

JUNE 2016

# NATIONAL GEOGRAPHIC TOMB RAIDERS

Looting the World's Ancient Treasures

**EXPLORER**

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Not surprisingly, this area of sand flats and shallow water in the northern Bahamas is called Tiger Beach.

## 82 Swimming With Tigers

The writer dives with tiger sharks, awesome predators that are critical to ocean health. *By Glenn Hodges Photographs by Brian Skerry*

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*By Emma Marris  
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*By Sam Quinones  
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The interplay of nature and human activity forms patterns in the Nevada desert.

*Story and Photographs by Jamey Stillings*

**On the Cover** King Tut's burial mask hasn't been taken by looters, but many other treasures have. *Photo illustration by Javier Jaén. Photos: Kenneth Garrett, National Geographic Creative (Tut); PeopleImages/Getty Images (glove)*

**Corrections and Clarifications** Go to [ngm.com/corrections](http://ngm.com/corrections).

## The Story Behind the Photo

Some stories just break your heart. So it is with the behind-the-scenes story of the girl featured in this month's article on Manú National Park in Peru. The girl's name is Yoina. She's a member of the Matsigenka tribe, an indigenous group that lives in Manú, one of the most biodiverse places on Earth.

When we saw Yoina's picture, taken for *National Geographic* by photographer Charlie Hamilton James in June 2015, all of us were captivated by the image of this 10-year-old girl, neck deep in the Yomibato River near her village, looking defiantly at the camera, a pet tamarin on her head.

That photo did what great photos do. It made us want to know more—about the girl and about her life. Because her tribe and others have inhabited the area for generations, it's their legal right to live in the protected rain forest with a few limitations: no gun hunting and no other activities that would irreparably harm the environment.

Yoina "didn't really care much for having her photo taken, and that's why she's got a bit of attitude in the shot," says Hamilton James, who has covered Manú's people and animals for 20 years. "I must have shot around 20 frames like that, and she's only smiling a little in one of them."

From there the story takes a tragic turn. The next month Yoina's mother, Carmen, died after giving birth to her ninth child. The baby—named Grace Kelly at the suggestion of a visiting nurse's wife—was adopted by Carmen's sister. The aunt also cares for Yoina, who shaved her head in mourning. But the sad events did not stop there. Soon after, Yoina's pet tamarin was killed when it overturned a boiling pot on itself. The family buried it.

When our reporter Emma Marris went to Manú, she sought out Yoina. The girl still lives with her aunt and helps care for baby Grace. On that visit (left) Yoina had less hair but a bit more of a smile, in gratitude for the gift of a photo with her pet.

We strive to bring you stories of people and places that are remarkable, remote, endangered—or, as in Manú's case, all three. We can't know what we'll find on return visits, but we're heartened by the words of people like Matsigenka teacher Mauro Metaki. "We know how to take care of the forest," he says. To live off the land but at the same time protect it, "we take just a little."

Thanks for reading *National Geographic*.



Susan Goldberg, Editor in Chief



Posing with a photo of herself with a pet tamarin, Yoina smiled—which she wouldn't do in the first photo.



**Grand Cayman Blue Iguana** (*Cyclura lewisi*)

**Size:** Body length (snout to vent), up to 51.5 cm (20 inches); tail length, up to 42.5 cm (16.7 inches) **Weight:** Up to 10 kg (22 lb) **Habitat:** Inland dry shrubland on Grand Cayman Island **Surviving number:** Estimated at 441



Photographed by William Burrard-Lucas

# WILDLIFE AS CANON SEES IT

Down but not out. The Grand Cayman blue iguana came to the verge of extinction with just 25 remaining in the wild in 2002, but has clawed its way back. The world's largest iguana has benefited from an aggressive captive breeding program aimed at reintroducing it into its natural habitat. Once a year, females lay up to 22 eggs in underground burrows.

Though their young still face predation by feral animals, road mortality and habitat loss, they represent a second chance and remarkable comeback for the species.

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



*We believe in the power of science, exploration, and storytelling to change the world.*

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### 3 Questions

[nationalgeographic.com/3Q](http://nationalgeographic.com/3Q)



## Why We Must Continue to Explore Space

History records **Buzz Aldrin** as the second man to set foot on the moon. At age 86, the former astronaut is still trying new feats. He has appeared on television on *The Big Bang Theory* and *Dancing With the Stars*. He has written nine books, including *No Dream Is Too High: Life Lessons From a Man Who Walked on the Moon*. And he continues to urge Earth's inhabitants to press farther into space.

### Why is it important for us to keep exploring space, to even colonize Mars?

We are stagnating on Earth. We are reverting to the past. We are not pioneering. We are not looking forward. And if we do not explore, we will expire.

What has held us back? A variety of things, including aging astronauts, public apathy, the lack of exciting activities in space, budget constraints, and leaders who underappreciate such aspirations.

### Do you like any of the films set in space—and do you think there really are other beings out there?

I liked *The Martian*. I also thought that *Gravity* was good. At one point in my space career, I could have been like George Clooney's character, free to maneuver on my space walk—but NASA insisted on me having a tether. As for extraterrestrial life, Carl Sagan said that extraordinary claims require extraordinary evidence. Some believe that the monolith on Phobos [a small moon of Mars] had intelligence behind its structure, for example. But we don't have the extraordinary evidence right now.

### What was the biggest lesson you learned from being an astronaut?

It has evolved from when I returned from the moon to today. You have to remember that I wasn't named an astronaut right away. So when I look back on things, what I remember is the process. The process of becoming an astronaut and going [to the moon] taught me the lesson of persistence. If at first you don't succeed...



Buzz Aldrin's latest book, *No Dream Is Too High*, is available wherever books are sold.

PHOTO: REBECCA HALE, NGM STAFF

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# VISIONS





### Spain

Hundreds of brightly clad teammates form the base of a human tower during the biennial *Concurs de Castells* competition in Tarragona. The Catalan cultural tradition dates to the 18th century. UNESCO officially recognized it in 2010.

PHOTO: DAVID OLIETE CASANOVA

### Canada

In a home aquarium in Kenora, tiny bubbles stipple the stems and skins of cherries submerged in soda water. Effervescence like this occurs when carbon dioxide saturates a liquid and clusters on smooth surfaces before rising and escaping.

PHOTO: LAURENS KALDEWAY







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**Vietnam**

As two women sew fishnets in the village of Vinh Hy, waves of green fabric swell like a restive sea. Fish is a key source of protein in Vietnam. The country also has extensive shrimp and catfish farms, making it one of the world's top seafood exporters.

PHOTO: QUANG TRAN

If you have type 2 diabetes

ACTOR PORTRAYAL

### Indication and Limitations of Use

Trulicity is a once-weekly injectable prescription medicine to improve blood sugar (glucose) in adults with type 2 diabetes mellitus. It should be used along with diet and exercise. Trulicity is not recommended as the first medication to treat diabetes. It has not been studied in people who have had inflammation of the pancreas (pancreatitis). Trulicity should not be used by people with a history of severe gastrointestinal (GI) disease, people with type 1 diabetes, or people with diabetic ketoacidosis. It is not a substitute for insulin. It has not been studied with long-acting insulin or in children under 18 years of age.

### Important Safety Information

**Tell your healthcare provider if you get a lump or swelling in your neck, have hoarseness, trouble swallowing, or shortness of breath while taking Trulicity. These may be symptoms of thyroid cancer. In studies with rats or mice, Trulicity and medicines that work like Trulicity caused thyroid tumors, including thyroid cancer. It is not known if Trulicity will cause thyroid tumors or a type of thyroid cancer called medullary thyroid carcinoma (MTC) in people. Do not take Trulicity if you or any of your family members have ever had MTC or if you have Multiple Endocrine Neoplasia syndrome type 2 (MEN 2).**

Katherine  
JEWELRY DESIGNER  
WITH TYPE 2 DIABETES

Do not take Trulicity if you have had an allergic reaction to dulaglutide or any of the other ingredients in Trulicity.

### Trulicity may cause serious side effects, including:

- **Inflammation of your pancreas (pancreatitis).** If you have pain in your stomach area (abdomen) that is severe and will not go away, stop taking Trulicity and call your healthcare provider right away. The pain may happen with or without vomiting. It may be felt going from your abdomen through to your back.
- **Low blood sugar (hypoglycemia).** If you are using another medicine that can cause low blood sugar (such as insulin or a sulfonylurea) while taking Trulicity, your risk for getting low blood sugar (hypoglycemia) may be higher. Signs and symptoms of low blood sugar may include dizziness, blurred vision, anxiety, irritability, mood changes, sweating, slurred speech, hunger, confusion or drowsiness, shakiness, weakness, headache, fast heartbeat, or feeling jittery. Talk to your healthcare provider about low blood sugar and how to manage it.
- **Serious allergic reactions.** Stop taking Trulicity and get medical help right away if you have symptoms of a serious allergic reaction, such as itching, rash, or difficulty breathing.
- **Kidney problems (kidney failure).** In people who have kidney problems, diarrhea, nausea, and vomiting may cause a loss of fluids (dehydration). This may cause kidney problems to get worse.
- **Severe stomach problems.** Trulicity may cause stomach problems, which could be severe.



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Katherine uses what's inside her to reach her goals. For her art, she uses her passion. For her diabetes, she helps her body release its own insulin.

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\*Trulicity is not a weight loss drug. In studies, people who lost weight lost 2-6 lbs on average.



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#### Tell your healthcare provider if you:

- have or have had problems with your pancreas, kidneys, or liver.
- have severe problems with your stomach, such as slowed emptying of your stomach (gastroparesis) or problems with digesting food.
- have any other medical conditions.
- are pregnant or plan to become pregnant, or if you become pregnant while taking Trulicity. It is not known if Trulicity will harm your unborn baby.
- are breastfeeding or plan to breastfeed. It is not known if Trulicity passes into your breast milk. You should not use Trulicity while breastfeeding without first talking to your healthcare provider.
- are taking other medicines including prescription and over-the-counter medicines, vitamins, and herbal supplements. Trulicity may affect the way some medicines work and some medicines may affect the way Trulicity works.
- are taking other medicines to treat diabetes, including insulin or sulfonyleureas.

#### The most common side effects with Trulicity may

**include:** nausea, diarrhea, vomiting, decreased appetite, and indigestion. Talk to your healthcare provider about any side effect that bothers you or does not go away. These are not all the possible side effects of Trulicity. Call your doctor for medical advice about side effects.

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

**Please see next page for additional information about Trulicity, including Boxed Warning regarding possible thyroid tumors including thyroid cancer.**

**Please see Instructions for Use included with the pen.**

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### Information for Patients about Trulicity (dulaglutide):

This is a brief summary of important information about Trulicity (Trū-li-si-tee). Please read the Medication Guide that comes with Trulicity before you start taking it and each time you get a refill because there may be new information. This information is not meant to take the place of talking with your healthcare provider or pharmacist.

#### What is Trulicity?

Trulicity is a once-weekly, injectable prescription medicine that may improve blood sugar (glucose) in adults with type 2 diabetes mellitus, and should be used along with diet and exercise.

- It is not recommended as the first choice of medicine for treating diabetes.
- It is not known if it can be used in people who have had pancreatitis.
- It is not a substitute for insulin and is not for use in people with type 1 diabetes or people with diabetic ketoacidosis.
- It is not recommended for use in people with severe stomach or intestinal problems.
- It is not known if it can be used with long-acting insulin or if it is safe and effective for use in children under 18 years of age.

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

**Trulicity may cause serious side effects including possible thyroid tumors, including cancer.** Tell your healthcare provider if you get a lump or swelling in your neck, hoarseness, trouble swallowing, or shortness of breath. These may be symptoms of thyroid cancer. In studies with rats or mice, Trulicity and medicines that work like Trulicity caused thyroid tumors, including thyroid cancer. It is not known if TRULICITY will cause thyroid tumors or a type of thyroid cancer called medullary thyroid carcinoma (MTC) in people.

#### Who should not use Trulicity?

##### Do not use Trulicity if:

- you or any of your family have ever had a type of thyroid cancer called medullary thyroid carcinoma (MTC) or if you have an endocrine system condition called Multiple Endocrine Neoplasia syndrome type 2 (MEN 2).
- you are allergic to dulaglutide or any of the ingredients in Trulicity.

#### What are the possible side effects of Trulicity?

##### Trulicity may cause serious side effects, including:

- **Possible thyroid tumors, including cancer.** See “What is the most important information I should know about Trulicity?”
- **inflammation of the pancreas (pancreatitis).** Stop using Trulicity and call your healthcare provider right away if you have severe pain in your stomach area (abdomen) that will not go away, with or without vomiting. You may feel the pain from your abdomen to your back.
- **low blood sugar (hypoglycemia).** Your risk for getting low blood sugar may be higher if you use Trulicity with another medicine that can cause low blood sugar such as sulfonylurea or insulin.

**Signs and symptoms of low blood sugar may include:** dizziness or light-headedness; blurred vision; anxiety, irritability, or mood changes; sweating; slurred speech; hunger; confusion or drowsiness; shakiness; weakness; headache; fast heartbeat; feeling jittery.

- **serious allergic reactions.** Stop using Trulicity and get medical help right away, if you have any symptoms of a serious allergic reaction including itching, rash, or difficulty breathing.
- **kidney problems (kidney failure).** In people who have kidney problems, diarrhea, nausea, and vomiting may cause a loss of fluids (dehydration) which may cause kidney problems to get worse.
- **severe stomach problems.** Other medicines like Trulicity may cause severe stomach problems. It is not known if Trulicity causes or worsens stomach problems.

**The most common side effects of Trulicity may include** nausea, diarrhea, vomiting, decreased appetite, indigestion.

Talk to your healthcare provider about any side effect that bothers you or does not go away. These are not all the side effects of Trulicity.

Call your doctor for medical advice about side effects. You may report side effects to FDA at 1-800-FDA-1088.

Trulicity (dulaglutide)

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### Before using Trulicity tell your healthcare provider if you:

- have had problems with your pancreas, kidneys, or liver.
- have severe problems with your stomach, such as slowed emptying of your stomach (gastroparesis) or problems digesting food.
- have any other medical conditions.
- are pregnant or plan to become pregnant, or if you become pregnant while taking Trulicity. It is not known if Trulicity will harm your unborn baby.
- are breastfeeding or plan to breastfeed. It is not known if Trulicity passes into your breast milk. You should not use Trulicity while breastfeeding without first talking to your healthcare provider.
- **are taking other medicines**—including prescription and over-the-counter medicines, vitamins, and herbal supplements. Trulicity may affect the way some medicines work and some medicines may affect the way Trulicity works.
- are taking other medicines to treat your diabetes including insulin or sulfonylureas.

