We immediately responded by picking him up and hugging him. I have to wonder if there is something in human genes that makes our response to a puppy so immediate and positive. Are we genetically predisposed to connect with dogs? Can a case be made that dog lovers had a better chance of survival with the help of man's best friend—in a violent and uncertain world—to put food on the table and guard against threats? It makes sense to me, but cat lovers may not buy my theory.

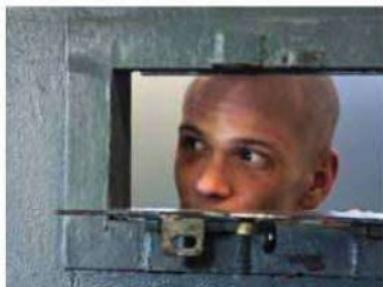
A handwritten signature in black ink, appearing to read "Chris Jones". The signature is fluid and cursive, with a large, stylized initial 'C' and 'J'.



Jackson the Jack  
Russell terrier extends  
a friendly paw.

PHOTO: REBECCA HALE, NGM STAFF

NAT GEO CHANNEL



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**Hard Time**  
**Tuesdays at 10 p.m.**  
Get to know the inmates  
of an Ohio state prison.



**Wild  
Mon  
Inves  
shoc**

For a full schedule of listings go to [natgeotv.com](http://natgeotv.com).



THIS MONTH

## Beast Hunter

Once upon a time, mountain gorillas and giant pandas were considered mythological creatures. Do other seemingly folkloric animals actually live and breathe in the wild? Biologist and explorer Pat Spain aims to find out. Follow his quest to separate fiction from fact in *Beast Hunter*, as he uses the latest technology to track down species thought to exist only in our imaginations. He's a trained scientist, but Spain's most powerful assets on this journey might just be his enthusiasm and inquisitive mind. Don't miss *Beast Hunter*, premiering March 4 at 9 p.m. and then every Friday at 9 p.m. on the National Geographic Channel.

In Cameroon (left) a Pygmy shaman applies ceremonial dye to "beast hunter" Pat Spain before a hunt.

NAT GEO  
**WILD**

Case Files  
days at 9 p.m.

Investigate Earth's most  
amazing natural events.

PHOTOS: ANDREW BAKER (BOTTOM LEFT); INSTITUTE  
FOR MARINE MAMMAL STUDIES (BOTTOM RIGHT)

# VISIONS OF EARTH

**United Kingdom** On the  
Piles of powder and extr



banks of Loch Tulla in the Scottish Highlands, trees emerge during a snowstorm. The cold made last winter one of the region's harshest in decades.

PHOTO: BILLY CURRIE PHOTOGRAPHY/GETTY IMAGES



**Spain** A late afternoon stroll in Barcelona becomes a study in black and white in March. Temperatures in the city, on the Mediterranean coast, usually fall betw



ite during a rare snow shower last  
between 50° and 60°F this time of year.

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## TECHNOLOGY

**Solar Magellan?** A month into their quest to be the first to circle the world in a sun-powered ship, the European crew of the *Tûranor PlanetSolar* drew the curiosity of some locals in the Atlantic Ocean. “We stayed next to four magnificent sperm whales for nearly 20 minutes,” says the ship’s master, Patrick Marchesseau. “They seemed completely at ease with the silent visitor.”

That visitor was a 95-ton catamaran that had embarked in September on a journey expected to last about eight months. The \$17.5-million craft can hit up to 12 knots and aims to show the potential of clean-energy travel. Yet some seafaring traditions die hard: With the first crossing of the Equator, says project leader Gerhard Beinhauer, comes a fitting celebration “with King Neptune, assisted by Helios, the god of the sun.” —Erin Friar McDermott

### THE ROUTE

During its attempt to circumnavigate the world, the *Tûranor PlanetSolar* aims to remain mostly within 30 latitudinal degrees of the Equator to maximize its exposure to the sun.





PHOTO: PLANETSOLAR. NGM MAPS

## HISTORY

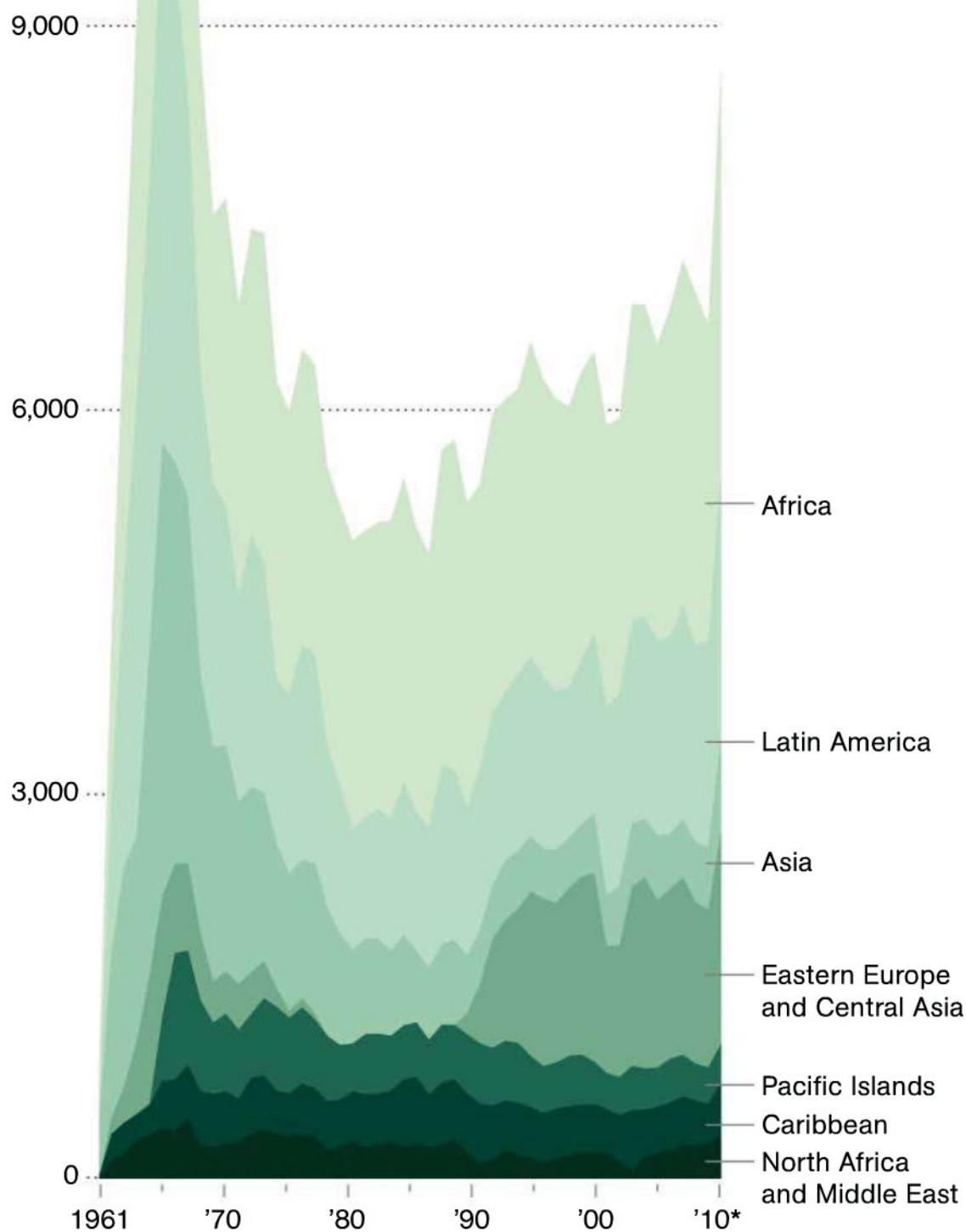
**Peace Corps Rising** Fifty years ago 51 Americans arrived in Ghana to “promote world peace and friendship.” Since then, more than 200,000 volunteers—ages 18 to 86, some now diplomats and politicians—have served in 139 nations.

But the Peace Corps is no fame game or numbers story; it’s a sign of the times. Historian Stanley Meisler says participation dipped as the Nixon Vietnam era “took the shine off doing something for the U.S.” As memories faded, the luster of service returned. Now, on the group’s golden anniversary, Oval Office support and recession woes are lifting enlistment.

Next, says director Aaron S. Williams: Help out in Haiti, continue to empower women, improve food security. Competition for recruits? No problem. “The service pie is growing bigger,” he says, “and we’re going to get a larger slice.” —*Jeremy Berlin*

## Peace Corps volunteers and trainees, by year and region served

Since the Peace Corps's debut in 1961, volunteer numbers have fluctuated. Officials say Congress's shifting funding priorities are a prime reason.



# The New Moon

A lunar portrait—and an early history of our solar system—is emerging from a wealth of fresh topographic data.

Move over, man in the moon. Now there's more to see, thanks to the first detailed lunar-surface map. Since 2009 NASA's Lunar Reconnaissance Orbiter has been bouncing laser beams off the moon to gauge elevation. Last fall the results emerged as a high-resolution map (right), including a point over a mile higher than Mount Everest and a complete catalog of 5,185 craters wider than 12.5 miles. The impact pattern suggests that around 3.8 billion years ago two asteroid storms pelted the moon and the Earth, whose dynamic crust retains fewer celestial fingerprints.

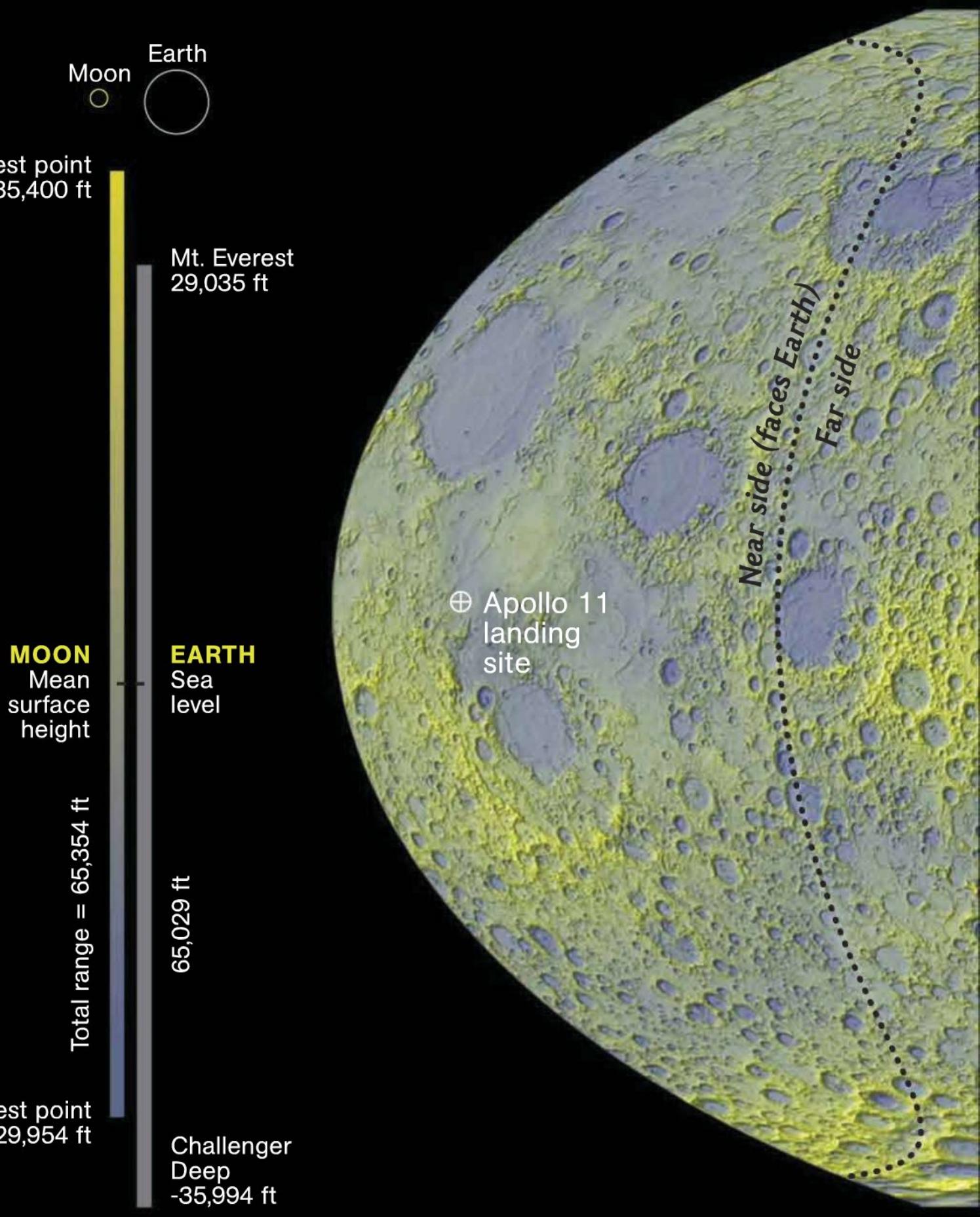
Also newly found: frozen water in craters at the lunar poles—the coldest known spots in our solar system. "This is a renaissance period in moon studies," says NASA's Richard Vondrak. With surveys of Mars and Mercury also under way, more cosmic folklore may soon be jettisoned as well. —*Jeremy Berlin*

Higher

3

Lower

-2



Near side (faces Earth)

Far side

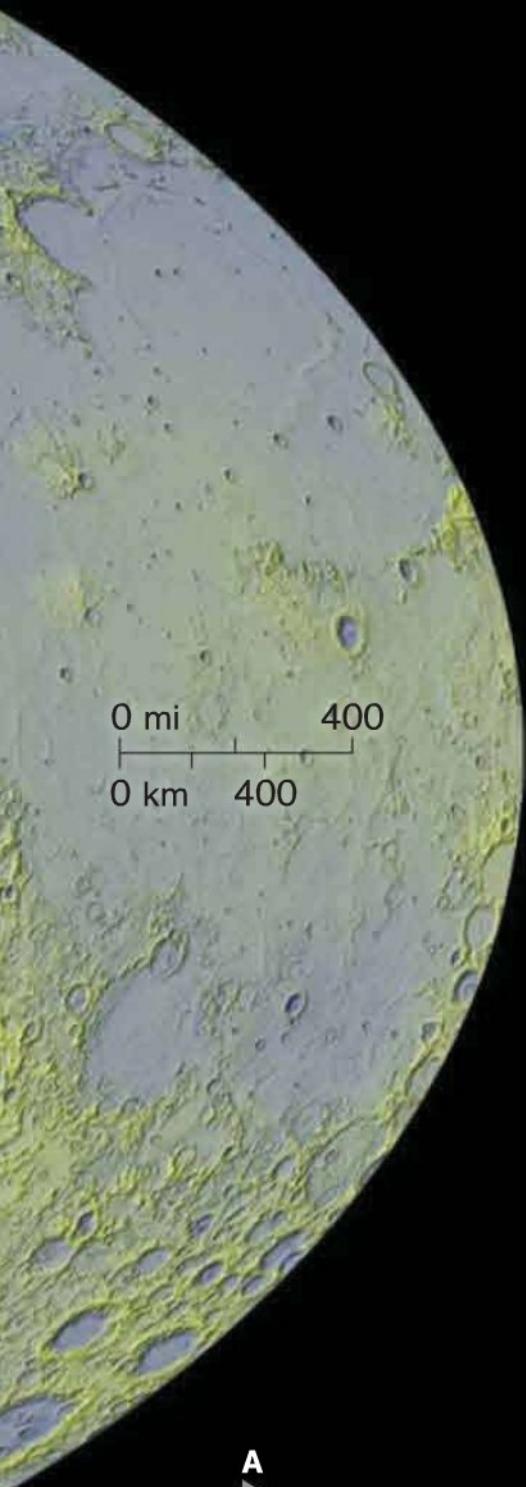
HIGHEST  
+ POINT

A

B

Profile  
below

LOWEST  
+ POINT



## MOON BEAMED

Three billion surface readings by the Lunar Orbiter Laser Altimeter reveal a landscape more rugged than previously thought.



## CONSERVATION

**Dolphin Delivery** The pink river dolphin of Bolivia is the landlocked country's only cetacean—a colorful but unprotected character known locally as the *buefo*. No wonder, then, that scientists and environmentalists scrambled last spring after 20 of these mammals got stuck in a half-mile-long, five-foot-deep part of the drought-stricken Pailas River, a tributary of the Grande River.

By August a rescue was under way. Workers led by Enzo Aliaga-Rossel (right, at far left) and another zoologist spent 12 days hoisting dolphins into boats with fishing nets and covering them with wet cloths. They were then placed in tanks in mattress-padded trucks and transported three hours, by land and water, to a release site on the

Grande. All were saved, says Aliaga-Rossel, adding that greater human awareness is key to a rosy *buefo* future.  
—Catherine Zuckerman





Rescuers pull a dolphin from the  
too shallow Pailas River in Bolivia.

# CONSERVATION





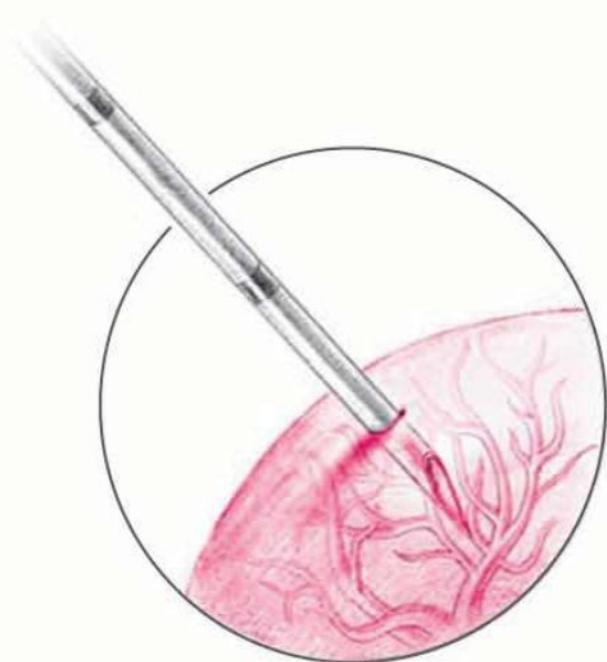
## **Elephants at Risk**

The protected pachyderms of West Bengal, India—such as those in the Mahananda Wildlife Sanctuary (left)—are hardly out of harm's way. In fact, since 2004, 27 have been killed by trains barreling down the hundred miles of track that run where they roam.

Now the Ministry of Railways is under pressure from conservationists and the environmental ministry to enforce speed limits, reduce travel at night (when most casualties occur), and prune vegetation to improve the driver's view. —Catherine Zuckerman

## HOW TO (RE)GROW A KIDNEY

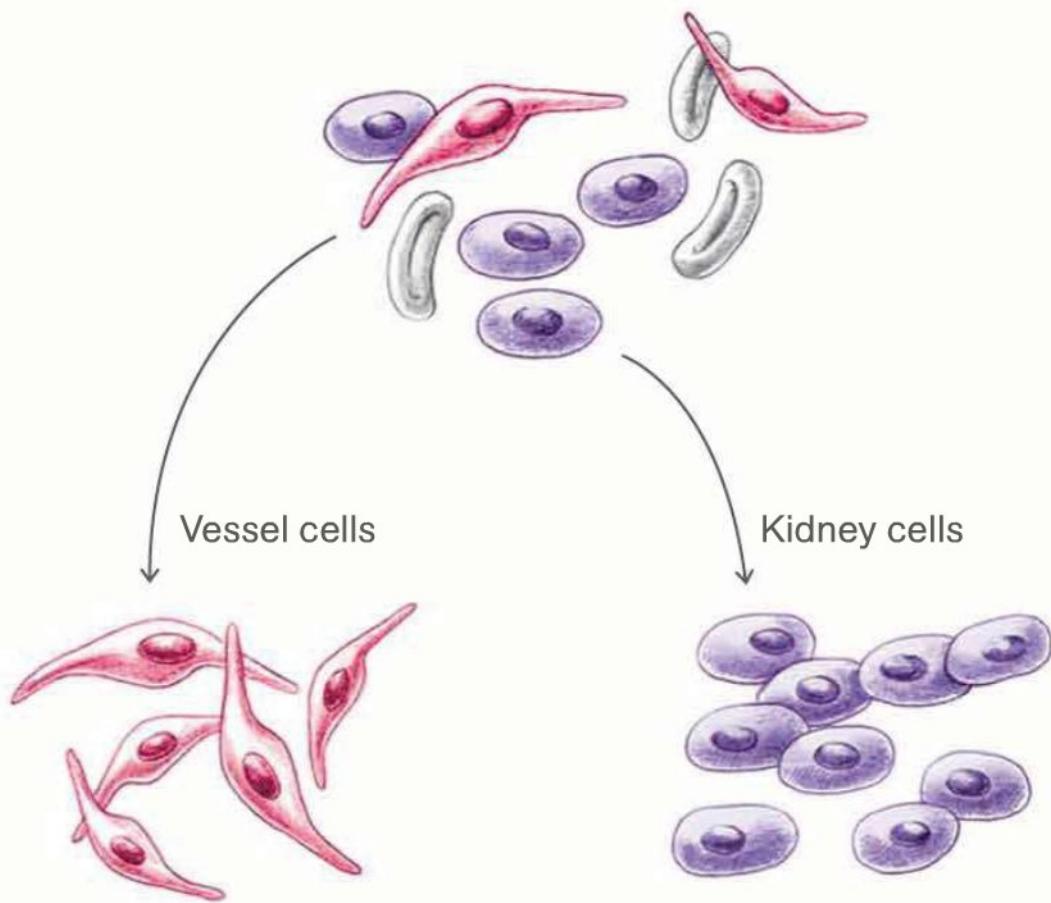
More people are waiting for kidneys than any other organ, but it's one of the hardest to grow. A transplantable "bioartificial" kidney is many years away. Here's the strategy being followed at Wake Forest.



1

**Sample**

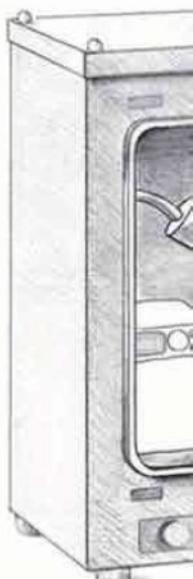
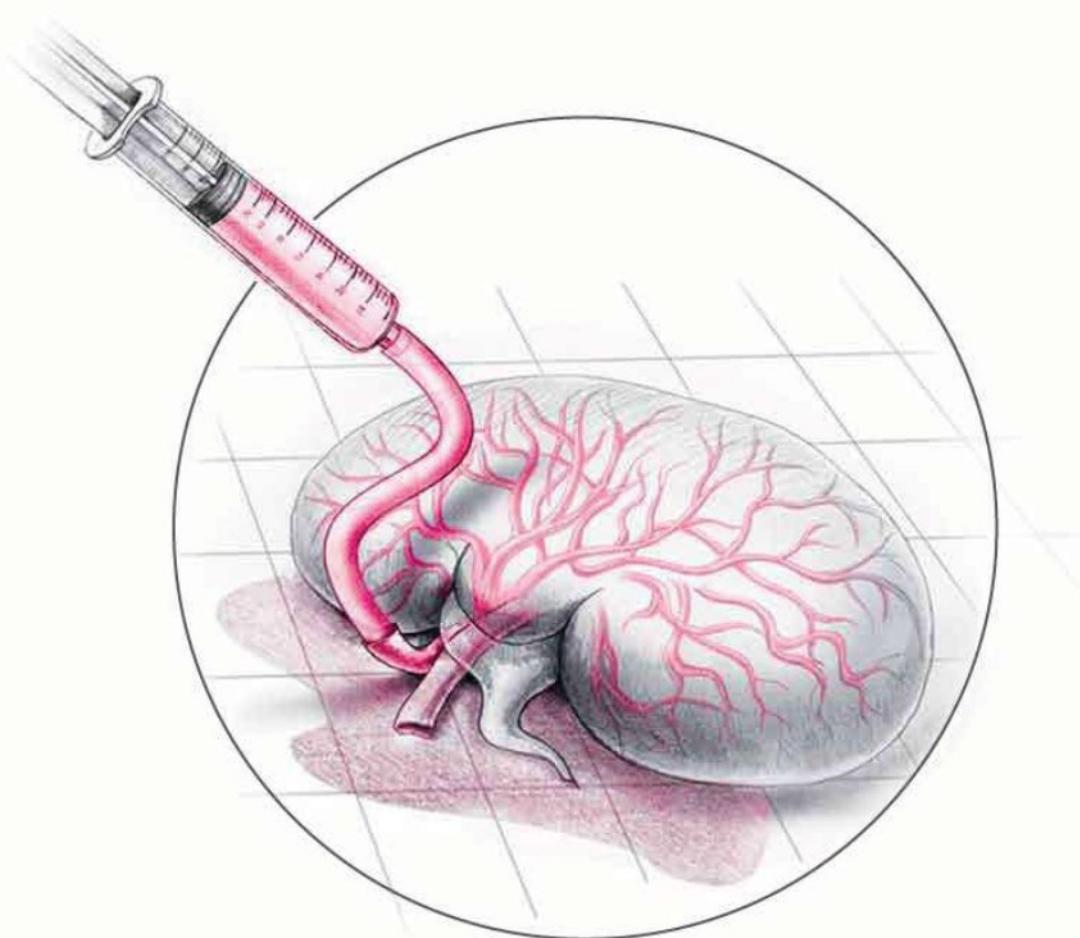
a tiny bit of the patient's kidney.



**2** Sort  
kidney tissue cells  
from those of  
blood vessels  
running through it.

**3** Multiply  
both types  
of cells in  
lab cultures.

## THE BIG IDEA | CONTINUED

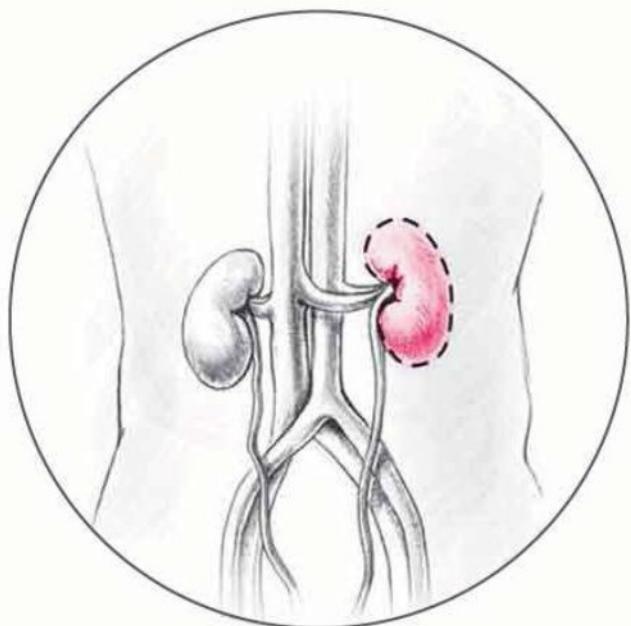
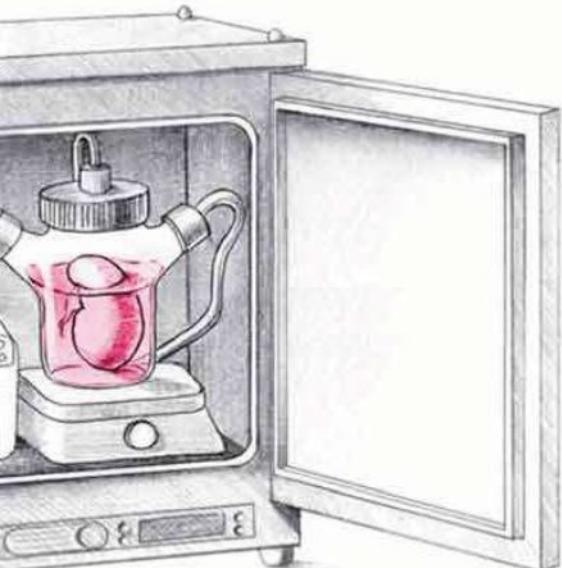


**4**

### Seed

the cultured cells of the patient onto a scaffold, which is made from a pig kidney by washing it with mild detergent until the pig cells are gone and only the tough collagen remains.