### Before using Trulicity, talk to your healthcare provider about low blood sugar and how to manage it.

#### How should I use Trulicity?

- Read the **Instructions for Use** that comes with Trulicity.
- Use Trulicity exactly as your healthcare provider tells you to.
- Your healthcare provider should show you how to use Trulicity before you use it for the first time.
- Trulicity is injected under the skin (subcutaneously) of your stomach (abdomen), thigh, or upper arm. **Do not** inject Trulicity into a muscle (intramuscularly) or vein (intravenously).
- **Use Trulicity 1 time each week on the same day each week at any time of the day.**
- You may change the day of the week as long as your last dose was given **3** or more days before.
- If you miss a dose of Trulicity, take the missed dose as soon as possible, if there are at least 3 days (72 hours) until your next scheduled dose. If there are less than 3 days remaining, skip the missed dose and take your next dose on the regularly scheduled day. **Do not** take 2 doses of Trulicity within 3 days of each other.
- Trulicity may be taken with or without food.
- **Do not** mix Trulicity and insulin together in the same injection.
- You may give an injection of Trulicity and insulin in the same body area (such as your stomach), but not right next to each other.
- Change (rotate) your injection site with each weekly injection. **Do not** use the same site for each injection.

**Do not share your Trulicity pen, syringe, or needles with another person.** You may give another person an infection or get an infection from them.

**Your dose of Trulicity and other diabetes medicines may need to change because of:**

- change in level of physical activity or exercise, weight gain or loss, increased stress, illness, change in diet, or because of other medicines you take.

For more information go to [www.Trulicity.com](http://www.Trulicity.com) or call 1-800-LillyRx (1-800-545-5979).

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GOLD

VISIONS

YourShot.ngm.com

## *Best of the World*

*Assignment* Partnering with *National Geographic Traveler*, we challenged the Your Shot community to take cover-worthy photographs of favorite spots.



### EDITOR'S NOTE

‘We received more than 34,000 submissions for this assignment—our biggest ever. In the otherworldly blue scene above, the ice-cliff formation frames the subject perfectly.’

*Monica Corcoran, Your Shot director*

### **Swee Ong Wu**

*Singapore*

Wu was on a snowmobile expedition through the Arctic wilderness of Norway’s Svalbard archipelago when he took this photograph. “I was exploring an almost cavelike ice structure when I saw this opening,” he recalls. “It really looked as though I was in a completely new world.”



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# EXPLORE



## Drinking Water From the Deep

A desalination project built around a unique area of undersea topography could produce potable water for drought-ravaged California.

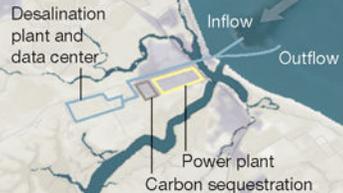
The public-private partnership, called the Monterey Bay Regional Water Project, would take seawater that originates in a two-mile-deep submarine trench off Monterey Bay and pipe it to a computer data center. There the water would be used to cool the center before undergoing desalination; the plant would produce enough water daily for 55,000 homes and save enough energy to power almost 65,000 homes annually. Calcium from the plant's waste stream would be recycled to make limestone building materials. And project leaders expect that pumping water from colder depths will reduce the impact on aquatic life.

Heather Cooley, director of the water program for the nonprofit Pacific Institute, cautions that there is "no silver bullet to address water scarcity." She advocates trying other "cheaper and faster" water conservation measures before embarking on desalination projects.

But Brent Constantz, CEO of the project's developer, DeepWater Desal, says options are exhausted: "Desalination is inevitable. We want to make it as environmentally friendly as possible." Construction permits could be granted by the state after an environmental review. Constantz hopes the project will begin pumping water in 2018. —*Nina Storchlic*

### Guarding Aquatic Life

The plant's pumps would draw very cold water from a "wave" that originates in a deep underwater canyon. By using colder water, project leaders expect to reduce negative impacts on fish and invertebrates that live in warmer surface waters.



Scale varies in this perspective.  
Distance between Point Pinos Lighthouse and Seal Rock is 22.5 miles (36.2 kilometers).

JASON TREAT AND CHARLES PREPPERNAU, NGM STAFF  
SOURCES: DEEPWATER DESAL; MONTEREY BAY AQUARIUM RESEARCH INSTITUTE (CANYON DATA); ESRI STREETMAP; USGS

# PACIFIC OCEAN

## Plumbing the Depths

The Monterey Canyon plunges more than two miles below the surface. A current of cold seawater moving toward the uppermost photic zone, where light penetrates the ocean and abundant marine life resides, will be pumped into the desalination plant.

-8,176 ft  
-2,492 m

-9,022 ft  
-2,750 m

-6,499 ft  
-1,981 m

Monterey Canyon

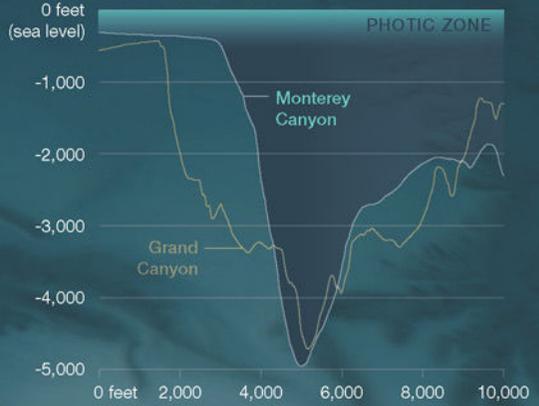
-5,049 ft  
-1,539 m

Cross section at right

-3,763 ft  
-1,147 m

-2,225 ft  
-678 m

Cross section of canyons



Monterey Canyon extends beyond the depth shown from this perspective. The Grand Canyon cross section is located near Grandview Point.

Bay

Deep, cold ocean water is dense and takes more energy to desalinate. Sending it through a heat exchanger warms the water while cooling a data center, a net energy savings.

Cold ocean water



**DATA**  
Using the cold water to cool the data center cuts its energy needs nearly in half.

Data center

**FRESHWATER**  
The plant pumps salt water through a membrane that filters out salt and other materials, leaving potable water.



Desalination plant

Power plant



Brine, the intensely salty water that's a by-product of desalination, can be pumped back into the trench for safer dispersal, project leaders say.

Brine

Carbon capture



**CONSTRUCTION MATERIALS**  
Limestone is created by combining the calcium waste from desalination with carbon produced by the power plant.

## A Desalination Circle

What do construction materials, Internet data, and freshwater have in common? They're all part of an innovative, multi-technology desalination project in water-starved central California.

Seal Rock

Santa Cruz



## Ceramic Star Chart



When pieces of an ancient two-handled cup were found in Greece in 1990, archaeologists could identify the animals painted around its circumference but were unable to work out their meaning. The odd menagerie, including mammals, a reptile, and an arachnid, wasn't a typical decoration, such as a hunting scene.

Some two decades later, when University of Missouri Ph.D. student John Barnes saw the reconstructed cup (left) in a museum, inspiration struck. A stargazer since childhood, he thought the animals might be symbols of constellations. "A hundred people can look at an artifact and each bring something different to it," he says. "In this case, I brought astronomy." What he sees (above, left to right): The tail end of a bull is Taurus, a snake is Hydra, a hare is Lepus, a dog is Canis Major, a scorpion is Scorpius, a dolphin is Delphinus, and a lion is Leo.

The cup was likely a votive object, offered in a temple in the city of Halai in about 600 B.C. Barnes believes the constellations may even be grouped according to seasons, connecting the cup to specific celebrations on the annual religious calendar. —A. R. Williams

### THIS ANCIENT BROOCH CROSSED MANY MILES

Archaeologists were startled to uncover a 1.5-inch-tall, owl-shaped cloak fastener on the Danish island of Bornholm. "The colors were so vivid that the eyes seemed to be glaring at us," says Christina Seehusen. Likely created in a Roman provincial workshop between A.D. 150 and 250, the bronze brooch retains most of its enamel and glass design. How did it end up so far north? Perhaps it was a gift from a visiting Roman official, or a local man brought it home after serving as a mercenary in the Roman army. Whatever route it took, the artifact is so intriguing that the National Museum in Copenhagen has now laid claim to it. —ARW





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EXPLORE

Us



## *On-Time Treatments*

They say there's a time for everything—though you might not know it from looking at a pill-bottle label. Most say how many pills to take but not when to take them. That's a problem, “because symptoms and treatment efficacy vary by time of day,” says University of Texas at Austin biomedical engineering professor Michael Smolensky. Strokes, for instance, tend to occur in the morning; asthma usually flares up at night. “If you take your medication at the wrong time,” he says, “it may not work as well...or you could experience more side effects and toxicity.”

Humans and animals have a set of internal clocks in their brains, organs, tissues, and cells that naturally sync with Earth's 24-hour light-dark cycle. Timing medications to those circadian rhythms is called *chronotherapy*—a field still foreign to many prescribers. Circadian biologist Georgios Paschos of the University of Pennsylvania School of Medicine suggests a remedy: “more clinical trials that investigate the optimal timing of drug administration.” —*Jeremy Berlin*

ART: JENNA FITE. PHOTO: REBECCA HALE, NGM STAFF

# There is something **TERRIBLY WRONG** with the Home Security Industry

**Hi.** Maybe you've been broken into before, or maybe you haven't. But if you ever decide to protect your home against unfortunate events like that, you're in for a shock. We don't want to scare you off of protecting your home, because honestly, it's really important that you do it. But we feel responsible for sharing these facts with you: Most alarm companies take advantage of people who want to feel safe. They offer you a "free" outdated alarm, but then require you to sign a long-term contract full of nasty fine print. It's pretty sickening really...but this isn't going to be all bad news. There is a better way to protect your home—get a SimpliSafe home security system. Our founder, a Harvard engineer, studied the alarm industry and found all kinds of problems with it. He designed SimpliSafe to fix them, so you can be safe, without having to spend a fortune or sign any contracts. SimpliSafe is wireless, you can order it online, and it's easy to install yourself—anyone can do it. It fits any home, apartment, or business. And it's more affordable, more reliable, and stronger than just about anything else out there.

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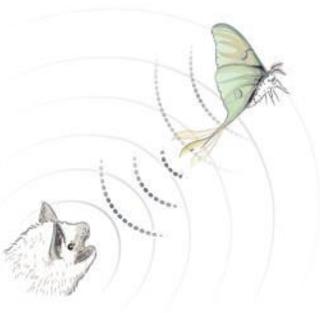


## *Moths vs. Bats*

Light green, long winged, and roughly the size of a playing card, the luna moth is a striking creature. It's a clever one too, say biologists Jesse Barber and Akito Kawahara, who have found that the "tails" at the ends of *Actias luna*'s wings are more than just cool-looking appendages. They're actually expendable decoys that trick hungry bats.

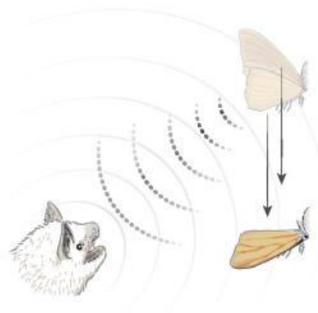
As the echolocating hunter comes in for the kill, says Barber, the moth's moving tails distract and fool the bat, knocking its attack off target; it may nab a bite of an extremity but seldom the whole insect.

"Moths and bats have been engaged in acoustic warfare for 60 million years," say Barber and Kawahara. This work expands scientists' knowledge of "antipredator deflection strategies," they say—and of how moths adapt to compete in this "evolutionary arms race." —*Catherine Zuckerman*

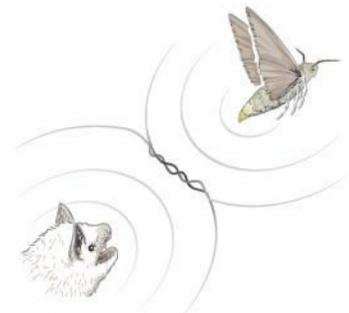


### THREE MOTHS, THREE MANEUVERS

**Deflection**  
Luna moths flutter their wing "tails" to throw incoming bats off target, often diverting attack.



**Sudden descent**  
Eared moths evade bats in several ways, including by closing their wings and dropping out of the predators' path.



**Sonar jamming**  
Hawk moths create ultrasound clicks by rubbing body parts together. The sound interferes with bats' echo processing.



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## Urban Planting

Rooftop farms have sprung up so quickly in American cities over the past decade that even the USDA doesn't know how many exist. Several can be found in New York City, providing local communities access to fresh produce. In some cases (like Brooklyn's Eagle Street Rooftop Farm, pictured here), the farms also offer educational and volunteer opportunities for people itching to flex their green thumbs.

The question of how to grow more food efficiently in metropolitan areas has gained urgency as urban populations rise: The UN Food and Agriculture Organization estimates that by 2025, 3.5 billion people will live in cities. But to increase yields in cities (as elsewhere), farmers must contend with climate change's effects on growing conditions.

One potential solution: more innovative designs. For ecologist Dickson Despommier that means vertical farming, cultivating fruits and vegetables under controlled settings within tall buildings—now particularly popular in Japan. Architect Mitchell Joachim's solution takes a different shape: The spherical pod he developed has a food-growing system on the outside and habitable space inside. The pod can be sized up to fit a larger site, Joachim says, or down to fit a high-rise balcony. —*Catherine Zuckerman*

PHOTO: MARIO WEZEL





EXPLORE

**Field Notes** National Geographic explorers, photographers, and writers report from around the world

## 2016 Emerging Explorers

# Leading the Way: Meet the Next Generation of Explorers

Scientists, conservationists, storytellers, and innovators—National Geographic’s newly announced emerging explorers are making discoveries that will change the world. We’ll follow their progress over the coming year.

### ARTHUR HUANG

Architect and engineer

Arthur Huang’s dreams are made of garbage. His latest? “A piece of trash that’s going to fly,” he says.

Huang’s dreams tend to become reality. This one is parked in his company’s top-floor office in Taiwan, and it’s called the EcoFighter—a two-seated aircraft with wings made of the material from recycled plastic bottles.

As a young architecture student, Huang grew disillusioned that despite all the talk of “going green,” it seemed no one was producing 100 percent sustainable materials. He decided to invent them himself. It wasn’t easy. He had to build his own manufacturing machinery, because the recycled materials broke existing equipment. But now his firm, Miniwiz, which he founded in 2005, transforms discarded plastic, clothing, and rice fiber into useful and beautiful things. Huang has opened “trash concept” stores for Nike, built a nine-story pavilion in Taipei, and collaborated with Italian furniture designers to re-create their classic pieces using boards made from cigarette butts. “We’re trying to sell the trash back to the people who produce it,” he explains.

Few have followed suit. “Our biggest problem right now is a lack of competitors,” Huang says. But his next dream may change that: Miniwiz will put its designs online so that entrepreneurs can build and sell their own



Using materials made from trash, like the reprocessed plastic bottles pictured here, Arthur Huang creates lighter, stronger, and more sustainable designs, from electronics to buildings.

unique products. “If trash can fly,” he says, “why can’t you make it into a shelf or clothes?”

### THANDIWE MWEETWA

Lion biologist

Conservationist Thandiwe Mweetwa knows that while driving on patrol in the Zambian grasslands she is “just another car” to the young lioness with an abnormally shaped ear. But she still feels a bond with the animal. Five years ago the 28-year-old biologist and her team at the Zambian Carnivore Programme rescued the big cat from a poacher’s snare. Mweetwa has since watched her recover and raise three cubs.

Growing up in the wildlife-rich Luangwa Valley, Mweetwa was awed by the animals roaming near her village. When her school’s conservation club preached the importance of protecting them, her path was set. Now Mweetwa collars and tracks lions, leopards, hyenas, and wild dogs. The work is dangerous, but not only because she handles wildlife: “There are a lot of precautions you can take to make sure things go OK,” she says. “It’s the poachers I’m worried about.” In parts of Zambia, armed poachers

PHOTO: THEODORE KAYE



# Because of you, explorers are making big discoveries.

Generous donor support made it possible for National Geographic Explorer-in-Residence Lee Berger to assemble a team of scientists—including 2016 Emerging Explorer Marina Elliott, pictured here—to excavate a cave in South Africa where they discovered bones belonging to a previously unknown early human relative.

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shoot at both wild animals and their guardians.

Mweetwa's biggest impact may be felt in the relative safety of a classroom. To combat poaching before it begins, Mweetwa plans to go into more schools and ask students to join her in promoting conservation over extermination.

### WASFIA NAZREEN

*Mountaineer, activist, and educator*

When Wasfia Nazreen reached the summit of Mount Everest in 2012, she took out her satellite phone and called her mom in Bangladesh. It was a turning point for Nazreen, who would descend from the top of the world to international acclaim and, finally, acceptance from her family. Her mother had abandoned her when she was 11. By the time they reconnected almost two decades later, Nazreen had become an outspoken gender activist and mountaineer. Her family did not approve, but after Everest their shame turned to pride. "If I'd known this, I probably would have strategized climbing mountains before," she says, laughing.

Nazreen describes herself as "the odd one out" at home in Bangladesh. She went to the U.S. at age 17 on a full college scholarship and then to India, where she worked with Tibetan refugees and discovered a passion for mountain climbing. In 2011, two years after returning to

Wasfia Nazreen holds the Bangladeshi flag atop Denali, North America's tallest mountain. She has climbed every continent's highest peak.



Bangladesh, she announced a plan to summit the highest peak on each of the seven continents. Timed to the 40th anniversary of Bangladeshi independence, her goal was a celebration of progress for women. But she discovered there was still work to do when her critics mounted attacks: "They didn't want to see a woman on top," she says. "Literally."

In November 2015 she planted the Bangladeshi flag on Oceania's Puncak Jaya and became one of some 50 women to accomplish the seven-summit feat. Already that challenge has paled in comparison to what's next: using Ösel Bangladesh, her new foundation, to build a support network for young women in her country and then across South Asia through education and outdoor training. So far, three fathers have contacted her to say they named their daughters Wasfia. "I'm not saying this out of ego," she says. "But they're thinking bigger for their daughters, and this is such a non-traditional thing to imagine." —*Nina Storchlic*



Thandiwe Mweetwa measures a sedated lion in Zambia. She's pushing for full monitoring of lion trophy hunting, which is likely to resume this year.

The rest of the 2016 emerging explorers: Asha de Vos, marine biologist and ocean educator; Marina Elliott, biological anthropologist; Panut Hadisiswoyo, conservationist; Naftali Honig, wildlife crime investigator; Jedidah Isler, observational astrophysicist; Yukinori Kawae, archaeologist and Egyptologist; David Lang, maker and writer; Jeffrey Marlow, geobiologist, writer, and educator; Genevieve von Petzinger, paleoanthropologist; Gao Yufang, conservationist

# world beat

EVENTS & OPPORTUNITIES • ADVERTISING & PROMOTIONS



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## Basic Instincts

A genteel disquisition on love and lust in the animal kingdom

# Truly Fatal Attraction

In a fairy tale by the brothers Grimm, a piper's music lures rats to their doom. What leads the mouselike creature pictured here to its death? Its own libido.

Life is short and sex-centered for the genus *Antechinus*. Six months after they're born, the small, carnivorous marsupials reach adulthood. For five more months, they gain weight that they'll burn off having sex, says mammalogist Andrew Baker of Australia's Queensland University of Technology. Then the animals enter "a one- to three-week period where they spend all their time mating." Males fight over females, promiscuous mating ensues, and a single coupling can last 14 hours. Small wonder, as Baker observes, that "both sexes become really stressed."

As a human does when stressed, an *Antechinus* produces the hormone cortisol—useful in small amounts but poisonous in large ones. *Antechinus* males "also have all this testosterone coursing through them from trying to get girls," Baker says, and the testosterone keeps cortisol gushing when it should shut off. As the cortisol hits toxic levels, males' immune and other systems fail, and they drop dead by their first birthday. The *Antechinus* population has been halved—until the females bear their annual litters of four to 14 jelly-bean-size young, which, six months later, will be adults.

"If you had to sit down and design a reproductive system," Baker says, "you wouldn't come up with this one." —*Patricia Edmonds*

### HABITAT

Forested and grassland areas in Australia

### CONSERVATION STATUS

One in five *Antechinus* species is listed as threatened. There may be only 500 alive of the recently discovered *Antechinus arktos*, listed as endangered.

### OTHER FACTS

Depending on the species, an *Antechinus* can weigh from 0.5 to 7 ounces.

**Only 22 species of mammals practice suicidal reproduction, and 15 of them are *Antechinus*.**



NATIONAL GEOGRAPHIC

PHOTOARK  
JOEL SARTORE

This male brown *Antechinus* was photographed at Australia's Healesville Sanctuary.



**Manú National Park**  
is a natural wonder,  
protected—for now—  
by isolation and the  
indigenous hunters  
deep in its rain forest.

No more than a thousand Matsigenka people live in the national park along the Manú River and its tributaries. They farm and hunt in the forest but only for their own subsistence. Spider monkeys are a favorite quarry—and also favorite pets.



# *PERU'S WORLD APART*



Clay cliffs just outside Manú National Park form a natural salt lick that attracts various animals, including these red-and-green macaws. More than a thousand species of birds—10 percent of the world total—live in and around the park.





Two women from the “uncontacted” Mashco-Piro tribe watch the photographer’s boat pass on the Alto Madre de Dios River. A century after their settled forebears likely fled into the forest to avoid enslavement by rubber barons, a small group has begun appearing on the riverbank



By *Emma Marris*

Photographs by *Charlie Hamilton James*

**E**lias Machipango Shuverireni picks up his long, palm-wood bow and his arrows tipped with sharpened bamboo. We're going monkey hunting in Peru's Manú National Park—a huge swath of protected rain forest and one of the most biodiverse parks in the world.

The hunt is legal. Elias belongs to an indigenous group called the Matsigenka, of whom fewer than a thousand live in the park, mostly along the banks of the Manú River and its tributaries. All the park's indigenous inhabitants—so-called uncontacted tribes as well as the Matsigenka—have the right to harvest plants and animals for their own use, but they can't sell park resources without special permission, and they can't hunt with guns. Elias and his wife—people in Manú go by first names—grow yucca, cotton, and other crops in a small clearing on the Yomibato River. Their children gather fruit and medicinal plants. Elias catches fish and fells trees. And he hunts, especially spider monkeys and woolly monkeys—favorite foods of the Matsigenka. Both are threatened species.

Things have been this way for a long time, but the Matsigenka are growing in number, which worries some biologists who love the park. What if their population doubles? What if they start using guns? Could the monkey populations survive? And without those species, which disperse the seeds of fruit trees as they snack through the jungle, how would the forest change?

As the forest outside the park becomes

increasingly fragmented by natural gas extraction, mining, and logging, protection of the park becomes more crucial. So does this question: Are the people who live inside it good for it or bad? And is the park good for them?

Elias, 53, has curly black hair and an intense gaze. He's wearing a green soccer jersey, shorts, and sandals made from old tires. His home is a clearing with several open, palm-thatched buildings. As we cross his fields and plunge into the jungle on a muggy day last November, we're accompanied by his son-in-law Martin, his daughter Thalia, and a teenage granddaughter. Like Elias, Martin is armed with a bow and arrows. Thalia wears a handwoven sling to carry back plants. I've got Glenn Shepard, an anthropologist who has spent 30 years working and living among the Matsigenka and is one of the few outsiders fully fluent in their language.

Five minutes into the jungle we hear the calls of dusky titi monkeys. The hunters don't break stride; titi monkeys are target practice for teenagers. Another five minutes and we hear a troop of capuchin monkeys. Elias pauses, even raises his bow, but lets them go. He's holding out for something more *poshini*—that is, delicious.

A pet saddleback tamarin hangs on tight to Yoina Mameria Nontsolega as the Matsigenka girl takes a dip in the Yomibato River, deep inside Manú National Park.



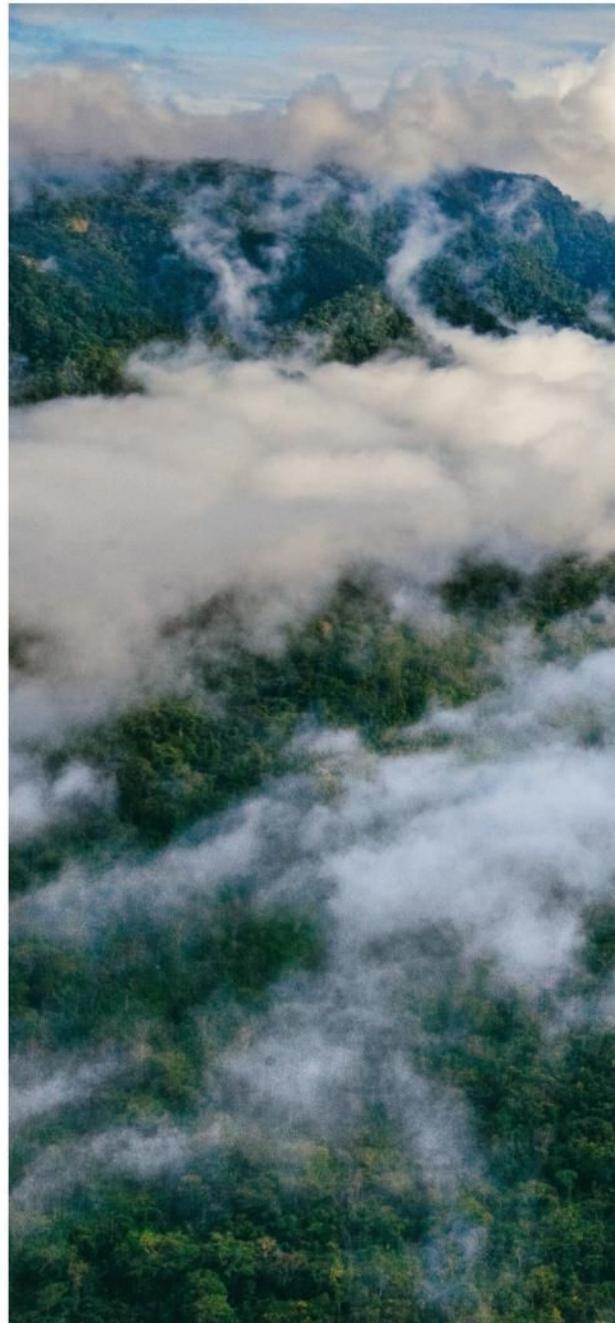
We begin a tour of fruit trees and soon find several with recently dropped fruit. Monkeys have been here, but they're gone. Another hour goes by. At last Thalia's face lights up. *Osheto*, she says in a whisper—spider monkeys.

Now we see them, leaping at high speed through the crowded treetops, 60 to 100 feet above our heads. The hunt is on—and I, for one, am stumbling over roots, crashing through vines, slipping in mud, and running into thorns and spiderwebs while watching for snakes. Elias and his family are more graceful, but this jungle is difficult even for them. Hunting animals on the ground—fat peccaries, say—is tough enough. To bag a spider monkey, a Matsigenka hunter first has to catch up with it, then shoot more than six stories straight up at an erratically moving target.

He has several natural medicines to improve his chances. A day or so before a hunt he'll often drink ayahuasca, a potent, psychoactive mix that makes him vomit. It's supposed to purge him of harmful spiritual influences and put him in contact with the spirits that control his quarry. To sharpen his aim, he may squeeze a plant's juice into his eyes. During the hunt itself, he may chew some sedges, or *piri-piri*, that harbor a psychoactive, mind-focusing fungus. Shepard, who has tried them, calls them jungle Ritalin.