**5**



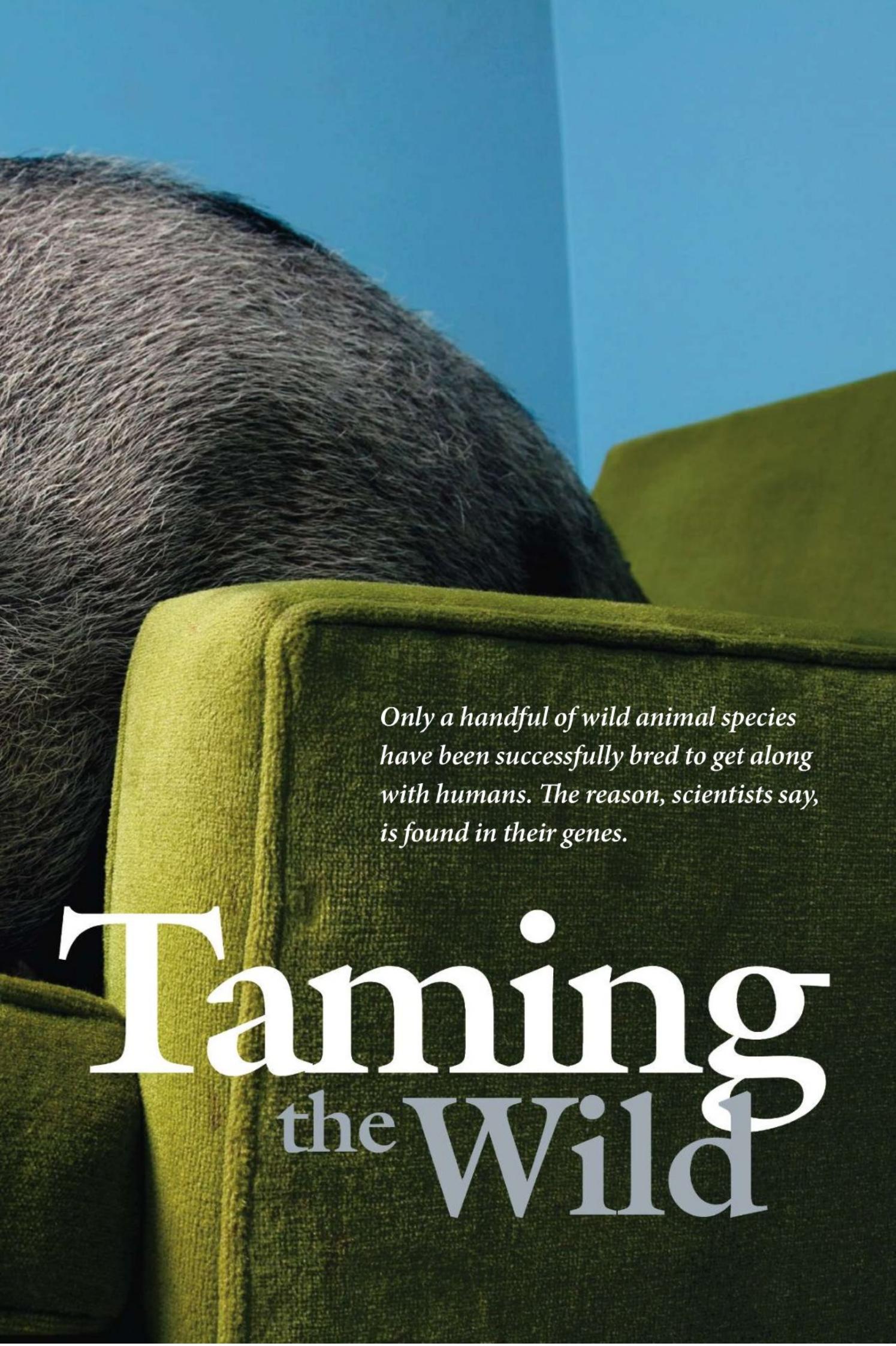
8 weeks later

**Incubate**  
at 98.6°F in a bio-reactor that delivers oxygen and nutrients to the growing tissue.

**6** **Implant**  
into the patient a functioning human organ—his own.



Daisy Mae, a miniature Vietnamese potbellied pig, lounges like a family member in West St. Paul, Minnesota.



*Only a handful of wild animal species have been successfully bred to get along with humans. The reason, scientists say, is found in their genes.*

# Taming the Wild





### DECISION TIME

Dogs, but not chimpanzees, will follow a finger with their eyes to hidden food—testament to their close social bond with humans. In this experiment at Duke University, will Tasmania favor the pointing of a known caretaker (at left) over that of a stranger?





### GONE TO EXTREMES

Two chickens, both eight weeks old but vastly different in weight, show off size-based breeding by geneticist Paul Siegel at Virginia Tech. "We're using artificial selection as a tool to look at natural selection. We just accelerate it."





### IMPROBABLE PETS

Foxes bred through generations to be as human-friendly as dogs get a boost from Lyudmila Trut (center) and other staff at the Institute of Cytology and Genetics, in Novosibirsk, Siberia.



A photograph of a fox standing on a large, ornate sofa with yellow and green damask patterns. The fox is facing away from the camera, looking out through a large window with a wooden frame. The window looks out onto a forested area with bare trees. The fox has a thick, light brown coat with a white patch on its back. The sofa has several pillows, one of which is red and patterned.

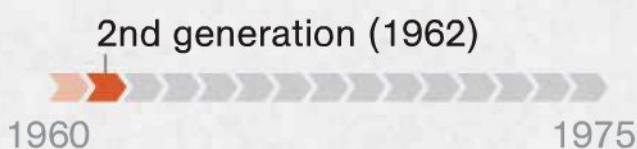
## A DOG'S LIFE

Alisa, one of two Novosibirsk foxes living as pets in a wealthy home outside St. Petersburg, is friendly with her human companions and with the family's yellow Labrador too.

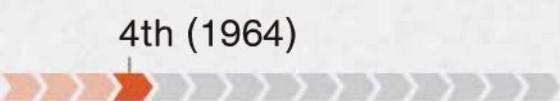
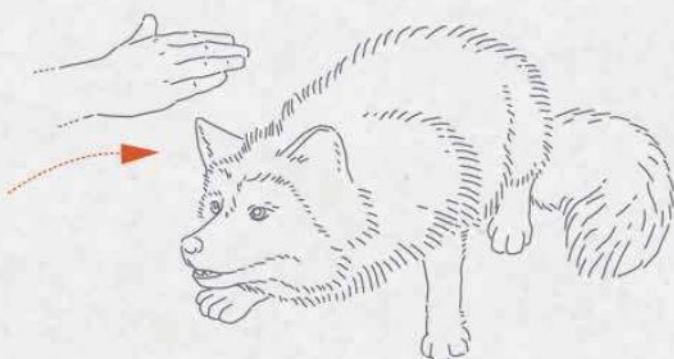
# Making Friends

Beginning in 1959, researchers in Siberia selectively bred foxes to encourage friendliness toward humans. Over generations, other behavioral traits that distinguish dogs from wild canids emerged, followed by changes in morphology (next screen).

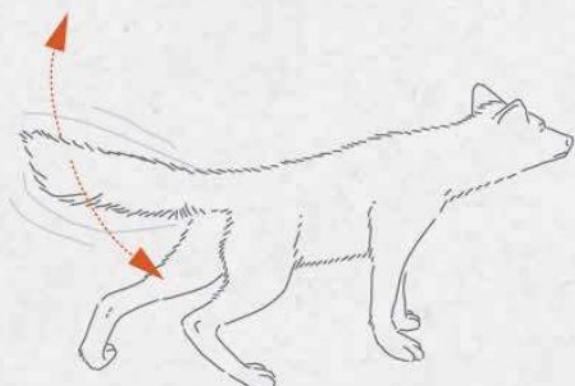
## BEHAVIORAL CHANGES



**Approachability**  
Aggressive response to  
humans starts to disappear.



**Tail wagging**  
Some kits (pups) wag tails and  
approach humans voluntarily.



MORE >

6th (1966)



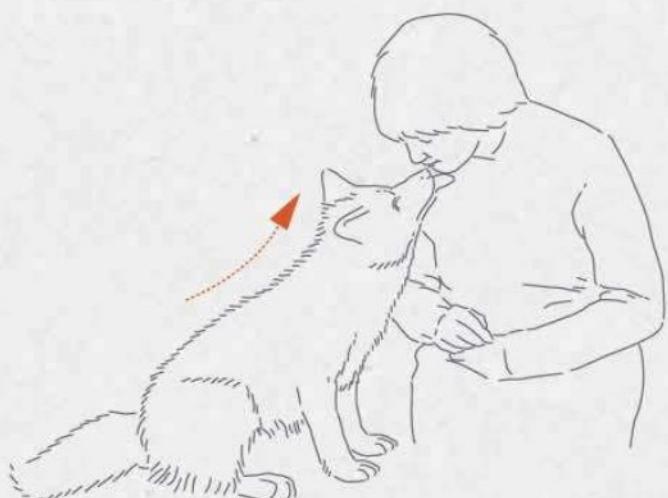
### Petting

Kits whimper, allow themselves to be petted and carried.



### Full affinity

When let out of cage, friendliest kits follow humans and lick them.



## MORPHOLOGICAL CHANGES

9th (1969)



### Floppy ears

Instead of pricking up soon after birth, ears stay floppy up to three months.

### Coat-color variation

First kits born with piebald (spotted) fur and star pattern on forehead.



FERNANDO G. BAPTISTA AND  
MARGUERITE B. HUNSIKER, NGM STAFF  
SOURCE: LYUDMILA N. TRUT, INSTITUTE  
OF CYTOLOGY AND GENETICS OF THE  
SIBERIAN BRANCH OF THE RUSSIAN  
ACADEMY OF SCIENCES

13th (1973)



15th (1975)



### Curly Tail

Untamed foxes' tails point down; tamed ones' curl up upon seeing humans.

### Shorter tail

Rarely, vertebrae are shorter, thicker, and fewer in number.





**SHORT HOP** Two wolves and a wolf-dog hybrid (foreground), traveling ambassadors for a sanctuary for captive-born wolves, illustrate the genetic stepping-off point for all dog breeds.



## **BRED TO BE BAD**

This brown rat's angry display at the photographer reflects 73 generations of breeding for hostility to humans. Scientists at Novosibirsk and in Germany are comparing the aggressive rat genome to that of rats selected for friendliness, attempting to untangle connections between DNA and behavior.









### MOTHER OF ALL HENS

Wild red jungle fowl, progenitors of the modern chicken, crowd a pen near Statesboro, Georgia. Remnants of a population collected in north-central India in the early 1960s, these birds may be the last of their kind—genetically speaking. As humans push farther into the wild bird's South Asian habitat, the chickens they bring with them interbreed with jungle fowl, polluting their genomes.



# Out of the Wild

Only a few animal species have proved capable of being domesticated. Valued for food, skins, transport, companionship, or sentry, most were domesticated in Asia, where humans first began cultivating crops as well.

- █ Asia
- █ Africa
- █ North America
- █ South America



15,000 YEARS AGO



Sheep



Goat



Cow



Pig

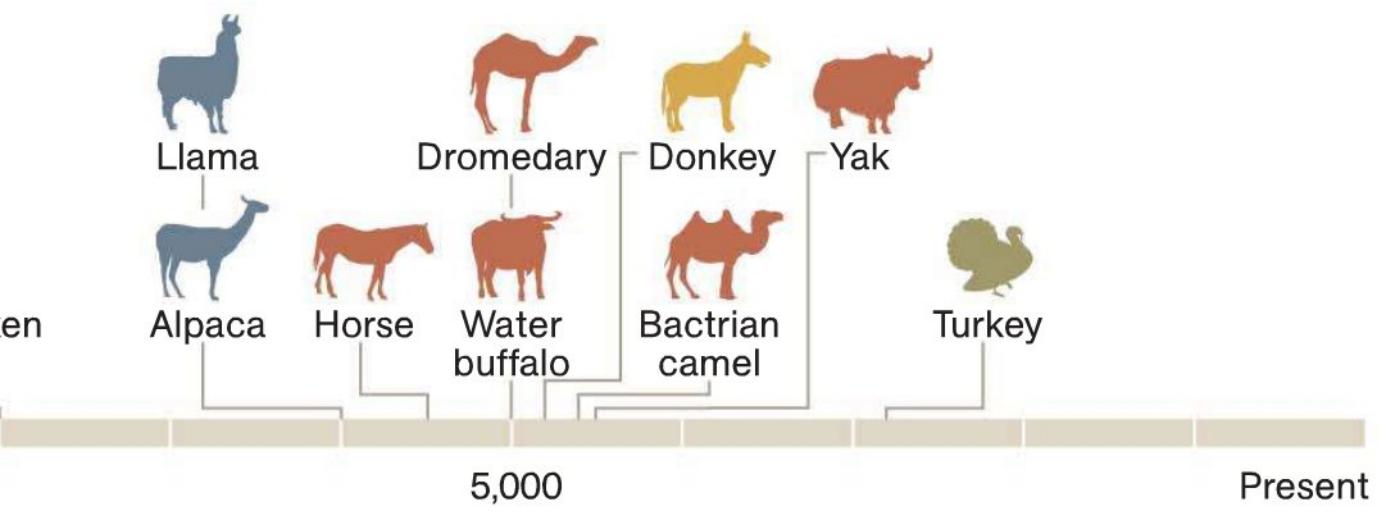


Cat



Chick

10,000



## **ANCIENT BOND**

A woman milks a mare in the village of Kogershin in southern Kazakhstan. Recent archaeological studies have shown that the Botai people of the Eurasian steppes were the first to actively domesticate horses, 5,500 years ago.