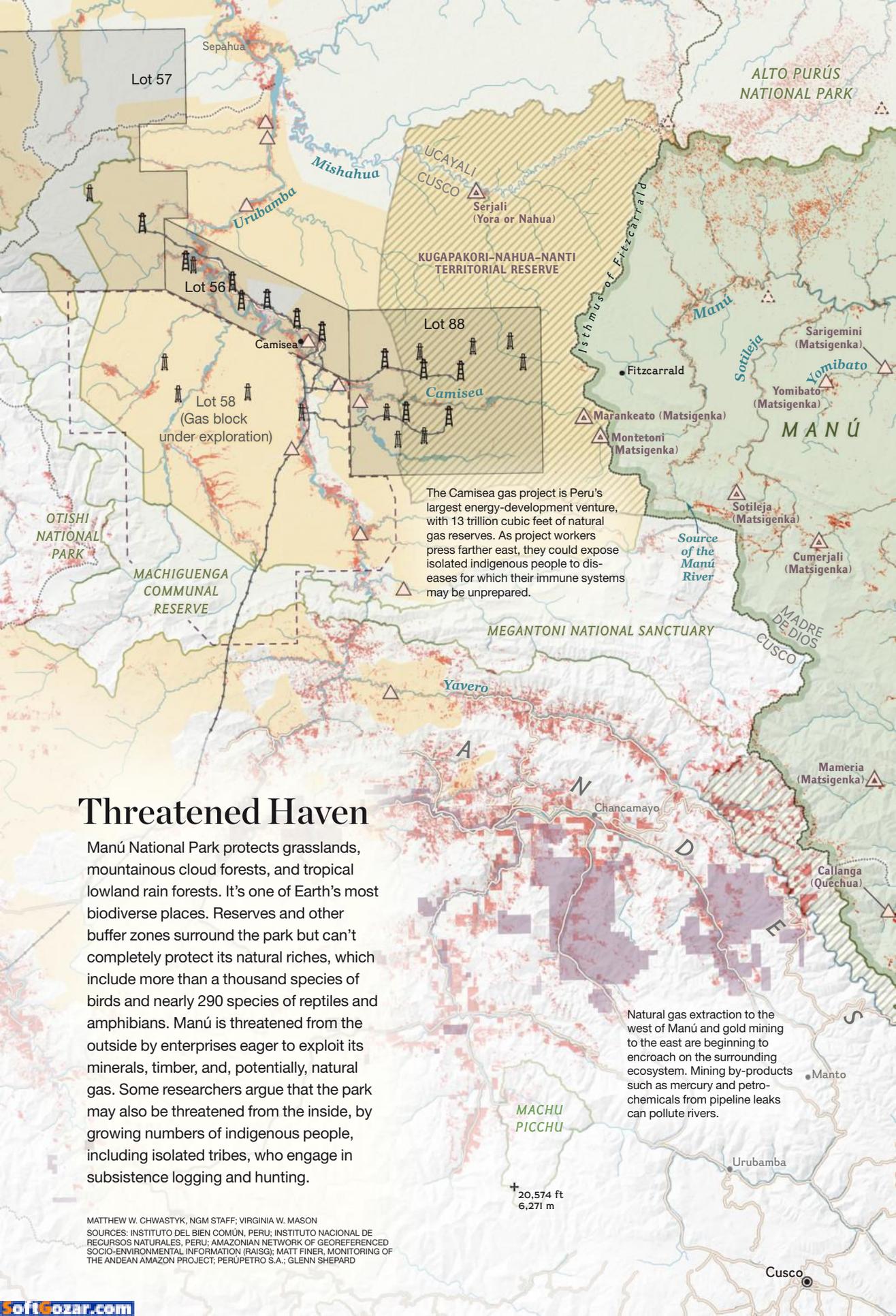
But none of these performance enhancers guarantee success. We follow Thalia's signals as the dark, long-limbed shapes flit away far above us. Elias bounds ahead, catches up with a female, takes aim, and looses an arrow. He misses. The monkeys bolt. There's no chance for a second shot. If he'd had a shotgun, the monkey would have been dead.

**N**o guns, no roads, no buying or selling: There may be people in Manú, but it feels far, far away. The most popular route to the park involves a 10-hour ride down the Andes on a hair-raising road, followed by five hours in a motorized canoe on the Alto Madre de Dios River to its confluence with the Manú River. The main park entrance is near there, but to visit Elias's village and others—which





The Alto Madre de Dios flows along the southern boundary of Manú Park. To enter the park, visitors typically take a motorized canoe downstream for five hours—longer if the water is low—then continue upstream on the Manú River.



The Camisea gas project is Peru's largest energy-development venture, with 13 trillion cubic feet of natural gas reserves. As project workers press farther east, they could expose isolated indigenous people to diseases for which their immune systems may be unprepared.

Natural gas extraction to the west of Manú and gold mining to the east are beginning to encroach on the surrounding ecosystem. Mining by-products such as mercury and petrochemicals from pipeline leaks can pollute rivers.

# Threatened Haven

Manú National Park protects grasslands, mountainous cloud forests, and tropical lowland rain forests. It's one of Earth's most biodiverse places. Reserves and other buffer zones surround the park but can't completely protect its natural riches, which include more than a thousand species of birds and nearly 290 species of reptiles and amphibians. Manú is threatened from the outside by enterprises eager to exploit its minerals, timber, and, potentially, natural gas. Some researchers argue that the park may also be threatened from the inside, by growing numbers of indigenous people, including isolated tribes, who engage in subsistence logging and hunting.

MATTHEW W. CHWASTYK, NGM STAFF; VIRGINIA W. MASON  
 SOURCES: INSTITUTO DEL BIEN COMÚN, PERU; INSTITUTO NACIONAL DE RECURSOS NATURALES, PERU; AMAZONIAN NETWORK OF GEOREFERENCED SOCIO-ENVIRONMENTAL INFORMATION (RAISG); MATT FINER, MONITORING OF THE ANDEAN AMAZON PROJECT, PERUPETRO S.A.; GLENN SHEPARD

Declared a national park in 1973 and expanded in 2002, Manú protects more than 6,600 square miles, including its namesake watershed. In 1977 UNESCO designated the park and one of its buffer zones a biosphere reserve.



**Protected areas**

- Indigenous territory
- Manú National Park buffer zone
- Manú Biosphere Reserve boundary

**Settlements (indigenous group name)**

- Indigenous community
- Indigenous community in initial contact
- Isolated group in area
- Road
- Proposed road

**Deforestation 2000-2013**

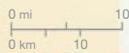
- Active deforestation

**Mining**

- Under exploration
- Planned or potential

**Natural gas**

- In production
- Under exploration
- Pipeline
- Gas-drilling platform
- Exploratory well



**NATIONAL PARK**

Manú's remoteness has been the park's salvation. A controversial proposed road linking villages outside the park with Cusco and Boca Colorado could mean greater economic opportunities but could also facilitate illegal logging and mining.

In the buffer zones Peruvian authorities can promote conservation efforts, indigenous community projects, and sustainable activities such as ecotourism.



requires permission from the Peruvian government—Shepard and I had to motor for several more days up the Manú and its tributaries. The remoteness has protected the park from loggers and miners, and also from tourists. A few thousand at most visit each year.

At 6,627 square miles, the park covers the entire watershed of the Manú River, from grasslands at nearly 13,000 feet, on the eastern flank of the Andes, down through moss-draped cloud forest to the lowland rain forest of the westernmost Amazon Basin. It's a sumptuous, extravagant, overwhelming landscape. The region is traversed by tapirs, crowned by flights of scarlet macaws, veined with snakes. Ninety-two species of bats own the night sky; 14 species of primates swing through the trees, pursued by harpy eagles with six-and-a-half-foot wingspans. Butterflies are everywhere: scarlet knights; giant blue morphos; tiny, transparent glasswings. And on every surface, vertical and horizontal, there are ants. At night the foliage sparkles in your headlamp with what looks like pixie dust—the shining eyes of hundreds of thousands of insects.

There are a thousand tree species of all sizes, many of them woven together with thick lianas. Among the most ecologically important are figs. Because they fruit all year long, they sustain many animals through the dry season.

“I've seen a hundred monkeys in a single tree,” says Duke University ecologist John Terborgh. “On moonlit nights, if they're hungry, they'll get up at two in the morning and be there at 4 a.m.” Terborgh and his colleagues took over the Cocha Cashu Biological Station soon after the park was established in 1973. The research area covers less than one percent of the park but harbors 70 species of nonflying mammals and more than 500 species of birds.

“Manú is one of the few places in the tropics where there is an opportunity to experience and study biodiversity in its full glory,” says Kent Redford, an ecologist at Archipelago Consulting in Portland, Maine. “It is an extraordinary flowering, relatively little impacted by the human hand.”





Loggers remove softwood timber just south of Manú Park. Valuable hardwoods such as mahogany have already been logged illegally along nearby roads and rivers. But the park itself has largely been protected by guards, and its inaccessibility.

**R**ich as it is, Manú isn't an untouched Eden. There's plenty of history here. Many tribes speaking multiple languages lived along the Manú River's banks, so highly populated that one tribe called it the River of Houses. Inca and then Spanish conquistadores, facing the impenetrable forest and skilled warriors, failed to subjugate the settled tribes. But trading with the Inca connected them to the wider region. And Spanish diseases, which killed untold numbers, began connecting the region to the wider world.

In the 1890s this world was again turned upside down. Rubber for tires was selling at get-rich-quick prices. Rubber barons hired Amazonian natives to tap trees and also to raid

the Piro—who are now often called Yine, after their language—moved down the Manú River, eventually establishing villages such as Boca Manú and Diamante on the Alto Madre de Dios River. Into the void stepped the Matsigenka. They moved in from the west and south, first to the remote headwaters, then eventually to the vacated Manú riverfront, after missionary schools were established there in the 1960s.

In communities such as Tayakome and Yomibato the Matsigenka now have not only schools but also medical clinics and communal satellite phones. The charity Rainforest Flow recently installed sanitation and water-treatment systems that deliver clean water to nearly every household. People in these sprawling

**It's easy to imagine we're watching people untainted by civilization, living in primeval bliss. I have to remind myself that they're more like refugees from genocide.**

other tribes for slave labor. One ambitious baron, Carlos Fermín Fitzcarrald, got more than a thousand people, mostly members of the Piro tribe—relatives of the Mashco-Piro who lived along the Manú—to carry a riverboat piece by piece over the isthmus separating that river from the upper Mishahua. His arrival opened up the Manú Basin to rubber tapping.

With Piro as his troops, Fitzcarrald tried to enslave the tribes along the Manú. Hundreds died resisting him; the river is said to have flowed red. Another tribe, the Toyeri, was almost wiped out. Some Mashco-Piro died, and others are thought to have fled into the forest. It's their descendants who've made news lately by coming out of the forest and seeking contact.

In short, the political geography of Manú is neither primeval nor isolated. It has been buffeted for more than a century by the forces of a globalized economy, in which technological innovation and consumer demand in one part of the world shape—and often damage—the lives of those who live near valuable natural resources.

After the rubber boom collapsed, most of

settlements—from one house you generally can't see the next—hunt, gather, and grow their own food. But they also play Peruvian pop on boom boxes and wear knockoff Crocs and T-shirts that say things like “Palm Beach,” along with their traditional clothes. The Matsigenka who live near the headwaters still wear hand-spun cloth and get by without money or metal tools. Over time they've been trickling into the riverfront villages, looking for axes and medical care.

The Mashco-Piro are more isolated still. Since the rubber days they've kept to themselves, hunting and gathering deep in the forest. But they've likely been well aware of the outside world, and in the past five years members of one group have begun appearing on the beaches of the Alto Madre de Dios, just outside the park, beckoning to boats and gesturing for food. They may have been driven out by the intrusions of mining, natural gas, and logging industries or by a recent decline of the peccaries, which are a major food source.

Tourists and local people have given things to them, sometimes with tragic results. In

2011 some Mashco-Piro killed Nicolas “Shaco” Flores, a Matsigenka man who’d given them tools and food for years. In 2015 they killed a young man in the village of Shipetiari.

Romel Ponciano is one of several Yine from villages like Diamante who work for the Peruvian Culture Ministry trying to build friendly relations with their isolated kin. He and the others staff a post on the Alto Madre de Dios, across from a riverbank where a group of Mashco-Piro has often appeared.

The riverfront post is named Nomole, “brothers” in Yine. Still, Romel’s initial contacts with the isolated group were stressful. They asked him to shoot an arrow and take off his clothes. They stared into his eyes and mouth, smelled his armpit, felt his testicles—all to find out whether he really was a brother. Romel has since warmed to them—they nicknamed him Yotlu, meaning “little river otter”—but he never turns his back on them. “Maybe in five or 10 years they will walk around like us,” he says. “They will still have their arrows for hunting, but not for killing. They kill because they are afraid.”

Doctors who’ve examined the Mashco-Piro say that so far their isolation has kept them healthier than local settled indigenous people, who struggle with respiratory infections and dental bacteria transmitted by outsiders that can leave them coughing and toothless. But the Mashco-Piro’s isolation also means they have little or no immunity, so viral diseases like measles and yellow fever could easily kill them.

As we round a river bend on the way to Nomole, I catch a glimpse of moving figures on the far shore. We’re too far away to make out faces, but we can see their naked, sienna brown bodies against the beach of gray river rocks. They have a fire going, and white smoke billows upward. For our safety and theirs, to protect them from disease, we don’t seek to make contact.

Under the wide blue sky, surrounded by seemingly endless jungle, it’s easy to imagine we’re watching people untainted by civilization, living in primeval bliss. I have to remind myself that they’re more like refugees from genocide. Traumatized unto the fifth and sixth generation

by the rubber boom, living as hunter-gatherers where their forebears had farmed, they’re not uncontacted at all. They were contacted in the 1890s, plenty.

**T**he devastating rubber boom was followed by other resource booms. Timber, gold, natural gas—all are being wrested from the forest by poorly paid locals. They then rise in price as they make their way through middlemen to trade centers in the Andes. Aside from some small-scale illegal logging inside the park, Manú remains a dark green exception in this landscape of extraction.

Just outside the park’s northwestern boundary, pipelines carry the output from the rich Camisea fields, which produce up to 1.2 billion cubic feet of natural gas a day and contribute enormously to Peru’s economy. Recent exploration to the southeast could tempt Peru to run a pipeline through the park to connect with the Camisea lines. David Hill of the *Guardian*, who has reported from the region for years, says one company, Pluspetrol, is interested in exploring inside the park. Whether the Manú Basin becomes an oil and gas center, Hill says, “depends on Peruvian and international civil society. It depends on the Matsigenka and the Yine.”

Park guards in Manú, though spread thin, are a deterrent to small-scale loggers, miners, and hunters, but most observers agree that Manú’s sheer remoteness has been its best defense. “It is protected by its inaccessibility,” says Ron Swaisgood, scientific director at Cocha Cashu. But “gold mining and oil exploration are starting to eat away at the buffer areas. Some of these degradations can leak into the park.”

A road would speed that leakage considerably, and the governor of the Madre de Dios region, Luis Otsuka, is promoting one that would extend farther along the Alto Madre de Dios to Boca Manú. No longer would tourists—or loggers, or miners—have to use expensive, gas-guzzling boats to get there. The village of Diamante lies along the proposed road. Its residents are eager for it, so eager that they’re working hard to get it built.