COLUMBIA



NATURAL COLORED



KATAHDIN HAIR

### **WORTHY BREEDS**

A sampling of sheep at the Indiana State Fair reflects the diversity wrought by thousands of years of breeding. In the United Kingdom farmers bring their sheep to the Scottish Agricultural College in Edinburgh, where a CT scanner (right) analyzes the “carcass quality” of live animals, so the best can be selected for breeding.



NORTH COUNTRY CHEVIOT



KATAHDIN HAIR

SOMAT  
E



## **NO HIDING THE HIDE**

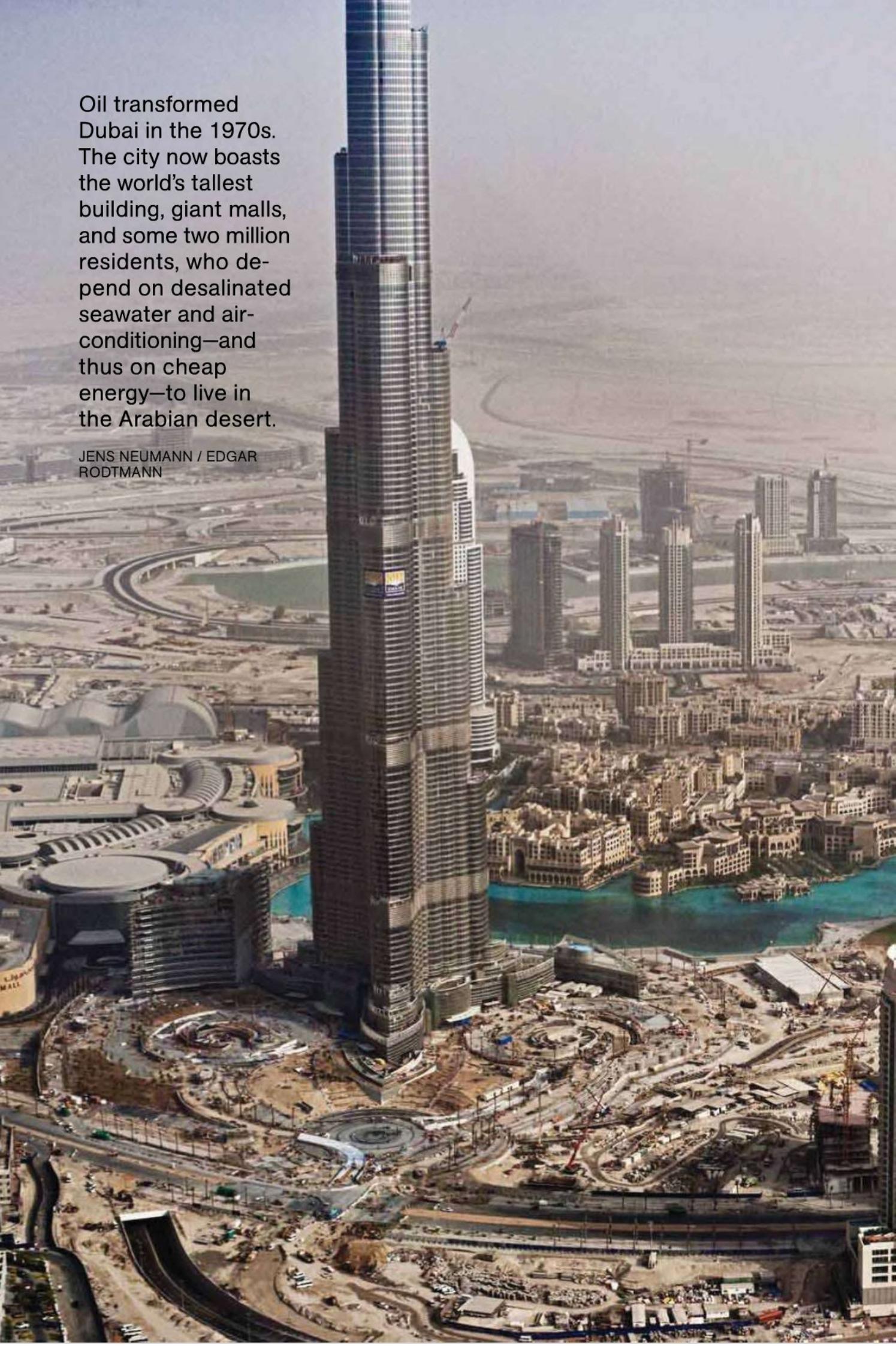
Piebald coats like the one on this Holstein cow are a signature trait of domesticated animals. An easy target for predators in the wild, piebald fur may have been selected for by humans to differentiate among livestock.





**Oil transformed Dubai in the 1970s. The city now boasts the world's tallest building, giant malls, and some two million residents, who depend on desalinated seawater and air-conditioning—and thus on cheap energy—to live in the Arabian desert.**

JENS NEUMANN / EDGAR RODTMANN



ENTER THE  
ANTHROPOCENE

# AGE OF MAN

It's a new name for a new geologic epoch—one defined by our own massive impact on the planet. That mark will endure in the geologic record long after our cities have crumbled.





## CHANGING SEAS

Rosignano Solvay, Italy

Photograph by MASSIMO VITALI



A Tuscan beach captures the textured drama of humans and the sea. The “tropical” sands aren’t natural; they’re whitened by carbonates from the chemical plant, which also discharged mercury until recently. The plant converts salt extracted from the sea into chlorine and other essential products. Fossil fuels power such transformations; worldwide, the CO<sub>2</sub> from smokestacks and tailpipes is slowly acidifying the ocean, threatening marine life.



**THE OIL CENTURY**

South Belridge, California  
**EDWARD BURTYNSKY**



Discovered in 1911, this field pumped on as cities were rebuilt for cars and as ancient petroleum molecules were spun into household products such as plastics, cosmetics, and pharmaceuticals. South Belridge today produces 32 million barrels a year—enough for nine hours of world demand. In this century the world's supply may plummet.



## MOVING MOUNTAINS

Kayford Mountain, West Virginia  
**J HENRY FAIR**



As oil companies drill deeper for offshore oil, mining companies work 24/7 to level Appalachian peaks for coal, which supplies half of U.S. electricity. This summit vanished in a day. Some 470 have been erased since the 1980s; the waste often buries streams. Mountaintop removal recovers just 6 percent of a coal deposit.





## **THE SIXTH MASS EXTINCTION**

Museum of History,  
Aralsk, Kazakhstan  
**CAROLYN DRAKE**

The ship sturgeon is near extinction, and it's already gone from the Aral Sea; water diversion for cotton farming reduced what was once the world's fourth largest lake to a dust bowl. In the past half billion years asteroid impacts and other natural events have caused five catastrophic mass extinctions of plants and animals. Humans may be causing a sixth.

# Why Is Our Impact Growing?

Is population growth the root cause? Or is it affluence, which leads to greater consumption of energy and other resources? Or technology, which offers new tools for exploiting and consuming? The IPAT formula is a way of thinking about the issue: It says the three factors compound. Since 1900 world GDP (a measure of A) and the number of patent applications (a measure of T) have grown even faster than population.

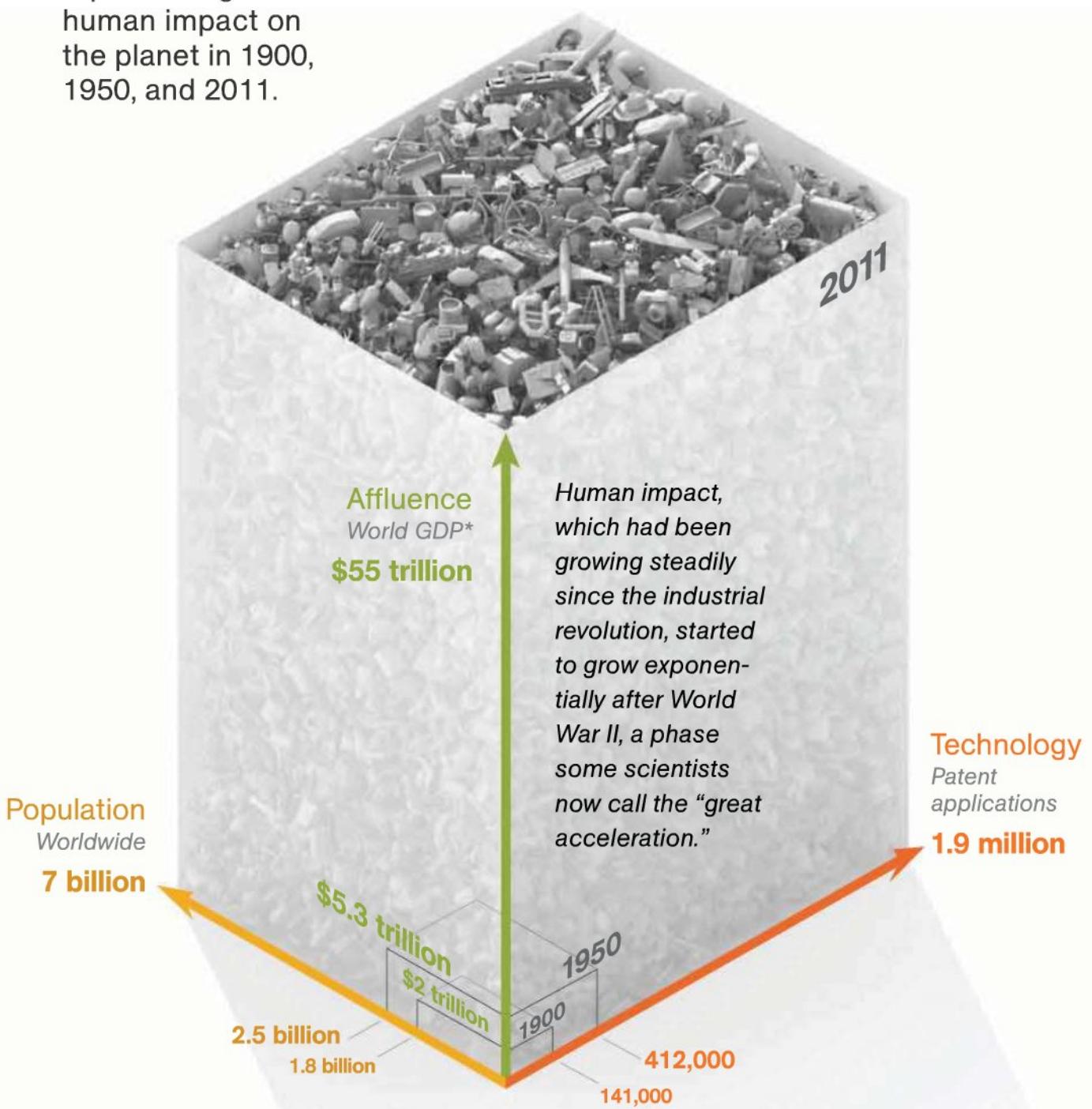
$$I = P \times A \times T$$

Human Impact      Population      Affluence      Technology

\*GDP FIGURES ARE CONSTANT 1990 INTERNATIONAL DOLLARS.

JOHN TOMANIO, NGM STAFF. ART: BRYAN CHRISTIE. SOURCES: UNITED NATIONS; ANGUS MADDISON, "STATISTICS ON WORLD POPULATION, GDP AND PER CAPITA GDP, 1-2008 AD," UNIVERSITY OF GRONINGEN; WORLD BANK; WORLD INTELLECTUAL PROPERTY ORGANIZATION

$P \times A \times T =$  width  
times height times  
length of three boxes  
representing the  
human impact on  
the planet in 1900,  
1950, and 2011.







## INDUSTRIAL FARMING

Almería Province,  
Spain

**EDWARD BURTYNSKY**

On the arid plains of southern Spain, produce is grown under the world's largest array of greenhouses and trucked north. Greenhouses use water and nutrients efficiently and produce all year—tomatoes in winter, for instance. But globally the challenge is grain and meat, not tomatoes. It takes 38 percent of Earth's ice-free surface to feed seven billion people today, and two billion more are expected by 2050.





## FOOD CHEMISTRY

El Ejido, Spain  
**REINALDO LOUREIRO**

Fertilizers and pesticides make possible the high yields and flawless produce celebrated by this Spanish billboard. The side effects are far-reaching—nitrogen runoff from fertilized land, for example, causes dead zones at the mouths of rivers worldwide.





## A DAMMED WORLD

Hoover Dam and  
Lake Mead, Nevada  
**MITCH EPSTEIN**

Dams tame floods, water crops (and people), and generate 16 percent of the world's electricity, carbon free. They have also displaced 40 to 80 million people and destroyed river ecosystems. More than half the world's large rivers are now dammed. Some, like the Colorado, are tapped out. Persistent drought has left a "bathtub ring" in Lake Mead, which supplies water to much of the Southwest.





Kudzu, a fast-growing Asian vine, has smothered millions of acres in the United States since it was planted in the 1930s to control erosion. Exotics spread by humans are a global threat to biodiversity. Most of the species on the U.S. threatened and endangered lists are there in part because of foreign invaders.





## A TIDE OF WASTE

Chittagong,  
Bangladesh

**EDWARD BURTYNSKY**

Ship breaking delivers jobs to Bangladesh and a wealth of scrap metal—but also asbestos, PCBs, and other toxics. Though waste recycling generally is booming, so is waste production. In American cities in recent decades, the two trends have just about offset each other.





## URBAN SUPERSPRAWL

Mexico City, Mexico  
**PABLO LÓPEZ LUZ**

Some 20 million people live in Mexico City, the world's fifth largest metropolitan area. In 1800 the urban fraction of the global population was 3 percent. Today it is 50 percent and rising. In crowded shantytowns, the need for clean water and sanitation is urgent. But urbanization has an upside: Per capita, cities use less energy and pollute less than rural areas.