The giant otter grows up to six feet long and eats up to eight pounds of fish a day. Once common in South American lakes and rivers, playing in noisy families, it's now endangered in most areas. But the population in Manú has risen since commercial hunting was banned in 1973.



When we arrive in town on our way out of the park, it seems deserted. Brightly painted houses cluster along the river. Fleece blankets with pictures of tigers and peacocks dry in the sun. The silence is interrupted only by a few kids and some roving chickens and pigs.

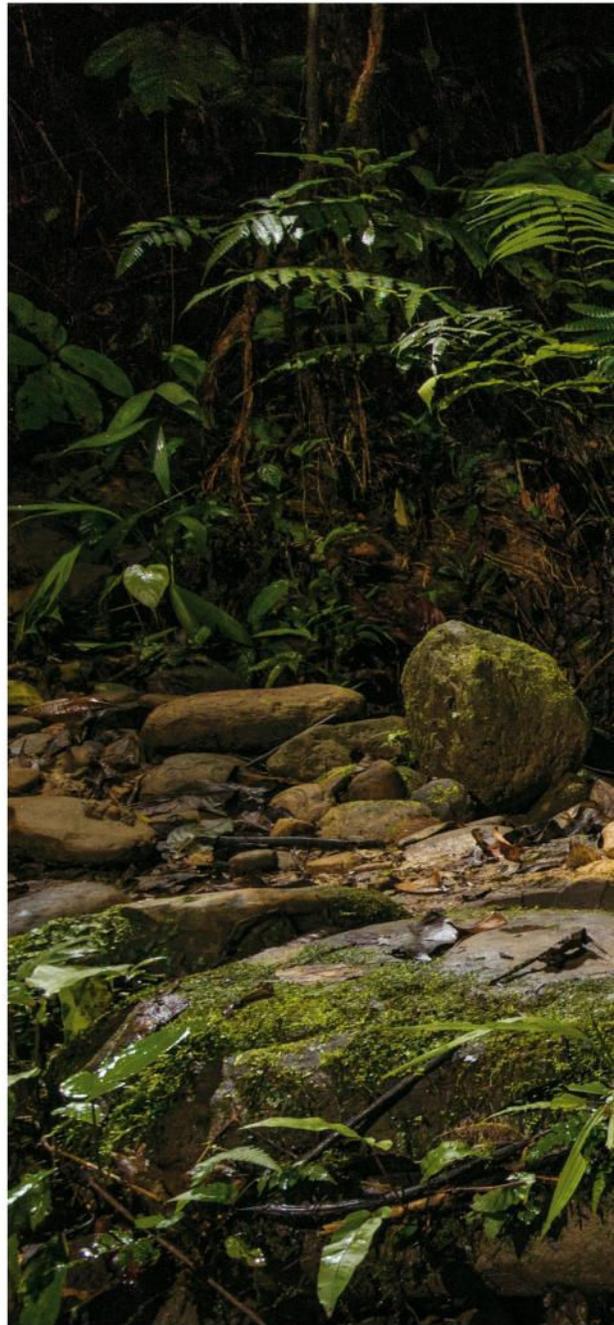
We find one shop open and have a beer, our first cold drink in weeks. As the day lengthens, men start filtering back into the village, each holding a machete, his back wet with sweat. Among them is village president Edgar Morales. He says the men have been cutting a trail for government surveyors, so that they can collect the data needed to gain approval for the road.

People in Diamante, Morales explains, grow a lot of bananas and take them by boat to sell in nearby Boca Manú. But they know they could get a better price in Cusco, and in general they feel ripped off. “Our kids who go out and work lumber get nothing,” Morales says. “We have good flatlands here, with loamy, dark earth. We can grow plantains, papayas, pineapples, yucca to sell in Cusco. Soon people here will have their own cars. People have warned us that bad people will come in and take our land, but we have 800 people here. We can defend ourselves.”

Peru’s Environment Ministry, which runs the park, opposes the road, and so do most of the indigenous residents of the region, according to park director John Florez. “The people demanding it are the colonists,” he says. “Diamante is the only native community asking for it.”

Mauro Metaki, a genial, mission-educated schoolteacher in Tayakome, is opposed to the road and frustrated that a few people in his community are in favor of it. “The regional governor is lying,” he says. “They are fools to believe him. He’s making them all excited saying that the road will benefit them. It will benefit him and his white friends, who will come in and take the lumber, the animals, and the gold. There will be nothing left for the Matsigenka.”

Sitting on the open first floor of his house, looking out over wild palms and cultivated bananas, mangoes, and sugarcane, listening to the soulful hoots of howler monkeys from across the river, Metaki explains how he sees Manú.





A camera trap caught this ocelot on a nighttime prowl. Ocelots weigh up to 33 pounds; their diet includes rodents, lizards, sloths—and also his chickens, says hunter and farmer Elias Machipango Shuverireni. Still, he admires the cats' beauty.

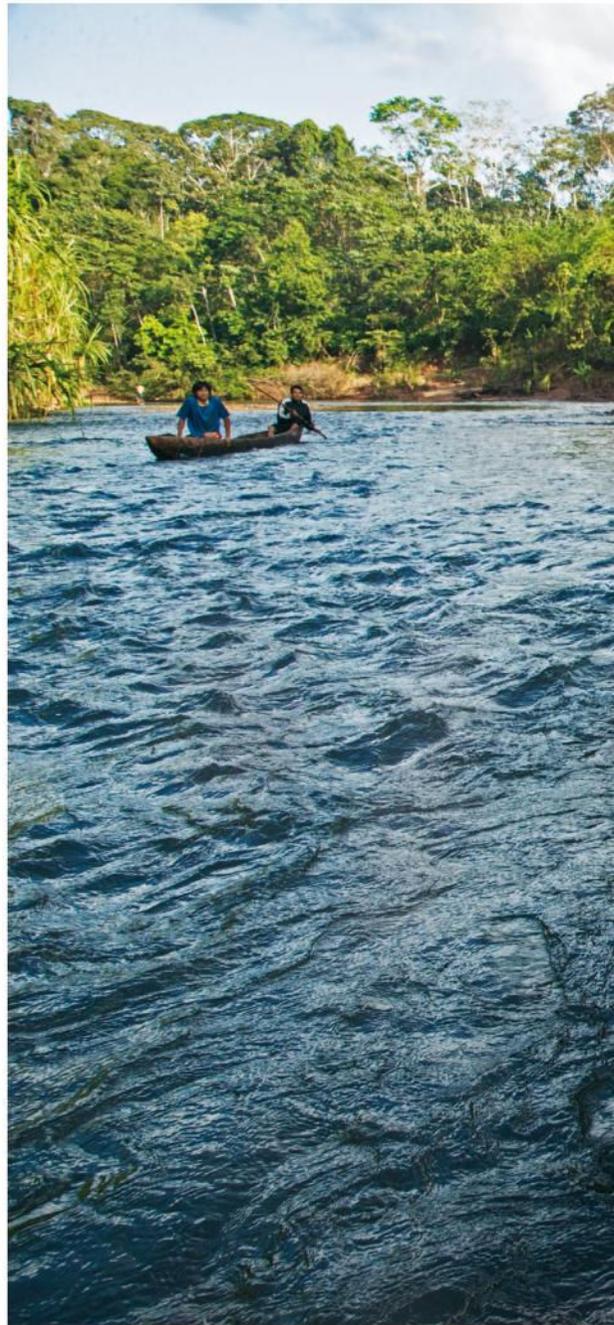
“There’s a park, but there are also people living here—right in the middle of it,” he says. “Sure, we hunt and fish, but we take just a little to feed our families. We know how to take care of the forest.”

**J**ohn Terborgh, the Duke ecologist, has for many years expressed the hope that the Matsigenka would leave the park—voluntarily, he emphasizes—for the wildlife’s sake and for their own economic opportunity. “Do I think there ought to be permanent settlements inside national parks?” he asks. “No. In this respect the U.S. model is a good one I am happy to endorse. Would you like to have farms and villages in Yellowstone or the Great Smoky Mountains?”

Some young Matsigenka are indeed beginning to leave, or at least to come and go; secondary schooling inside the park is limited. Samuel Shumarapague Mameria, a former president of Yomibato, says that young men who’ve left come back changed. “When they are here, they drip herbs in their eyes and they eat the piri-piri,” he says. “When they go downriver, they eat rice and onions and lose their hunting ability. Their heads are full of books and learning.” Similarly, he says, “when girls go downriver, when they come back, they are too lazy to spin cotton. Their souls only think about reading and writing. Their souls and bodies are full of paper.”

Some who go downriver don’t come back at all, taking jobs in logging and other professions. “You see young men leaving for work, abandoning a wife and kids, and starting new families outside,” says biologist Rob Williams. Most of the Matsigenka I talked to wish that there were adequate schools inside the park—and that their children would stay there.

The Matsigenka’s image of Manú, like their image of nature, includes them. Whereas Terborgh and other Western biologists come from a culture that separates humans from nature—both philosophically and as a conservation strategy—the Matsigenka see themselves as part of the natural order. They hunt monkeys, and so do jaguars. Key plants and animals have spirits and agency, just as people do, and there’s





Matsigenka schoolchildren on a field trip eat fish caught by a traditional method: Barbasco roots are pounded into a paste and swirled in the river. The roots release rotenone, a toxin that stuns fish but not the people who eat them.

Elena Chogótaro Oyeyoyeyo (foreground, with her baby) is among the Matsigenka from isolated areas who come to the settled village of Yomibato to get goods and services. Silverio Mambiro Shinti (standing) came to fish and to get an ax. Then he stayed and built a house.







For the Matsigenka who live in the village of Yomibato, the river of the same name is a vital source of food and transportation. It's also where students from the village school have their daily swimming lessons and frolic during recess.



no hard boundary between them. In Yomibato I was told matter-of-factly about a nice old man who turned into a jaguar and started killing chickens and dogs. Finally the jaguar was shot through the heart with an arrow and burned so that his spirit wouldn't come back again.

The Matsigenka and other indigenous people in the park are not only hunters; they're de facto armed guards. If all the people who live inside Manú were to leave in search of education and paid work, Shepard argues, other people would come in—and they'd probably be less willing to abide by the rules against guns and commercial extraction of resources. "There are no demographic voids in the Amazon," he says.

Today the Matsigenka act as an advance warning system. With their homes strung along the park's main rivers, they would notice if loggers or miners or coca farmers moved into its core, and with their deadly arrows, they—along with the Mashco-Piro—might be an immediate deterrent. In Brazil the Kayapo have been evicting illegal loggers and miners.

And as long as the Matsigenka don't use guns, Shepard says, their hunting isn't doing much harm. He and his colleagues asked dozens of hunters to record their hunting: the animals they killed, the ones that got away, and how long they traveled to find them. They found that the Matsigenka hunt five species enough to reduce their populations—spider and woolly monkeys, white-lipped peccaries, and two birds, the razor-billed curassow and Spix's guan.

But they also found that even if the Matsigenka population were to grow rapidly over the next 50 years, no more than 10 percent of the park would be depleted of spider monkeys—unless the hunters acquired shotguns. With guns they could quickly empty the forest of monkeys within a day or two's walk of their villages. If

the Matsigenka have so far abided by the park's firearms ban, it may be because they understand that guns might be at best a short-term boon.

**F**ive hours into our hunt Elias and his family are still scanning the treetops, looking for monkeys. Traveling along a ridge, we come across a mysterious, foul object—a wad of green leaves drenched in a dark liquid and covered with flies. Martin, Elias's son-in-law, explains that jaguars eat leaves and vomit them up, purging "just as we do, to be better hunters." Nearby Elias points out a wet stain of jaguar urine. "That piss is from now," he says.

Suddenly the jungle explodes with deep, urgent cries. An unseen troop of woolly monkeys, only a few yards down the ridge, is sounding a jaguar alarm. The cat is close. I freeze and feel a wash of adrenaline. Elias calmly sits down on a log and reaches into his net bag. He pulls out a few leaves of piri-piri and chews them.

Properly medicated, he plunges into the thick vegetation. He plans to take a woolly monkey and a jaguar too, if he can. Jaguars don't just compete with the Matsigenka for monkeys; they also kill children.

The rest of us wait, then creep down the trail. A moment later the rain begins. It shoots from the sky with the ferocity of a pressure washer. The noise of our movements now completely drowned out by the cacophony of a million glossy leaves being battered by raindrops, we sprint off the exposed ridge and take shelter under the trees. In a few minutes Elias appears, smiling, empty-handed, skunked by the storm.

Back at home he has no monkey meat to give his wife. But a baby spider monkey is warming itself by the fire. The Matsigenka love to tame forest animals as pets. When they do manage to kill a spider monkey, it often turns out to be a female slowed down by young offspring, and they bring the orphans home. Once the monkeys grow up, they're released back into the forest. This baby monkey is drenched to the skin, like the rest of us. We join it by the fire. The smoke rises above the papayas and floats across the Yomibato, out over the forest. □



Listen to photographer **Charlie Hamilton James** talk about what it's like to be on assignment in Manú. Part of our *Exposure* series, the video interview can be found at [ngm.com/Jun2016](http://ngm.com/Jun2016).

HECTOR SKEVINGTON-POSTLES



Alain Nonchopopo Chogotaro Asuso makes his own bows and arrows. For now, he and other Matsigenka hunters are honoring the park's ban on guns.

A photograph of an ancient Egyptian mummy lying on a gurney in a museum hallway. The mummy is wrapped in yellow and green striped bandages, with a golden mask and a golden collar. The hallway has blue doors on the left and a red beam at the top. The text is overlaid on the right side of the image.

# *Plundering the Past*

*The illegal antiquities trade is booming, wreaking havoc on the world's archaeological heritage.*



Seized by federal agents, an Egyptian coffin sits in a secret warehouse in New York.



*The damage done by looters at many ancient*



Satellite images of Mari, an ancient Mesopotamian city in eastern Syria, show a dramatic increase in looting pits between August 2011 (top) and November 2014. The structure at the center is a roof over the ruins of a once grand palace.

PHOTOS: IMAGE ©2016 DIGITALGLOBE, INC. ANALYSIS: AAAS



2011

*sites is so great it's visible from space.*



2014



*A debate is raging over how to save the masterpieces*



Looters in Cambodia often decapitate statues, as heads are easier to smuggle. PHOTOGRAPHED AT ANGKOR CONSERVATION, SIEM REAP





*of the past. Should we buy them from looters?*



By Tom Mueller

Photographs by Robert Clark

warehouse at a secret location in New York City, where federal authorities hold seized artifacts from around the world: a huge stone Buddha from India, terra-cotta horsemen from China, reliefs from Iraq, Syria, and Yemen. All are orphans of the illegal antiquities trade, victims of the international battle over cultural heritage.

From murderous temple thieves in India to church pillagers in Bolivia to hundred-man bands of tomb raiders in China's Liaoning Province, looters are strip-mining our past. Like most illegal activities, looting is hard to quantify. But satellite imagery, police seizures, and witness reports from the field all indicate that the trade in stolen treasures is booming around the world.

In Egypt, Parcak has pioneered the use of satellite imagery to measure looting and site-encroachment damage. Her research tells a grim tale: A quarter of the country's 1,100 known archaeological areas have sustained major damage. "At the current rate of destruction, all known sites in Egypt will be seriously compromised by 2040," she says. "It's heartbreaking."

Over the past two decades a series of high-profile court cases and repatriations have exposed the dark side of the antiquities trade, bringing to light criminal networks of diggers and traffickers who sell looted artifacts to Madison Avenue galleries and renowned museums. In 2002 Frederick Schultz, a prominent Manhattan dealer in ancient art, was sentenced to 33 months in federal prison for conspiring to receive stolen Egyptian objects. In 2006 the Metropolitan Museum of Art, under pressure from the Italian government, agreed to return the famous Euphronios krater—a wine-mixing bowl looted from an Etruscan tomb near Rome. And in recent years the drumbeat of war and turmoil in many antiquities-rich countries, culminating in the sack of ancient Mesopotamia by the Islamic State (ISIS), has sparked concern that the antiquities trade is helping fund terrorism.

Yet the debate about how to halt looting has reached an impasse. Archaeologists blame the

## *The lady in the striped wig*

with the staring eyes lies on a brightly lit table as the professor hovers a palm's breadth from her face. "Still in remarkable condition...extremely well preserved," the professor murmurs. As her gaze glides down the victim's body, painted on the lid of her coffin, she points out a fresh cut across the upper thighs, and symbols of the god Amun, an ibis, and magic spells from the Book of the Dead. "And here is her name and title: Shesep-amun-tayesher, Mistress of the House. By reading it aloud, I fulfill her wish to be remembered in the afterlife."

The Egyptian noblewoman has been dead some 2,600 years. Sarah Parcak, an Egyptologist at the University of Alabama at Birmingham, is examining her inner sarcophagus, one of three wooden cases that, nested like Russian dolls, once cradled her mummified body, the odor of which lingers in the coffin. Looters sawed this sarcophagus into four pieces and shipped it by airmail to the United States, where an antiques restorer put it back together. Months later customs agents discovered the coffin stashed at the home of a Brooklyn antiquities dealer. It lies in a

antiquities trade for looting, claiming that many artifacts on the market were stolen. Collectors, dealers, and many museum curators counter that most antiquities sales are legal. Some argue that the ultimate goal of safeguarding humankind's artistic heritage obliges them to "rescue" antiquities from unstable countries—even if it means buying from looters.

THE STORY OF SHESEPAMUNTAYESHER gives these abstract questions a harsh clarity. By piecing together clues from Egyptologists, museum curators, and federal agents, I'll retrace her journey from a grave somewhere in Egypt, through a complex network of antiquities smugglers, handlers, and dealers, to this high-security holding tank in New York City.

The first step is to locate Shesepamuntayesh-er's likely burial place. Based on her coffins' hieroglyphs and artistic style, Egyptologists at the University of Pennsylvania concluded that she lived around 600 B.C. A search of Egyptian coffin books and antiquities websites reveals a similar sarcophagus, of a woman with the same unusual name, reported to have been found at Abu Sir al Malaq, a site 60 miles south of Cairo.

In ancient times Abu Sir al Malaq, then called Busiris, was a prosperous city overlooking the floodplain between the Nile River and El Faiyum oasis. It was famed for its temples of Osiris, god of fertility and the afterlife, and for the splendid graves of its 4,000-year history. Today, in hazy sunlight, Abu Sir looks like a recently bombed battlefield. Craters and shafts gash the rolling sand where looters have rummaged in the earth with shovels, backhoes, and dynamite. In the process they've violated countless graves, leaving a grim scree of skulls and shattered bones around many looting pits.

Amal Farag, the head Antiquities Ministry official at Abu Sir and nearby sites, takes me on a tour of the site with five guards carrying

Kalashnikovs. A slender, upright woman of 49 with a hard mouth and gentle eyes, Farag picks up strips of cedar with wooden nails and traces of red pigment—fragments of ancient sarcophagi. "The looters keep only the good pieces and smash or throw down the rest," she says. "For every nice piece, they destroy hundreds."

Farag leads me to a shaft tomb in a hillside, angling down into a dark chamber. Here, in April 2012, she confronted three looters. During a routine visit to Abu Sir with a colleague, she noticed a taxi parked near the tomb. Coming closer, the two women came face-to-face with three tall, muscular men in galabia robes.

"I told my colleague, 'If you feel afraid, just pretend you're very proud,'" Farag says. Pride did the trick: After glaring at them wordlessly for a moment, the men climbed into the taxi and drove off.

Now Farag leads me into the tomb and points to the spot on the floor where she found two splendid sarcophagi that the looters had stashed under a blanket. As my eyes adjust to the gloom, I see niches cut in the rock walls of the chamber and tunnels leading to other chambers deeper in the hillside.

Perhaps Shesepamuntayesh-er was looted from a tomb like this. She would have lain in one of these niches, surrounded by the objects she'd cherished in life: jewelry, a walking stick, papyri containing magic spells, chests decorated with gods of the dead. Her ancestors and descendants would have occupied nearby niches, with their own treasures. If found intact, such a family tomb would open a bright window on the past. Even orphaned by looting as she is, Shesepamuntayesh-er is valuable because of her hieroglyphs and paintings, but properly excavated she'd be priceless—the difference between a page torn from a book and an entire book, set in a large library.

Farag and her colleague managed to haul the two coffins out of the grave and load them into their car so they could be moved to a safe place. On the drive back to ministry headquarters, they were chased by a Peugeot 504 that came within inches of their bumper. Finally, at an

## EXPLORER

Tune in at 8 p.m. on Sunday, June 5, to National Geographic Channel's Explorer series episode *Blood Antiquities*.

intersection, a truck cut off their pursuers and they escaped.

When we climb out of the tomb, the guards are scanning the neighboring fields and houses, assault rifles ready. Farag explains that local villagers feel no bond with ancient Egyptian culture and pillage their past in order to survive in the present. Poor residents of many archaeologically rich countries think this way, working as low-paid “subsistence diggers.”

Looting increased after the 2011 revolution, when government security forces melted away. But Parcak’s satellite analysis indicates that a major spike had already occurred two years earlier, when the global financial crisis battered the Egyptian economy, driving up food and gas prices and unemployment. Some jobless people turned to looting to survive.

The guards escort us to the highway, and Farag shakes my hand a long time. “Get off the roads by dark,” she says.

This still feels like a revolution.

DIGGING UP THE PAST for profit has been a profession for thousands of years. The earliest known trial of looters in Egypt took place in Thebes in 1113 B.C. A gang of looters led by an enterprising quarryman named Amenpanefer pillaged rock-cut tombs. The quarryman and his accomplices were convicted and probably executed by impalement.

Invading armies also have carried off Egypt’s antiquities. Roman conquerors sent entire obelisks back home in purpose-built ships. From the 16th through the mid-20th centuries, when Egypt was dominated by foreign powers, countless pieces of its past were sent to cultural centers abroad by means of gift, trade, and coercion. Foreign archaeologists received a portion of the artifacts found in their excavations through an official arrangement with Egyptian authorities known as *partage*, from the French for “sharing.” Travelers bought antiquities from licensed dealers in Cairo, Luxor, and elsewhere. Such transactions often went undocumented, because antiquities were widely considered personal possessions. Though laws already

existed to protect antiquities, the modern concepts of cultural property—and looting—were still evolving.

Change in Egypt and beyond began in the 1950s, as colonial empires dissolved and former subject countries gained self-rule. Inspired by a new sense of national identity, many countries strengthened existing laws or enacted new ones to protect their past, which included still buried artifacts. In 1983 Egypt declared that all items of cultural significance and over a century old belonged to the state. In 1970 UNESCO adopted the Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property, which to date 131 countries have signed.

Twenty miles north of Abu Sir, I meet Mohammed Youssef, director of the rich Middle Kingdom sites of Lisht and Dahshur. In the chaotic months after the revolution of January 2011, gangs of looters ravaged the sites, sometimes using earthmovers and digging at night under floodlights.

Youssef shows me the rock-cut tomb where, soon after the revolution began, he and one of his inspectors rescued two magnificent limestone reliefs stripped from another tomb. Two groups armed with machine guns were arguing over the reliefs. “When we approached, they shot their guns in the air. They weren’t afraid of us at all,” Youssef remembers. His team returned when the gunmen were gone, however, and recovered the reliefs.

Might makes right in unstable areas, especially in wartime. During the Cambodian civil war, the Khmer Rouge and other military groups often controlled looters working in their territory. Likewise in Syria today, ISIS takes a cut of looting profits, but so do groups affiliated with the armies of President Bashar al Assad, the Kurdish YPG, and the opposition.

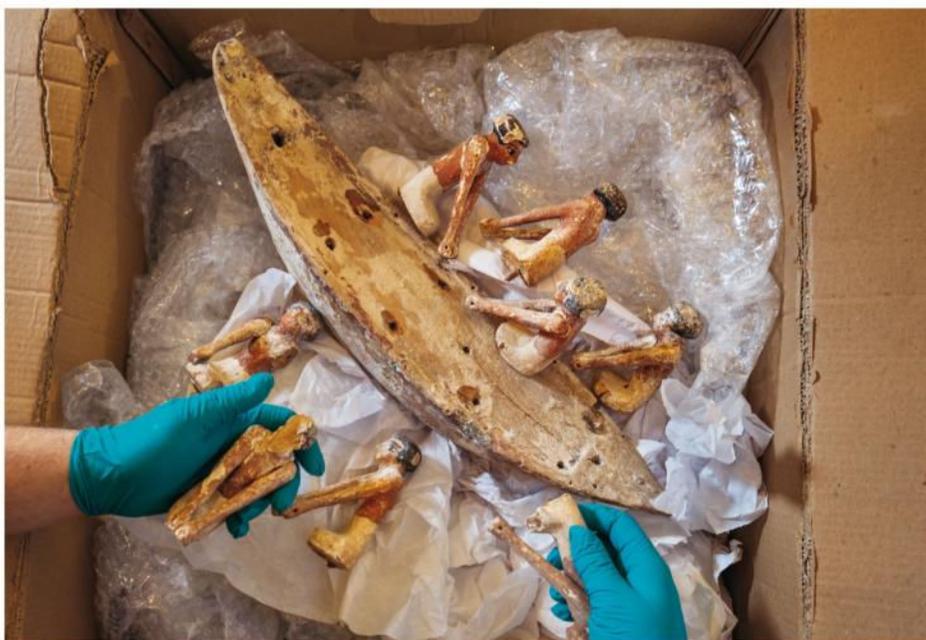
Youssef says important locals play a key role in Lisht and Dahshur. “There are very well known people involved in the looting. They are wealthy, prominent, untouchable.” One family in a nearby village, Youssef says, commands a large private militia.

Brig. Gen. Ahmed Abdel Zaher, the short, broad, jovial chief of operations of the Egyptian antiquities police, explains that many looting networks in Egypt are structured like four-tiered pyramids. (“Pyramids, of course!” he chuckles.) The base, perhaps three-quarters of the manpower, is made up of poor villagers whose knowledge of the local terrain and monuments is essential to finding loot. The second tier consists of intermediaries who collect objects from local diggers and organize workers into crews. Third-tier players, Abdel

In unstable areas, antiquities may follow the same distribution networks used by arms traffickers. “I often found caches of antiquities together with RPGs [rocket-propelled grenades] and other weapons,” says Matthew Bogdanos, a New York prosecutor and Marine Corps colonel who served in Iraq in the early 2000s.

Among the 50-odd ports, airports, and overland routes used to smuggle antiquities out of Egypt, I choose to visit Damietta. Shesep-amuntayesher’s coffins were shipped to the United States from Dubai, in one instance

Padding into the afterlife, Nile boatmen once accompanied an Egyptian on death’s long voyage. The artifacts were looted from a grave around 2009 and began a clandestine journey from Egypt to Dubai, then on to New York and Virginia, where they were seized by federal agents and eventually returned to Egypt.



Zaher says, spirit antiquities out of the country and eventually sell them to foreign buyers at the apex of the looting pyramid.

In Egypt, as in other source countries, profit margins rise steadily as artifacts move up the chain. Some second-tier looters have been reported to resell objects at 10 times the price they pay to diggers. “These are professional criminals, and antiquities are just one of the things they deal in,” Abdel Zaher says. He describes several recent drug raids in which police found antiquities alongside narcotics.

hidden in a container loaded with furniture. Damietta is one of Egypt’s busiest container-ports, doing a brisk business with Dubai, and is also the country’s furniture capital, where newlyweds go to furnish their first home. Port officials recently seized several shipping containers of furniture with illicit antiquities hidden inside.

It’s only 150 miles from Cairo to Damietta, but the drive takes me nearly five hours. The previous night insurgents had killed two police officers outside my hotel near Cairo, and sporadic RPG attacks have *(Continued on page 74)*



Grave robbing in Egypt is as old as the pharaohs. The tomb of Ramses V and Ramses VI in the Valley of the Kings near Luxor was plundered about 3,000 years ago, during a time of economic crisis and foreign invasion.



# LOOTING AND CONFLICT

## The ISIS Antiquities Pipeline

Destruction and theft of cultural antiquities are often linked to conflict. Since the outbreak of the civil war in Syria in 2011, looting has spiked to devastating levels. The so-called Islamic State (ISIS) has organized and regulated looting, using the plunder to help finance its operations.

Story and art by Matthew Twombly

### ANCIENT CITY OF PALMYRA, SYRIA

IN AUGUST OF 2015, ISIS FORCES TURNED THEIR CAMERAS ON, LINED THE PILLARS OF THE TEMPLE OF BAALSHAMIN WITH EXPLOSIVES, AND BLEW THE NEARLY 2,000-YEAR-OLD STRUCTURE TO PIECES.