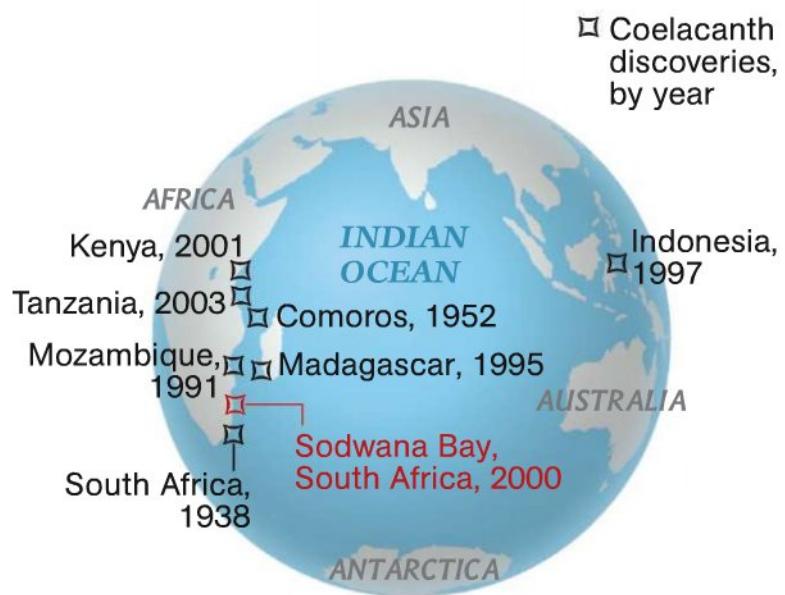
During 95 hours of diving, the photographer and his team spent a total of 81 minutes swimming alongside four coelacanths. The fish are easily distinguished by distinctive white markings.



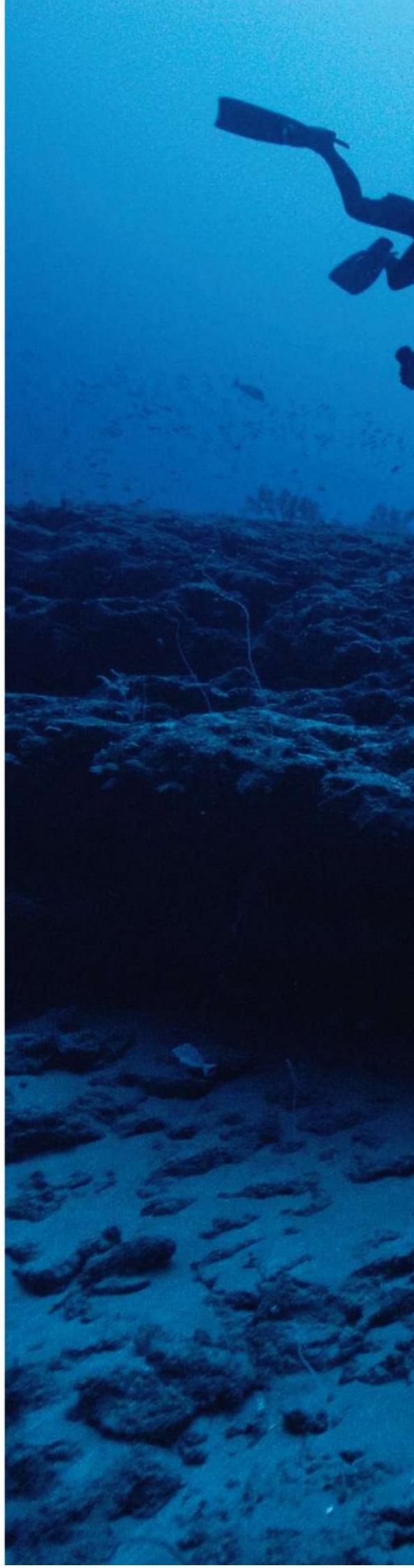


The coelacanth was thought to have gone extinct with the dinosaurs. Rediscovered in 1938, it is chronicled here in a rare photographic account.

# Ancient Swimmers



The elusive fish has been found along the eastern coast of Africa as well as Indonesia. The largest-known group—300 or so—lives near the island nation of Comoros. The expedition team (right) made 21 dives to depths of 300 to 400 feet in South Africa's Sodwana Bay area. Over the course of four weeks, they spotted coelacanths only six times. The nocturnal animals hide in underwater caves by day, then venture out at night, feeding on small fish, squid, and octopus.









A crystal layer behind the coelacanth's retina reflects light like a mirror, a boon in the ocean's dim waters. Its sail-like first dorsal fin provides stability while swimming. An extra tail lobe, unique to coelacanths, can be seen today and in fossils from millions of years ago.

PHOTOGRAPHS BY LAURENT BALLES



French biologist and prize-winning photographer Laurent Balles co-authored the documentary *The Science of Shark Sex*.

## It's not every day a coelacanth shows up in a fish tank.

But that's what happened in 1938, when Marjorie Courtenay-Latimer spotted a coelacanth with extra fins, and an extra lobe on its dorsal fin. Though she didn't know it straight away, she had just discovered the coelacanth, which was assumed to have gone extinct during the Cretaceous period but somehow outlasted the dinosaurs, living deep in the ocean, undisturbed.

Since this chance sighting, *L. maculatus* have been found in pockets in the Indian Ocean. Numbers are unknown, with estimates ranging from as few as 1,000 or as many as 10,000 individuals. They have mainly been photographed by divers using cameras attached to their vehicles. Divers first documented the species in 1938, when a specially trained team dived off the coast of Port Elizabeth, South Africa. —Caroline S. Williams

COELACANTHS

# ay that a living fossil fisherman's net.

In 1938, when a South African museum curator named Percy F. Nettleton copied a bizarre creature with thick scales, unusual nostrils, and a long tail, amid an otherwise ordinary haul of fish. Right away, Courtenay-Latimer had rediscovered a species that was assumed to have died out at the end of the Cretaceous period. It had outlasted many of its prehistoric peers, dwelling in deep, dark water—and undetected—for eons.

*Coelacanthus* (*Latimeria chalumnae*) have been found in several locations around Africa. No one knows how many there are—maybe as few as 1,000. Because of the depth of their habitat, they have been seen only by submersibles and remotely operated vehicles. Researchers first saw the fish in 2000; in January and February 2010, they descended 2,000 feet deep to take pictures of a small colony in Sodwana Bay, South Africa. *—Dolyn Butler*

## Fossil Fish

Named by a 19th-century naturalist, “coelacanth” comes from the Greek for “hollow spine”—a reference to the hollow spines that are part of its fin structure.

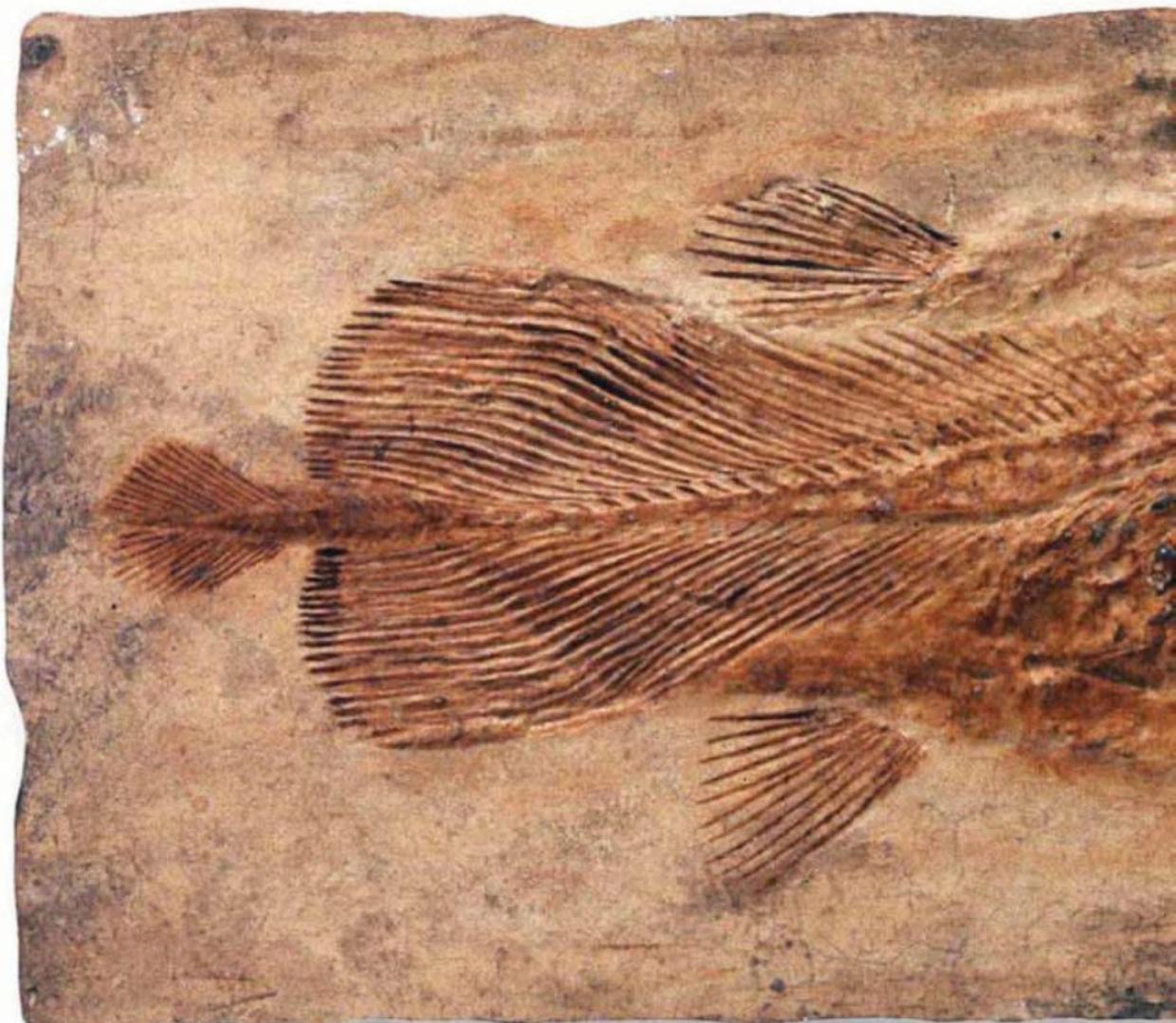
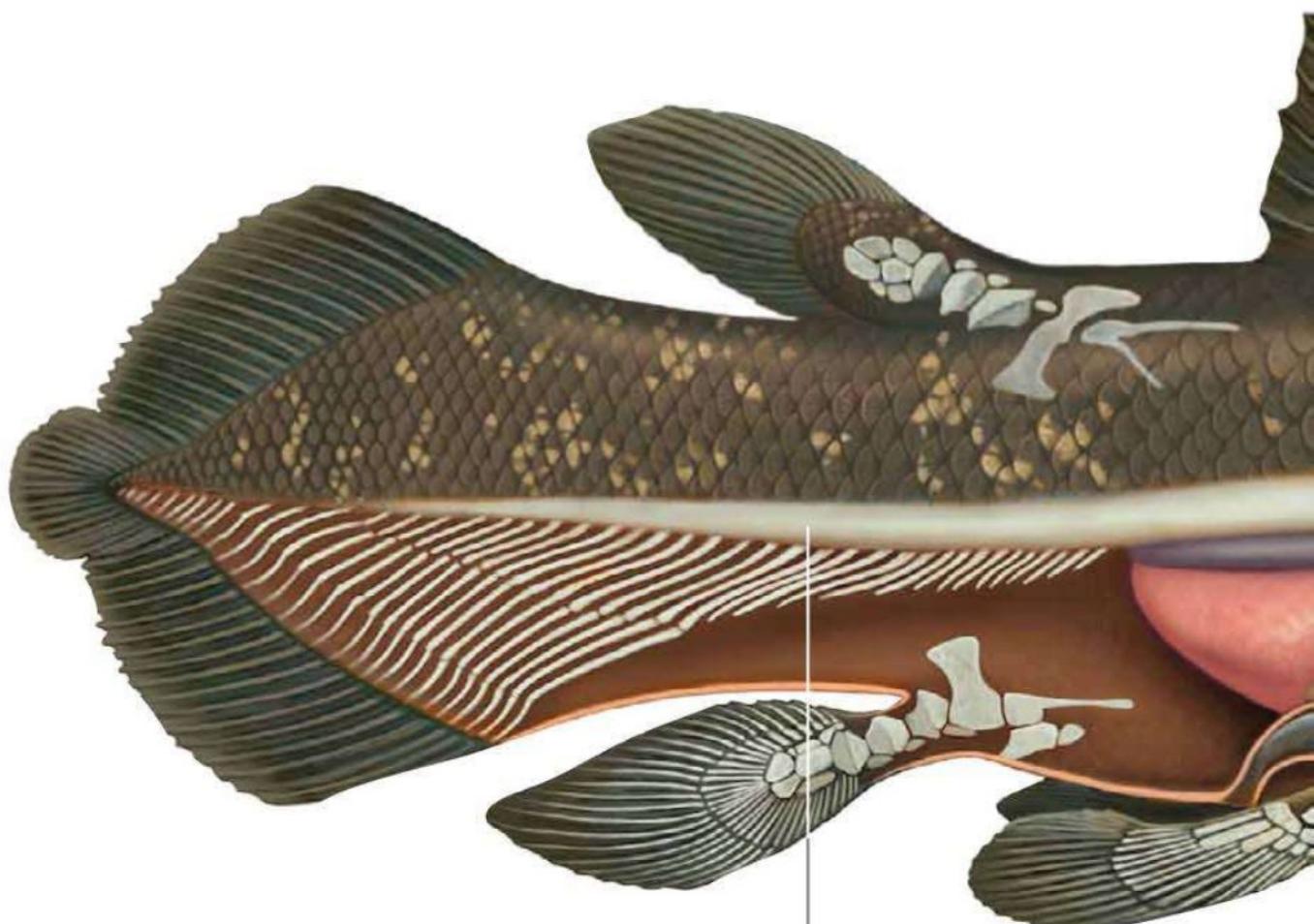




PHOTO: COLIN KEATES, DK LIMITED/CORBIS

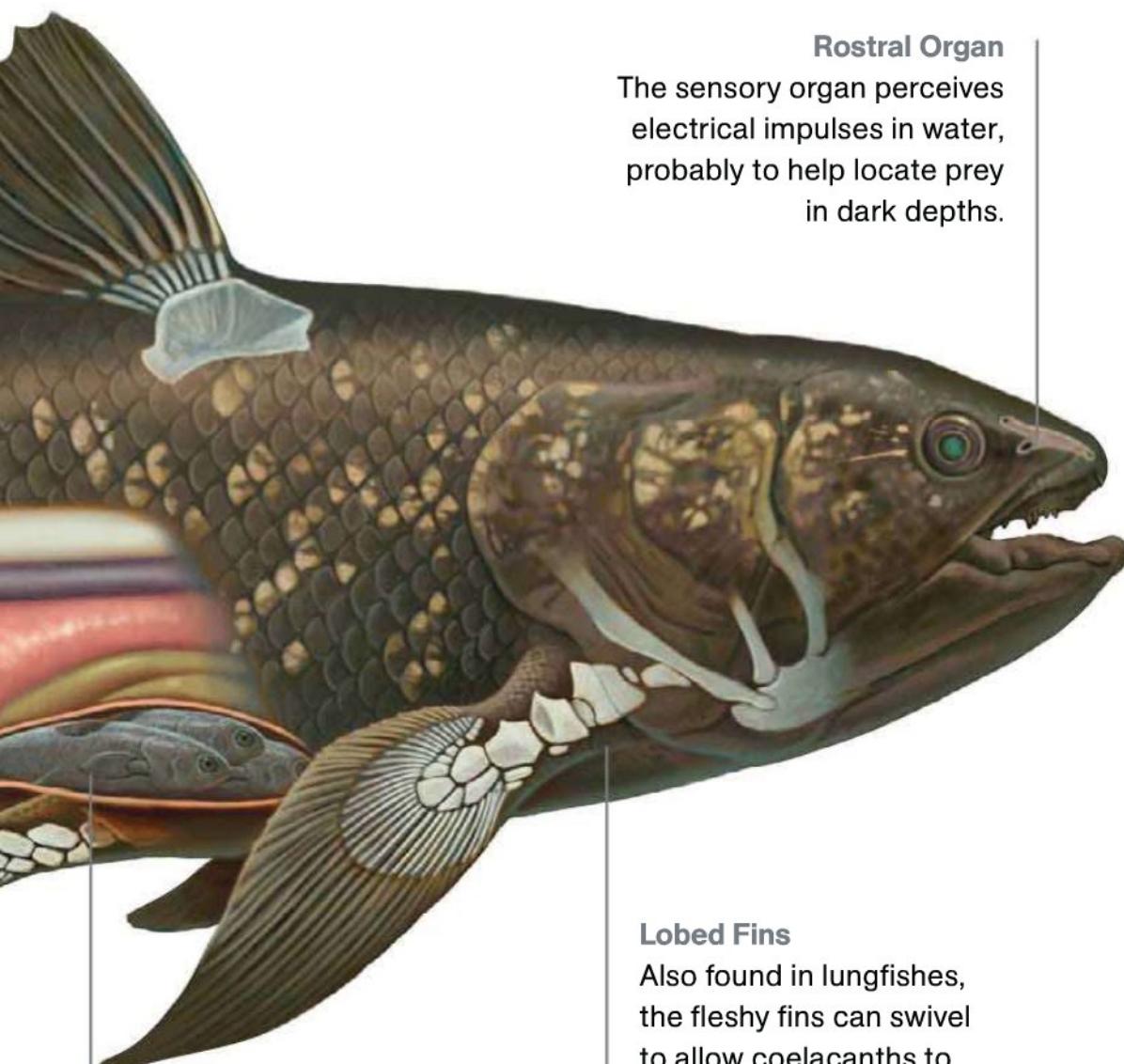
# Ancient Anatomy

The primitive-looking coelacanth can grow to about six feet and nearly 200 pounds.



## Notochord

This tough, elastic tube, which is partially hollow and filled with fluid, acts as a spine for the coelacanth.



### **Rostral Organ**

The sensory organ perceives electrical impulses in water, probably to help locate prey in dark depths.

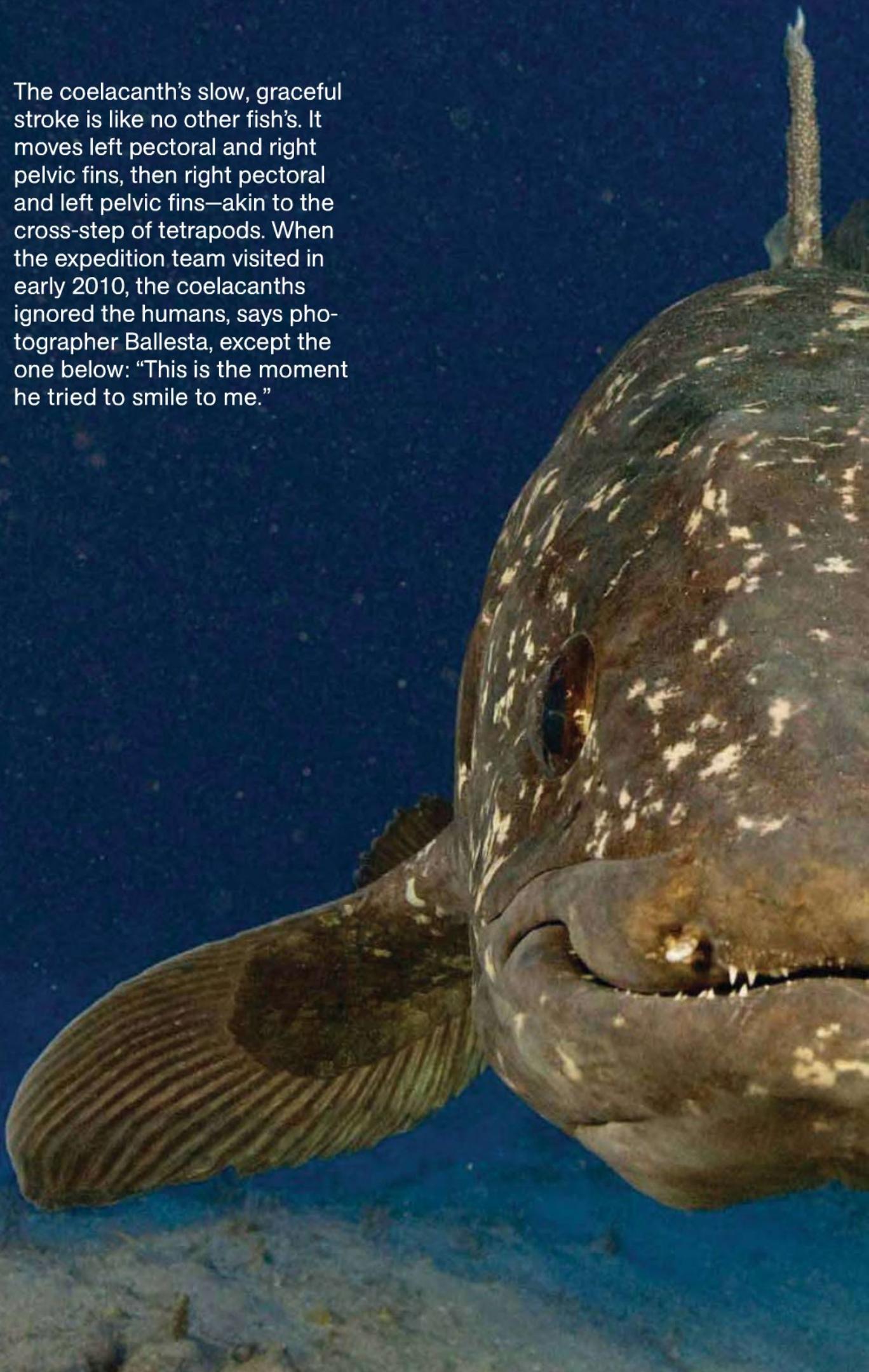
### **Lobed Fins**

Also found in lungfishes, the fleshy fins can swivel to allow coelacanths to maneuver precisely.

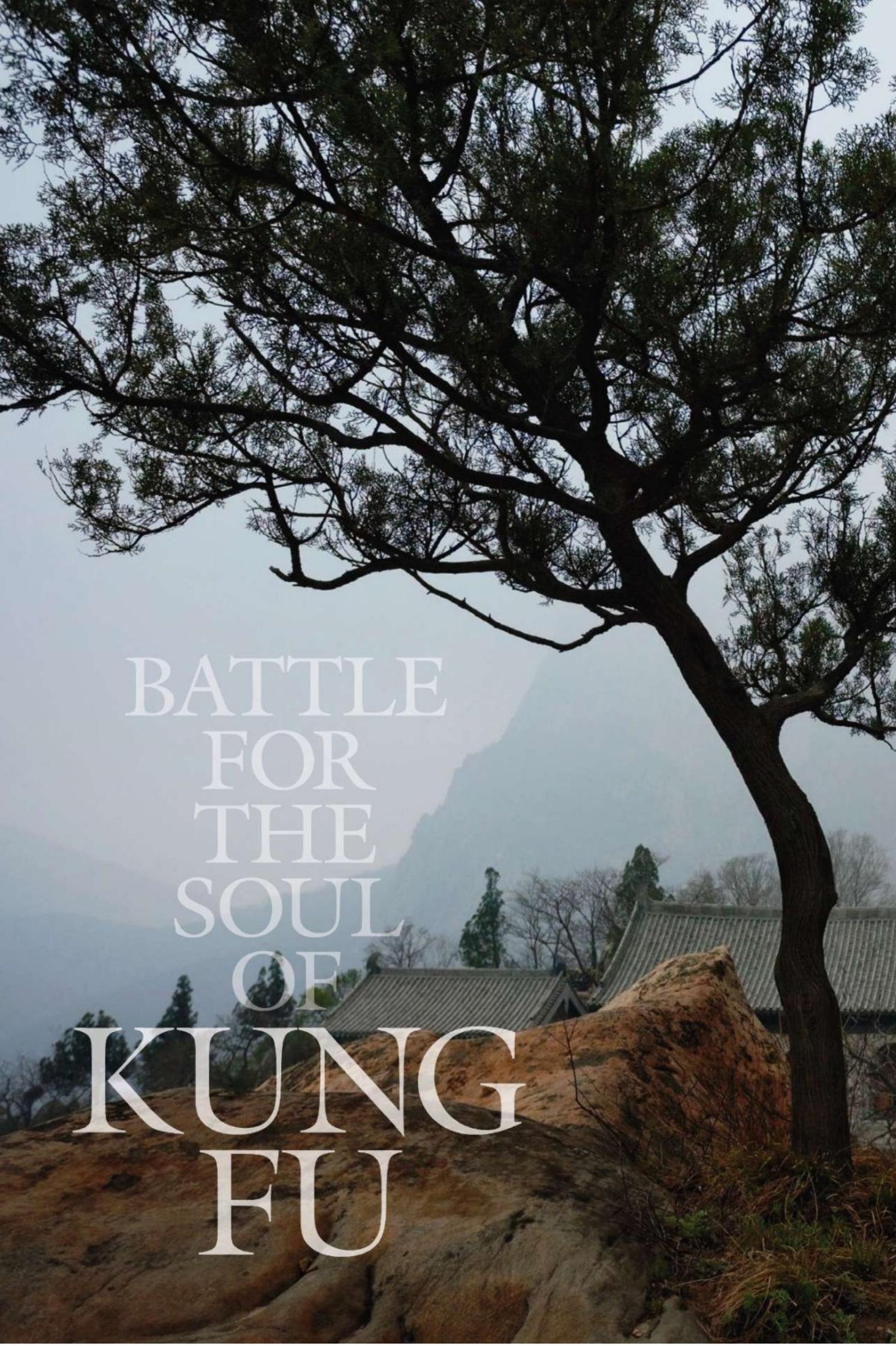
### **Live litter of pups**

Coelacanths give birth to a litter of up to 26 live and fully developed "pups." Gestation is likely a year or more.