IT'S ONE OF THE LATEST ACTS IN A LONG LIST OF SYSTEMATIC CULTURAL DEGRADATIONS PERPETRATED BY ISIS, PROUDLY DOCUMENTED AND PUT ON SOCIAL MEDIA FOR THE WORLD TO SEE.



THE CONFLICT IN SYRIA HAS SEEN INCALCULABLE ATROCITIES: PUBLIC EXECUTIONS, BEHEADINGS, KIDNAPPINGS, SLAVERY, AND THE KILLING OR DISPLACEMENT OF CIVILIANS.

THE REGION'S SHARED CULTURAL HERITAGE IS JUST ANOTHER VICTIM OF THE CONFLICT.



MAY 16, 2015. DAYR AZ ZAWR, SYRIA.

U.S. SPECIAL FORCES CONDUCT A NIGHT RAID ON AN ISIS STRONGHOLD. THEIR TARGET: THE HEAD OF THE ISIS DIVISION OF NATURAL RESOURCES, ABU SAYYAF.



ABU SAYYAF WAS KILLED IN THE ENSUING FIGHT, BUT U.S. FORCES RECOVERED SIGNIFICANT INTEL ON HOW ISIS LEVERAGES ANTIQUITIES TO FINANCE ITS OPERATIONS...



...PROFITING FROM THE BLACK MARKET TO TURN ARTIFACTS INTO GUNS AND AMMUNITION USED TO KILL AND TERRORIZE.

ISIS ALSO ISSUES SPECIFIC INDIVIDUALS WRITTEN LICENSES TO EXCAVATE WITHIN ITS TERRITORY, TAXING LOOTERS FOR WHATEVER THEY UNCOVER.



ENTIRE SITES ARE THUS DECIMATED, STREWN WITH HOLES AND PICKED CLEAN OF VALUABLE ARTIFACTS.



ISIS SEES THESE TREASURES, LIKE THE ONES AT PALMYRA, AS A WAY TO FORCE ITS IDEOLOGY ON THE WORLD AND DIRECTLY FUND ITS OWN ACTIVITIES.



THE REST OF THE WORLD SEES THESE TREASURES AS PRICELESS HISTORY, A SHARED CULTURAL HERITAGE, REDUCED TO RUBBLE.



Using toilet cleaner and a dental probe, middlemen clean antique coins dug up in Syria. Second-tier looters like these buy antiquities from diggers and sell them to smugglers and dealers, who resell them at a considerable profit.

MATTHIAS BRUGGMANN, CONTACT PRESS IMAGES



occurred on this road. Security is high, with regular roadblocks. I study the endless stream of trucks that pass them, piled high with onions, melons, caged chickens, and bales of wool. Any of these vehicles could have concealed Shesepamuntayesher's coffin.

ONCE SHESEPAMUNTAYESHER reaches Dubai, her trail finally grows clearer. On the basis of emails, customs declarations, and shipping manifests, prosecutors and federal investigators allege that three men were involved in sending her from Dubai to the United States: Mousa Khouli, a Syrian-born antiquities dealer based in New York City; Salem Alshdaifat, a Jordanian citizen based in Michigan; and Ayman Ramadan, a Jordanian based in Dubai. (Khouli eventually pleaded guilty to smuggling and making false statements to a federal agent and was sentenced to six months' home confinement. Alshdaifat pleaded guilty to a false official writing misdemeanor and was fined a thousand dollars. Ramadan remains a fugitive.)

Documents produced in litigation show that Alshdaifat sent snapshots of Shesepamuntayesher's coffin set to Khouli, and Ramadan and other parties eventually shipped the pieces—with misleading descriptions of the contents and value—to Khouli and a coin dealer in Connecticut. Khouli then used the same snapshots to resell the sarcophagi to a collector in Virginia. Investigators with U.S. Immigration and Customs Enforcement (ICE) allege that Ayman Ramadan handled antiquities looted from Syria, Jordan, and Libya. And emails between Alshdaifat and potential customers suggest his direct knowledge of looting in Egypt.

Brenton Easter, an ICE special agent who investigated the Shesepamuntayesher case, observes that international looting networks collaborate with each other far more successfully than law enforcement officials do with one another. He points out that the container that brought Shesepamuntayesher's outer sarcophagus to the U.S. was shipped by Amal Star Antiques, a Dubai company. According to Easter, Amal Star is owned by Noor Sham, of the Sham

family of antiquities dealers based in Mumbai, India. Investigative journalist Peter Watson, in his book *Sotheby's: The Inside Story*, alleged that members of the Sham family ran a major looting and smuggling operation that brought temple sculptures from India into the U.K. in the 1990s, sometimes via Dubai, and consigned several prominent pieces for sale with Sotheby's in London.

"I don't always know the good guys around the world, the other law enforcers in different countries," says Easter, surveying a world map pinned to his cube in the Department of Homeland Security's headquarters in New York. "But the bad guys all seem to know each other. It's like they're on speed dial." He says that a cooperator from the Middle East recently said that smugglers and dealers in the region are following his work carefully. He nods sharply, pursing his lips. "Guess that means I've got their attention. Good. Now I know I'm doing my job."

UNLIKE OTHER ILLICIT goods such as drugs or arms, looted antiquities start dirty but end clean (at least in appearance), their illegal origins being laundered as they pass through trafficking networks. Without a detailed provenance—a documented chain of ownership—it's impossible to know whether an object is fair or foul. Yet even many items that are collected legally lack a solid provenance, creating a dilemma that collectors, dealers, and museum curators face with every potential purchase.

Mousa Khouli sold Shesepamuntayesher to a pharmaceutical entrepreneur and antiquities collector named Joseph Lewis, who lives in Virginia. Lewis was indicted with Khouli and the others in May 2011 on charges that included conspiracy to smuggle and conspiracy to launder money. After nearly three years of intense litigation, he received a deferred prosecution agreement and the eventual dismissal of all charges. Lewis denies all wrongdoing, saying that he purchased the objects in the U.S. from a dealer who handled their importation.

If there is a collecting gene, Joe Lewis has it. His mother collected vinegar cruets, model

elephants, and duck decoys, while his father fancied firearms. Lewis himself started bottling ants shortly after he learned to walk. Now his 6,500-square-foot house holds all his mother's cruetts, ducks, and pachyderms, together with his own 30,000-specimen insect collection and an important assemblage of Egyptian antiquities.

"If you give me two of anything, I'll start a collection," says Lewis, a trim, chipper man of 60 whose speaking voice is almost a shout. He shows me cherrywood cases with drawer after

to own such an object, to live for a time beneath its calm, infinite gaze. Only a few months earlier I'd felt the same throb of wonder at Sotheby's while standing before a black diorite bust of a priest from the Temple of Karnak and knowing that, for \$500,000, it could be mine.

The future of antiquities collecting is threatened by the steady encroachment of U.S. and foreign laws, Lewis says, so he recently helped form an association to educate and defend collectors. He recites some of their tenets: Collectors, like museums, safeguard the cultural

A jumble of artifacts, some possibly fake, are offered for sale at an antiquarian shop in northwest Syria. Forged antiquities are a major industry in many countries, where they are fobbed off on unwary buyers, used to conceal real antiquities during shipment, and even substituted for original pieces in museums.

MATTHIAS BRUGGMANN,  
CONTACT PRESS IMAGES



drawer of purple-winged grasshoppers, iridescent butterflies, and giant wasps, all pinned out in death. We see his remarkable Egyptian collection, which includes several stunning sarcophagi housed in museum-quality cases complete with climate control.

As we admire a magnificent painted wood statue of Ptah-Sokar-Osiris, with his solemn golden face and mesmeric eyes, I feel the same pull that I've felt staring at a few other Egyptian antiquities, the same eerie sense of life stirring just below the surface. I understand the desire

property of humankind, which source countries often fail to protect. Even when an antiquity isn't excavated by archaeologists, it can retain significant scientific value. Many collectors add to public knowledge by sharing their antiquities with scholars and museums.

Through increased collaboration between the collecting and scholarly communities, a global registry of legitimate archaeological items could be compiled that would be a powerful tool against looting, Lewis believes. "If it ain't on the list, it can't be bought or sold," he





A guard at Abu Sir al Malaq surveys an ancient cemetery littered with human bones and looting holes. Looting is an old problem here, but pillaging surged after the global financial crisis and the Egyptian revolution of 2011.



Este



EDM  
EGA OS



OSORIO

06/08/01

16/12/84

RICARDO



VEGA

OSORIO

15-12-99

MUNDO  
SORIO

JUAN E. VEGA

A *huacero*, or tomb robber, offers a painted textile for sale in a cemetery in Huarney, Peru. But is this an authentic artifact looted from a pre-Inca site nearby or a modern fake? Only an expert can tell.

says of this hypothetical database. “If it’s not loaded, it’s looted. Done!”

Lewis is hardly the most outspoken advocate for collectors. James Cuno, president and CEO of the J. Paul Getty Trust, says that many recent repatriations have been mistakes, since the mission of encyclopedic museums is to collect, conserve, and share world cultural heritage—and objects returned to conflict areas often are at risk. To this end, he says one shouldn’t rule out buying looted artifacts if doing so would help save them from loss or destruction.

“Would you agree never to negotiate with terrorists, even if negotiating might save hostages?” he asks. “Simply not taking part in a market doesn’t make the market go away. These are not simple, risk-free, black-and-white questions.”

While the antiquities trade may have saved many masterpieces from destruction, the gray areas in which it operates leave it open to accusations that it drives looting—and seems to encourage some of its participants to deceive themselves about where their cherished objects come from.

Lewis says he prefers not to talk about the Shesepamuntayesher case but explains that he bought her set of coffins only after Mousa Khouli, the dealer, supplied a provenance that seemed plausible. (Khouli claimed that Shesepamuntayesher’s coffins came from his own father’s collection.)

Here’s the rub: The UNESCO convention of 1970, patrimony laws, and the court cases and repatriations of the early 2000s all should have made a detailed provenance ever more *de rigueur*. Yet many collectors, dealers, auctioneers, and museum curators still seem to feel entitled to the same secrecy and anonymity that traditionally have cloaked the antiquities trade. Private sales at the major auction houses are

on the rise, and vague provenances like “from a private Swiss collection” or “by inheritance” remain common.

Consider, for example, the statue of the priest that I admired at Sotheby’s. One week before it reached the auction block, Christos Tsirogiannis, a forensic archaeologist at the University of Glasgow, revealed that it was present in the “Schinoussa archive,” a photographic database compiled by a notorious looting and smuggling network. While being in this archive doesn’t prove an object is tainted, the auction house’s failure to mention this chapter in the statue’s provenance raises disturbing questions. (Sotheby’s calls Tsirogiannis’s claims “inaccurate and irresponsible.”)

“Since 2007 I’ve identified numerous objects from these [looters’] archives at nearly every major auction,” Tsirogiannis says. “The fact that the auction houses continue to sell them shows that they don’t really care to improve their behavior. They only care to continue to sell.”

Generic or nonexistent provenances have long been accepted at high-profile auction houses, even for art from looting-ravaged areas or war zones. From the 1970s to 2011, auction houses including Christie’s and Sotheby’s sold masterpieces of Khmer statuary, despite the evident risk that they had been stolen from jungle temples during and after Cambodia’s ferocious civil war. Major museums such as the Metropolitan and the Cleveland Museum of Art also bought or received Khmer statues.

“Those pieces should have raised every red flag in the world—no one could have bought or sold them in good faith,” says Tess Davis, a lawyer and executive director of the Antiquities Coalition, a Washington, D.C., advocacy group. “Just a few years before, collectors had been lamenting the absence of Cambodian



Egyptologist **Sarah Parcak**, a National Geographic fellow, won the 2016 TED Prize for her work in satellite analysis of looting. She’s using the million-dollar grant to develop an online platform to protect sites.

#### **How can our readers help combat looting?**

The online platform we’re building will empower anyone with a computer to use satellite imagery

to monitor archaeological sites and map looting activity. We plan to launch the site later this year. (For updates see [natgeo.org/space-archaeology](http://natgeo.org/space-archaeology).)

art in the U.S. But when a genocidal civil war broke out, magically the market was flooded by masterpieces—unprovenanced masterpieces with evidence of violent theft, sometimes cut off right at the ankles!”

Having followed the Shesepamuntayeshher coffins through the criminal supply chain that brought them from Egypt to the United States, it’s hard for me to see buying artifacts that lack ironclad provenance as anything but willful blindness. Archaeologist Ricardo Elia agrees. “This is straightforward,” he says, invoking the

cooperation of the Cambodian government.

“This kind of collaborative work, which aims at long-term loans rather than outright acquisitions, is a powerful and positive step for museum curators,” observes Patty Gerstenblith, a professor at DePaul University College of Law who specializes in cultural heritage.

On April 23, 2015, Shesepamuntayeshher’s coffin was flown back to Egypt, where it’s now on display in the Egyptian Museum in Cairo. Meanwhile some museum curators, as well as collectors like Lewis, are calling for an antiquities

A 10th-century warrior known as Duryodhana once graced Prasat Chen temple in northern Cambodia. Looters sliced it off at the ankles during the country’s murderous civil war and smuggled it out through Thailand. A 2011 sale at Sotheby’s was called off, and after a civil forfeiture action by the U.S. government, the sandstone statue was returned to Cambodia.

PHOTOGRAPHED AT NATIONAL MUSEUM OF CAMBODIA



basic laws of economics. “You pay money for looted objects, you drive more looting.”

The battle over cultural property continues, but there are signs of hope. In 2010 the Boston Museum of Fine Arts created a new job, “curator for provenance,” the first and only such position in the U.S. In 2013 officials at the Metropolitan Museum voluntarily repatriated two signature Khmer statues, a move later followed by the Cleveland Museum of Art and other U.S. museums. The Met subsequently held a major exhibit on Southeast Asian art, with the

database to help discourage looting and are proposing to meet with archaeologists in a search for common ground.

Finding this common ground is crucial, in source and consumer countries alike, says Sarah Parcak. Looting is likely to continue until diggers in Egypt and buyers abroad see antiquities not just as gorgeous objects but also as vital passages in the narrative of our past.