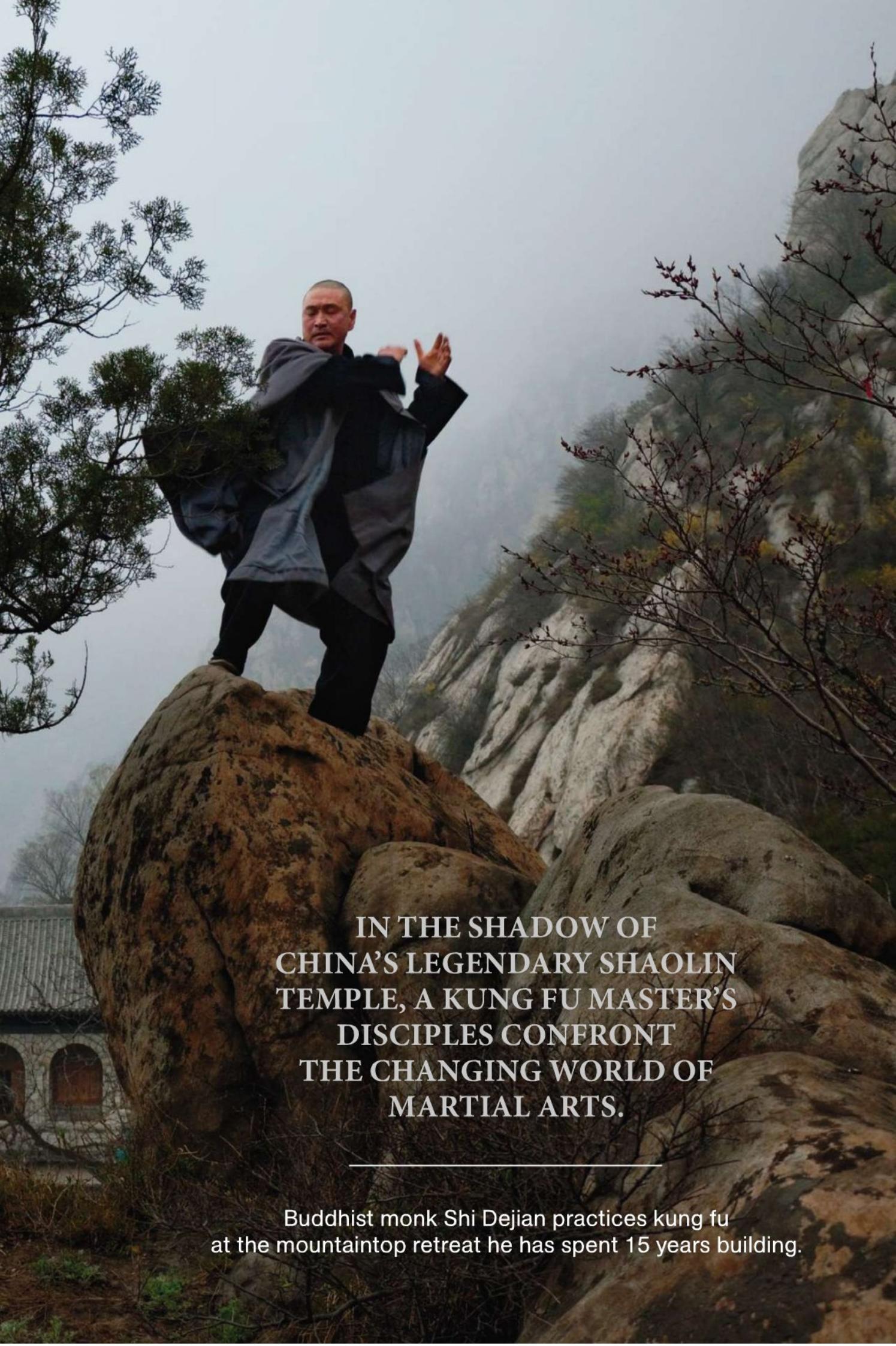
The coelacanth's slow, graceful stroke is like no other fish's. It moves left pectoral and right pelvic fins, then right pectoral and left pelvic fins—akin to the cross-step of tetrapods. When the expedition team visited in early 2010, the coelacanths ignored the humans, says photographer Ballesta, except the one below: "This is the moment he tried to smile to me."





The background of the image is a photograph of a landscape. On the right side, a large, dark tree with many branches and needles is silhouetted against a bright, hazy sky. In the middle ground, there are traditional Chinese buildings with dark green tiled roofs. Behind them, several misty, grey mountains rise into the distance. The overall atmosphere is mysterious and historical.

# BATTLE FOR THE SOUL OF KUNG FU



**IN THE SHADOW OF  
CHINA'S LEGENDARY SHAOLIN  
TEMPLE, A KUNG FU MASTER'S  
DISCIPLES CONFRONT  
THE CHANGING WORLD OF  
MARTIAL ARTS.**

---

Buddhist monk Shi Dejian practices kung fu at the mountaintop retreat he has spent 15 years building.





Teenagers at the Shaolin Tagou Martial Arts School in Dengfeng unleash a 20-minute flurry of fists and feet to build stamina. The city has become China's kung fu capital, boasting more than 60 martial arts schools and 50,000 students from all over China.



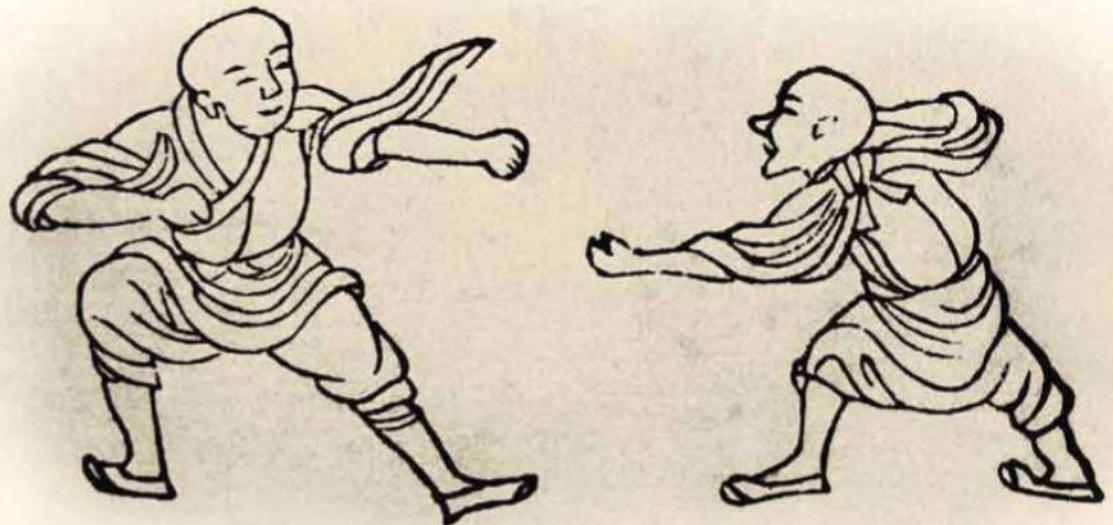


Students form a Chinese flag at the Tagou complex near the Song Mountains. As China's largest martial arts school, with 25,000 pupils, Tagou's specialties include large-scale shows. Its students performed at the Beijing Olympics opening and closing ceremonies.





Kung fu master Yang Guiwu, who died at age 77, is mourned by his family, dressed in traditional funeral robes. Yang's kung fu lineage extends back through generations of Shaolin monks. His own disciples are expected to pass on his teachings.



## SHAOLIN THROUGH THE AGES

**11th century B.C.**

Oldest Chinese reference to martial arts.

**A.D. 495**

Shaolin Temple founded by Indian Buddhist.

**621**

Thirteen Shaolin monks battle opponents of Tang rule, are honored by prince.

**1898-1901**  
Martial artists foment the Boxer Rebellion to challenge Western influence.

**1928** Warlord Shi Yousan burns Shaolin Temple, obliterating its vast library, including ancient martial arts texts.

**1940s** Shaolin monks ambush Japanese soldiers patrolling near the temple.

**1350s** Temple sacked by marauders, one of many such events in its history.

**1553** Shaolin monks help fight off Japanese pirate attacks on Chinese coast.

**2010** Shaolin Temple named a UNESCO World Heritage site.

**1966** Cultural Revolution's Red Guards ravage Shaolin Temple, beat the few remaining monks.

**1972** Kung Fu TV series begins, introducing the Shaolin Temple to Americans.

**1982** Martial arts champ Jet Li portrays a heroic monk in *Shaolin Temple*, a film that sets off a Shaolin frenzy in China.

**1999** Shi Yongxin installed as the 30th abbot of the Shaolin Temple.





Like other martial artists of his generation, Fan Fuzhong, 75, has seen kung fu banned by Japanese occupiers, discouraged by Mao's Red Guards, and resurrected as a cultural treasure in the new China.





In a scene for a Chinese TV series, stuntmen portray Shaolin monks battling bandit gangs during the Qing dynasty. Not your average nonviolent Buddhists, the monks loom as heroes in the national psyche.





“Gained merit in battle” reads the epitaph of two of the 231 eminent Shaolin monks honored with shrines in the Pagoda Forest. The number of layers in a shrine reflects a monk’s virtue; his bones, and often those of disciples, are buried below.





Monks file to prayer in the Shaolin Temple. Some 150 monks live at the temple, and visiting monks from across China and abroad come to study and meditate at the purported fountainhead of Zen Buddhism.





A monk seeks shelter from a snow shower in the Shaolin complex, lavishly rebuilt in recent years. Stone tablets throughout the grounds testify to the generosity of patrons from all over the world.





In their future careers Tagou pupils likely won't hit anyone with a staff. Yet the discipline and character they develop while perfecting its use, say their coaches, are weapons they will wield over their lifetimes.

THEY ARE THE EARTH'S POLLINATOR



RS. AND THEY COME IN MORE THAN 200,000 SHAPES AND SIZES.

# Gold Dusters



The perfume of the rare caper flower on Kauai tempts a hungry honeybee at dusk.

*APIS MELLIFERA ON CAPPARIS SANDWICHIANA, HAWAII*





With a vigorous quiver, an Arizona sweat bee “buzz pollinates” a deadly nightshade flower. Its vibrating body shakes free the golden dust that will feed the larvae back in the nest—and promise the plant’s DNA a future.

AGAPOSTEMON SP. ON SOLANUM ROSTRATUM, ARIZONA





Beetles are among the most ancient pollen carriers. This soldier beetle (above) munches a magnolia, which emits both scent and heat as lures. A bog orchid's pollen packet sits at the flower's mouth, ensuring that a probing mosquito gets a proboscisful (left).

Bees are the most prolific pollinators, but they're not alone. The tarantula hawk wasp feeds on milkweed pollen.

PEPSIS SP. ON ASCLEPIAS SUBULATA,  
ARIZONA





## WHAT POLLEN IS WORTH

Pollinators, especially bees, make the global garden grow. Insect pollination is worth more than \$200 billion worldwide. Vegetables, fruits, oils, and some nuts, the biggest contributors to that total value, are also the most vulnerable to insect declines. Of less concern: cereals, sugars, roots, and tubers, which self-pollinate or rely on wind.

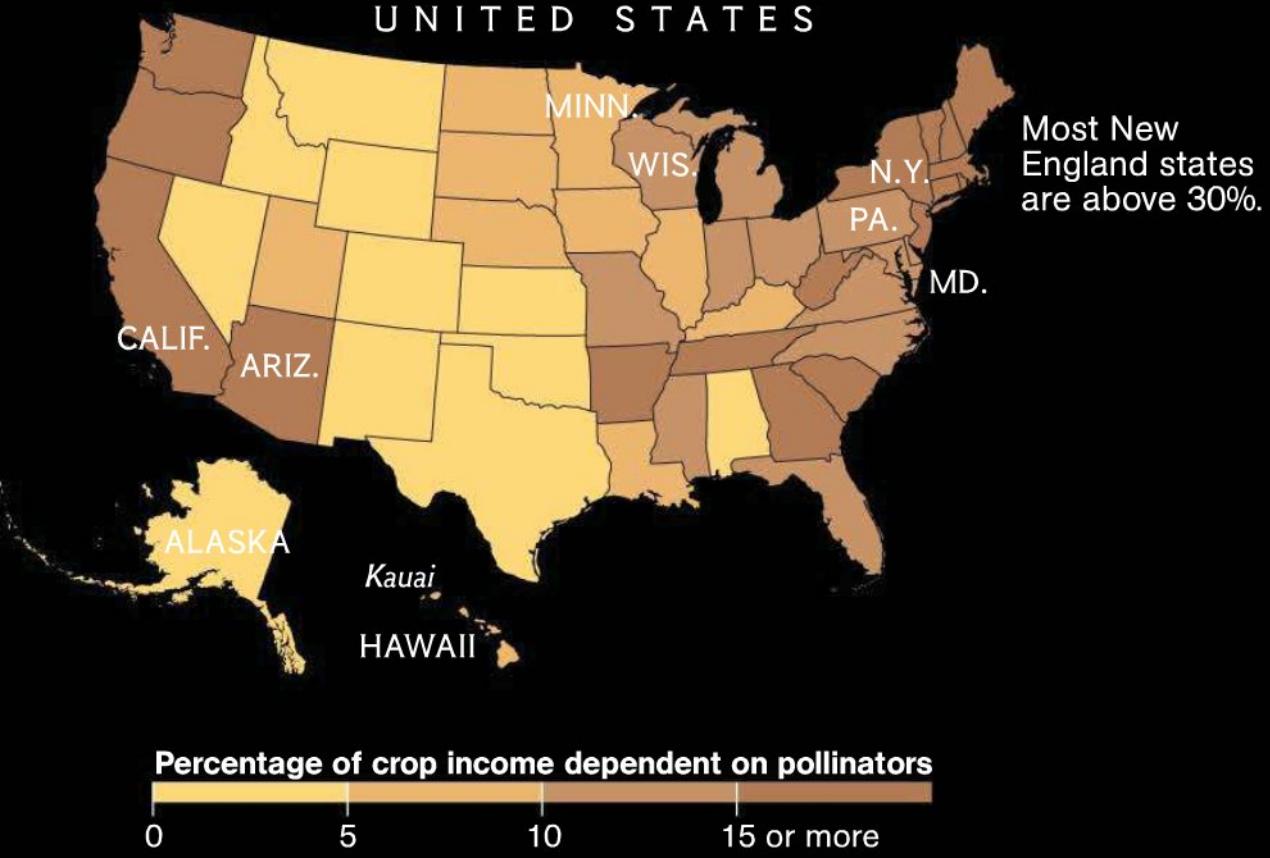
### U.S. Crop Pollination

- Dependent on other insect pollinators
- Dependent on honeybees
- Not dependent



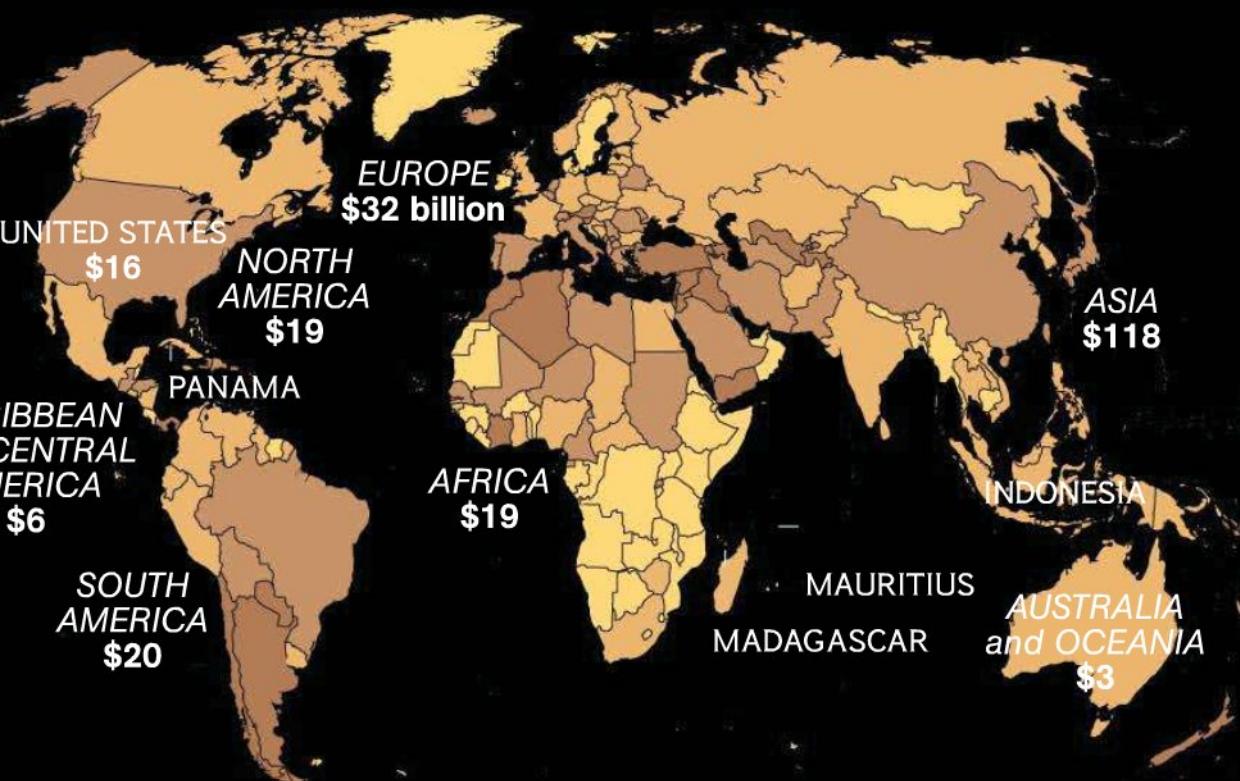
CAR  
and C  
AM

## UNITED STATES



**Percentage of crop income dependent on pollinators**

0    5    10    15 or more

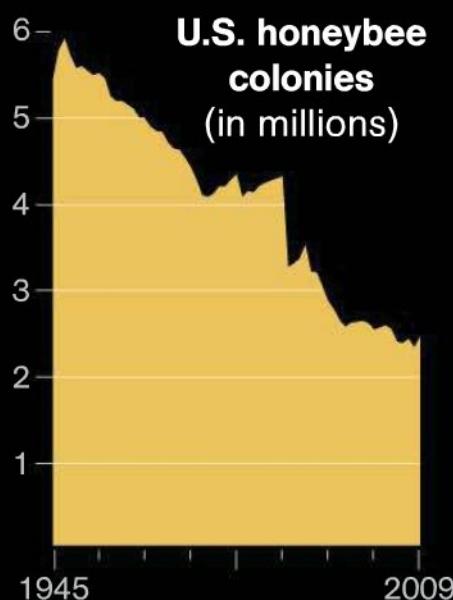


MARIEL FURLONG AND LISA R. RITTER, NGM STAFF; COLTER SIKORA

SOURCES: NICHOLAS CALDERONE, CORNELL UNIVERSITY (GRAPHIC); MICHAEL RUGGIERO, EXPERT SOLUTIONS INTERNATIONAL (U.S. MAP, 2008 USDA DATA); NICOLA GALLAI, FRENCH NATIONAL INSTITUTE FOR AGRICULTURAL RESEARCH (WORLD MAP, 2008 FAO DATA)

## HONEYBEE HEALTH

In 2010, scientists reported a possible cause of colony collapse disorder (CCD), the rapid die-off of millions of honeybees in many countries since 2006. Genetic studies pointed to a particular insect virus and fungus at work together. But those findings have come under debate, and definitive conclusions remain elusive. “CCD is likely a complex interaction,” says the USDA’s Jeff Pettis. “But the role of this pair of pathogens is still an open question.” Meanwhile, the blood-sucking Varroa mite (red dots right), also implicated in CCD, remains honeybees’ most devastating pest worldwide.





APIS MELLIFERA INFESTED WITH VARROA DESTRUCTOR

SOURCE: NATIONAL AGRICULTURAL STATISTICS SERVICE, USDA

Spring fog drifts over a Pennsylvania apple orchard at sunrise. Each year, owner John Lerew rents 180 honeybee hives holding millions of bees to pollinate several hundred acres. Most large farms bring in managed bees like these. "For us," says Lerew, "they're a must."

AMY TOENSING





An ornate day gecko laps nectar from tree blossoms on Mauritius. Rare pollinators, bug-eating lizards may substitute on islands where neither pollinators nor predators are plentiful—filling a niche held by others on the mainland.

PHELsuma ORNATA ON GASTONIA  
MAURITIANA, MAURITIUS





A Madagascar ring-tailed lemur,  
here gnawing a non-native cactus,  
ably carries pollen for native  
plants on its muzzle and hands.

LEMUR CATTA ON CEREUS HILDMANNIANUS,  
MADAGASCAR









This cast of pollinators gets mixed reviews for reliability. In Arizona a *Manduca* hawk moth swoops in to probe an angel's trumpet (left). The pair co-evolved, so their pollinating parts are a perfect fit, and the night feeder can see the flower in the dark. In Hawaii a non-native bird called a Japanese white-eye (above) robs nectar from the base of a *haha'aikamanu*. In this case the bird sidesteps the pollen, doing the plant no service at all.

Cross-pollination isn't ensured when an ant picks up pollen off a pancake plant: The ant may then crawl to the ground or another species.

*FORELIUS PRUINOSUS* ON *CHAMAESYCE* SP.,  
ARIZONA





A wild *Heliconius* loads up on pollen at a hot-lips blossom. Most butterflies only sip nectar, but this one has evolved with special equipment—a snout that allows it to mine and then digest pollen. Amino acids in the pollen extend the animal's life, giving it extra weeks to breed.

*HELICONIUS ERATO ON PSYCHOTRIA  
POEPPIGIANA, PANAMA*





# Circling Alaska in 176 Days

**Nobody had ever done it before:  
Hike, ski, and raft 4,679 miles  
through eight national parks,  
dozens of mountain ranges, and  
the length of the Yukon territory.  
Then along came Andrew Skurka.**



DENALI NATIONAL PARK, APRIL 27, 2010

"Skiing over this unnamed pass made me nervous," says extreme trekker Andrew Skurka. "I was worrying about an avalanche due to the warm and sunny spring weather." With 1,120 miles behind him, he still had 3,559 to go.



**DAYS WITH DRY FEET WHILE HIKING OR RAFTING: 20 OUT OF 11**

**LONGEST DISTANCE WITHOUT SEEING A ROAD: 657 MILES**

**LONGEST TIME WITHOUT SEEING ANOTHER HUMAN BEING: 24**



18

DAYS



#### DILLINGER RIVER, APRIL 17

“Despite my best efforts, my leather ski boots got soaked by the melting snow,” says Skurka, who tried to leap across some creeks and rivers.





#### DILLINGER RIVER, APRIL 17

"Sleep deprived, mentally spent, beat up by a blizzard, and about to start an arduous detour, I couldn't keep my game face," Skurka says of unexpected tears.





#### WONDER LAKE, APRIL 24

"My diet might look monotonous," Skurka says of his carefully weighed bags of chips, chocolate, and jerky. "But in the wilderness, hunger is the best seasoning."





### ALATNA RIVER VALLEY, AUGUST 19

"I paddled across this deep, slow-moving river in my small pack raft," Skurka says. On the other side, he built a big sandbar fire to warm up and cook dinner.

**CLOSEST BEAR ENCOUNTER: ABOUT TEN YARDS  
STRATEGY: THREW HIKING POLE AT BEAR, WHICH FLED  
MOST MOSQUITOES SMITTEN WITH A SINGLE SLAP: 14**





### ARRIGETCH PEAKS, AUGUST 23

"These teeter-tottering granite boulders all wanted to slide," Skurka says of a talus-covered pass in the central Brooks Range, where his friend Roman Dial joined him.





### COPPER RIVER, MAY 26

“The ice lingering on Miles Lake was too soft to walk on and too hard to paddle through,” says Skurka, who scooted across in his one-person inflatable pack raft.

# EXPLORERS JOURNAL | ZEB HOGAN



Zeb Hogan plunges fully clothed into India's Ramganga River to help a goonch catfish swim away after it was caught and tagged.





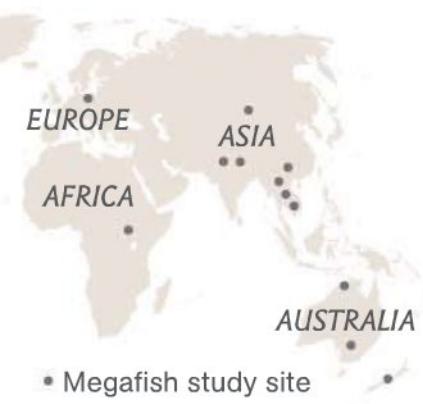
WORLDWIDE

# Wrangling Megafish

**The world's largest freshwater fish are in trouble. Biologist Zeb Hogan is identifying and protecting as many as he can—before they vanish forever.**

I've loved water ever since I was little. I grew up in Arizona, where you learn how precious it is. I get into the water a lot for my work. I'm not always as careful as I should be about the water I get into—dirty, shallow, or deep—as long as there is a big fish in it.

As a conservation biologist, I study these fish. I call them megafish. They're more than six feet long and 200-plus pounds, and they're typically *(Continued)*



■ **Society Project** Zeb Hogan's research is funded in part by your National Geographic Society membership.

## FLASHBACK

**Trunk Rocker** “Such a swing would thrill the most blasé,” claimed the caption for this photograph—which left the swinger unidentified—from “The Land of Sawdust and Spangles,” the story on circuses published in the October 1931 *National Geographic*. Author Francis Beverly Kelley did not take such performances lightly. “There’s no such thing as a tamed wild animal,” he wrote. “You can train them, but you never can be certain that they are tamed. Trainers who have trusted their jungle charges too far have been left behind in a horizontal position while the long show trains thundered away to the next town.” —Margaret G. Zackowitz



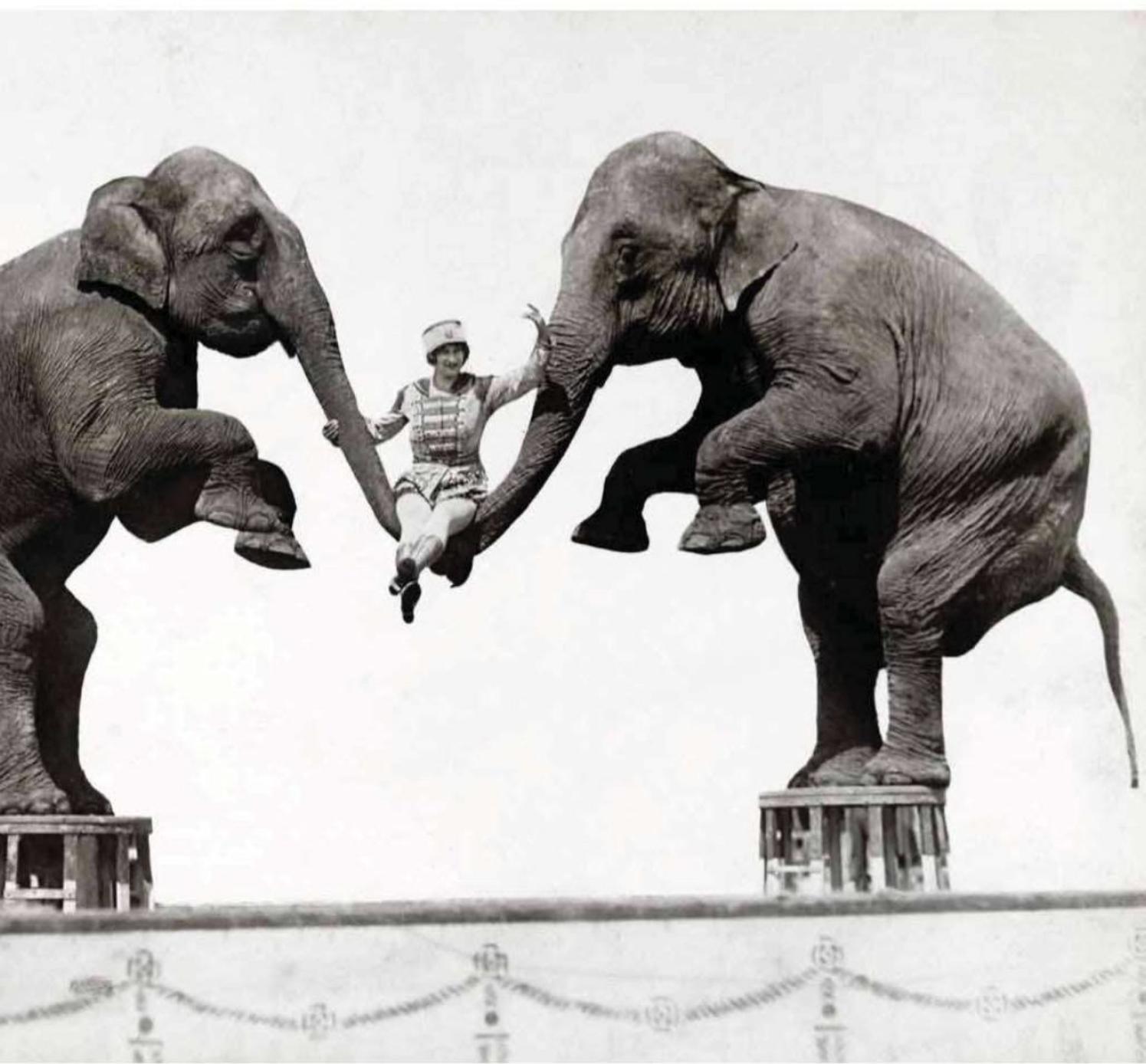


PHOTO: H. A. ATWELL STUDIO/NATIONAL GEOGRAPHIC STOCK