“Human history is the greatest story ever told,” Parcak says. “The only way we can understand it fully is if we uncover it together.” □

*This month*

TIGERS

*July*

GREAT WHITES

*August*

WHITETIPS



*THE  
SUMMER  
OF  
SHARKS*

We're terrified of sharks, thanks to their reputation as vicious killers. Shark attacks are rare but appear to be rising: There were a record 98 unprovoked attacks worldwide in 2015, six fatal. Less known are the crucial roles sharks play in ocean ecology. In this issue, and in the coming months, we'll look at three species with notorious reputations: tiger sharks, great whites, and oceanic whitetips. We'll meet scientists who are shedding new light on these enigmatic creatures that are vital to the seas, and not as scary as you might think.

ART: FERNANDO G. BAPTISTA, NGM STAFF





# Swimming with Tigers

*A novice diver comes face-to-face with some of the ocean's most feared predators—and sees their other side.*

With jaws and teeth designed to crush and shear hard objects such as turtle shells, a tiger shark faced with a foreign object—like a camera—can afford to bite first and worry about edibility later.





A diver keeps a close watch on a tiger shark in the Bahamas. But the scene may not be as dangerous as it looks: Tigers rely on surprise to hunt prey and are unlikely to attack divers who keep them in sight.

By Glenn Hodges  
Photographs by Brian Skerry

I saw *Jaws* the summer it came out, in 1975. I was nine years old, and I still remember how the theater erupted when Brody finally killed the monster shark. I absolutely loved the movie, and that night I dreamed of a shark swimming up through the toilet bowl and coming after me down the hall.

My experience paralleled America's. We loved *Jaws*, and we became paranoid about sharks. I grew up in the water at my grandparents' house on the Connecticut shore, and though I kept swimming after *Jaws*, it was always with the vague fear that teeth could tug on my leg at any moment. My sister, two years younger, was so traumatized by the movie that she'd go into the water only at low tide. Never mind that there'd been only two shark bites on the Connecticut coast since 1900. Facts are never as salient as feelings.

So when I got this assignment, I decided to do what I'd never wanted to do: swim with sharks. I would take scuba lessons and go to a place in the Bahamas known as Tiger Beach, where I'd dive with tiger sharks, the species responsible

for more recorded attacks on humans than any shark except the great white. It would be my first dive after getting certified—which means it would be my first dive anywhere other than a swimming pool or a quarry in Maryland—and it would be without a cage. Most people who got wind of this plan thought I was either very brave or very stupid.

But I just wanted to puncture an illusion. The people who know sharks intimately tend to be the least afraid of them, and no one gets closer to sharks than divers. The divers who



Watch photographer Brian Skerry in *Mission Critical: Sharks Under Attack*, premiering Sunday, May 22, at 9 p.m.



Tiger sharks in the protected waters of the Bahamas are relatively safe, but tigers rarely stay in one place for long. Their migrations often put them in the crosshairs of commercial fishermen. Though more than 70 shark species are in worse shape than tiger sharks, conservationists still classify them as “near threatened.”

run operations at Tiger Beach speak lovingly of the tiger sharks there, the way people talk about their children or their pets. They give them nicknames and light up when they talk about their personality quirks. In their eyes these sharks aren’t man-eaters any more than dogs are. (In fact, they are demonstrably less man-eating: In 2015 there were 34 human fatalities from dog attacks in the United States but just six fatalities from shark attacks worldwide.)

The business of puncturing illusions is tricky, though, because reality is rarely one simple thing or its simple opposite. The day before my

first dive at Tiger Beach, news came from Hawaii that a man had been attacked by a tiger shark so relentless that the man was able to escape only by pulling out the shark’s eyeball. The man’s feet were mangled, and one foot had to be amputated. (His name is Tony Lee, and I spoke to him a month after the attack. He says he doesn’t think he actually pulled out the whole eyeball, he likely just ruptured it, but it was certainly what made the shark let go. The punch-the-shark-in-the-nose defense? All that got Lee was a fistful of bloody knuckles.) It was one of three attacks off Oahu that month alone and part of an

unsettling spike in attacks in recent years that has led Hawaii to commission a study of tiger sharks' movement patterns.

But here it is important to stress that tiger sharks are not relevant just because of how many people they bite. As apex predators, they act as a crucial balancing force in ocean ecosystems, constraining the behavior of animals like sea turtles. As such, they are essential to the health of sea grass ecosystems, which are habitat to a wide array of marine wildlife.

Furthermore, tiger sharks' role in ocean ecosystems is likely to increase with climate change. If the planet and its oceans continue to warm, some species will be winners and

As easy as the diving is from a technical standpoint, though, it's usually something divers work up to. My fellow divers had hundreds of dives under their belt, and on the two-hour boat ride to the site the morning of our first dive, they kept saying things to remind me of this. (Things like, "Wow, I can't believe this is your first dive," and "Seriously, I really can't believe this is your first dive.")

But all that chatter stopped when we got to the site and our dive operators, Vincent and Debra Canabal, started tossing bloody chunks of fish overboard. Almost immediately the water filled with Caribbean reef sharks—dozens of them, mostly five-to-seven-footers,

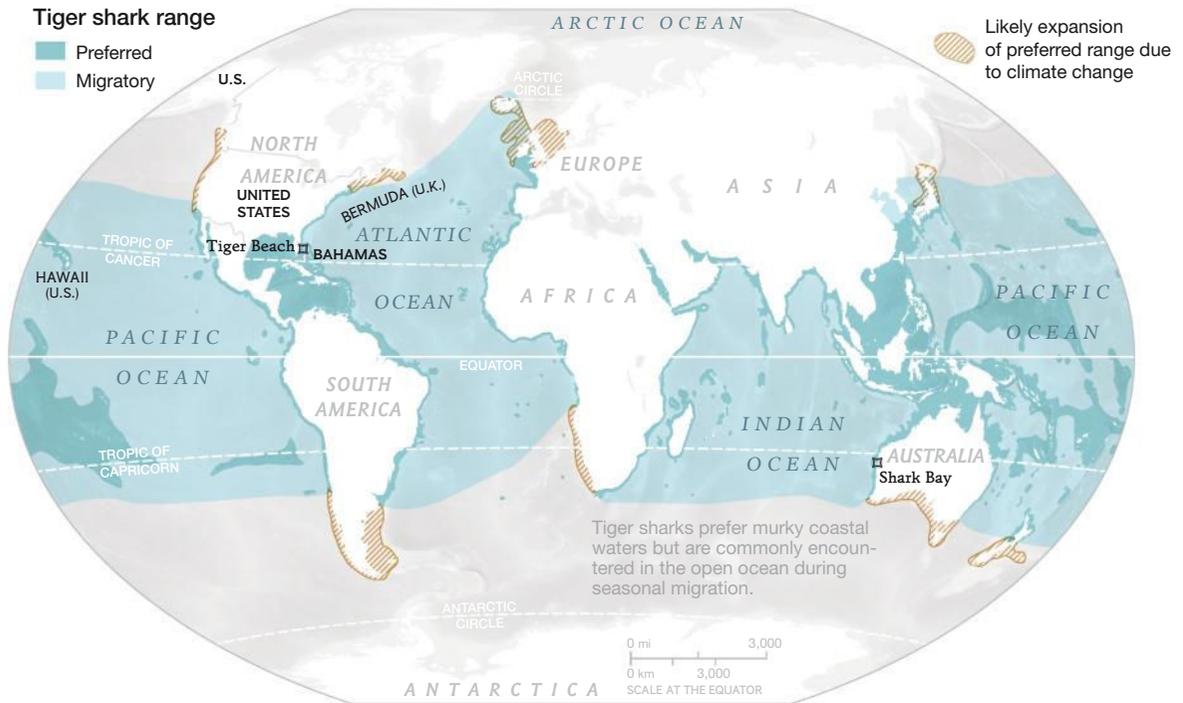
## **At the time I wasn't sure if the shark loved me like a pal or loved me like a pizza. I was like an overzealous ninja with the three-foot pole I carried to keep the sharks at arm's length.**

others will be losers, and tiger sharks are likely to be winners. They love warm water, they eat almost anything, and they have large litters of pups. (The small litter size of many other shark species makes them especially vulnerable to overfishing.) Put together, these characteristics make tigers one of the hardiest shark species. They are also among the largest: Mature females can exceed 18 feet and weigh more than 1,200 pounds. Only great whites and a few other shark species are larger. So that's the fuller explanation for my foray to Tiger Beach: I wanted to get to know the sharks that may increasingly populate our seas.

TIGER BEACH is not actually a beach. It's a shallow bank about 25 miles north of Grand Bahama Island, a patchwork of sand, sea grass, and coral reef that began attracting divers about a decade ago. It's prime habitat for tiger sharks and has ideal conditions for viewing them. The water is 20 to 45 feet deep and usually crystal clear. You strap on a bunch of weight, sink to the bottom, and watch the sharks go by.

swarming and fighting over the fish bits. Then lemon sharks—a little longer and thinner than the reef sharks—appeared here and there, and at last Vin spotted a huge dark silhouette. "Tiger!" he yelled, pointing. He rushed to suit up and then jumped in with a crate of mackerel to begin feeding the shark on the seafloor—in part to occupy it while the rest of us entered the water, and in part to make sure it wasn't too hungry when we did. And all of this was OK with me—the divers' comments, the swarming sharks, my first giant stride into the water—until I reached the bottom and immediately had to fend off the first tiger shark I'd ever laid eyes on, all 800 pounds of it.

The way Debbie described it later, this was just "Sophie" being curious and friendly. "She looved you," Debbie said again and again, because of all the attention Sophie paid me during the dive (really, she was all over me). At the time I wasn't sure if Sophie loved me like a pal or loved me like a pizza, and I was like an overzealous ninja with the three-foot plastic pole I carried to keep the sharks at arm's length. But after



watching how Vin and Debbie handled them over the next week's dives—caressing them after feeding them a fish, steering them gently away when it was time for them to move on—it became easy to see the sharks in a very benign light. Not once did they make a sudden or aggressive move toward anyone; they moved slowly and deliberately, swimming in large loops and then coming on a glide path to the feeding box, and I felt surprisingly safe in their presence. This is not an exaggeration: The taxi ride from the Freeport airport felt more dangerous than diving with these sharks did.

Most of the tiger sharks at Tiger Beach are habituated to divers, used to being fed and to not biting the hands that feed them. But even the ones that aren't familiar with the routine—and we had one of those during our first day diving—generally are not dangerous to divers. Tiger sharks are ambush predators, relying on stealth and surprise to catch their prey. At Tiger Beach you're not blindly paddling or swimming at the surface of the water, like most attack victims. You're down at the sharks' level, presenting

yourself as something other than prey—and that makes diving with them reasonably safe.

But not safer than that. There are videos of near misses at Tiger Beach—one in which a tiger shark tries to chomp a diver's head and another in which a tiger goes after a diver's leg—and there was a fatality here in 2014, when a diver simply disappeared. Our group even had a scare when an angelfish wandered into our midst and the reef sharks and lemon sharks went into a frenzy, chasing it as it hid between people's legs. (I had my turn in the shark tornado, trying to fend off the sharks as they whipped around me and crashed into my legs, and it was as unnerving as you'd think.) Everyone, including Debbie, thought someone was going to be bitten in the melee, and there were three half-ton tiger sharks milling around that might suddenly have taken an interest in a flailing, wounded diver.

The incident was a fluke, and we were back in the water the next day. But it was the kind of fluke that reminds you that sharks are wild animals, and Tiger Beach is a wild place, and wild animals and wild places are inherently





The health of this coral reef in the Bahamas might depend on tiger sharks in ways not yet understood. Scientists in Australia found the predators kept grazers from degrading sea grass ecosystems.



A newborn pup captured by scientists in Hawaii (a tiger shark hub) has the distinct striped markings along its three-foot body that give the tiger shark its name. The stripes will fade as the shark ages.



unpredictable. And according to scientists who study them, tigers are especially unpredictable.

**AFTER TIGER BEACH** I flew to Oahu to meet Carl Meyer at the University of Hawaii to discuss his research on the recent spike in tiger shark attacks. Meyer and his team have tagged hundreds of tiger sharks with satellite tags and acoustic tracking devices, and he says they're just beginning to understand the animals.

The movements of most shark species are fairly predictable, he says. "They'll go one place during the day, and one place at night. But for the most part we don't see that with tiger sharks. They can show up any time of day or night, and

size of baseballs—and they can have as many as 80 pups in a litter. What that might mean—although it's a "completely untested hypothesis," he cautions—is that pregnant sharks get to the islands hungry, and this makes them even more indiscriminate eaters than usual. But the uptick in attacks in the fall, a pattern noticed by native Hawaiians for generations (surfers call it Sharktober), might also be a function of having more sharks around the islands at that time of year.

Besides Hawaii's growing human population, another possible factor is a proliferation of sea turtles. Green sea turtles received federal protection in 1978, after decades of intense exploitation. Their numbers have been increasing ever

## In the Bahamas, which prohibited longline fishing in 1993 and designated its waters a shark sanctuary in 2011, the marine ecosystems are relatively healthy.

they may be there one day and back the next day, or there one day and then gone for three years."

At least some of this unpredictability is likely caused by the sharks' hunting habits, he says. As ambush predators, tiger sharks rely on surprise to catch their prey, and "if you're predictable, your prey is going to adapt to that predictability. So it makes sense to suddenly appear in an area and not be there very long."

Meyer says he doesn't know why attacks in Hawaii have spiked in recent years, jumping from an average of fewer than four a year from 2000 to 2011 to almost 10 a year from 2012 to 2015. But he says he would expect to see a long-term rise in attacks because of the increasing number of people in Hawaii's waters.

As for why attacks occur mostly in the fall, he points out that's when tiger sharks come to the main islands to give birth. Female tiger sharks make a huge energy investment when they ovulate. Their eggs are "enormous"—the

size of baseballs—and they can have as many as 80 pups in a litter. What that might mean—although it's a "completely untested hypothesis," he cautions—is that pregnant sharks get to the islands hungry, and this makes them even more indiscriminate eaters than usual. But the uptick in attacks in the fall, a pattern noticed by native Hawaiians for generations (surfers call it Sharktober), might also be a function of having more sharks around the islands at that time of year.

since. They're now common off Hawaii's shores and are a familiar food for tiger sharks. Tiger sharks and sea turtles have a long, shared history. They both hark back to the dinosaur age, and the fossil record suggests they may have evolved in tandem. With wide jaws and heavy, angled teeth that resemble old-style can openers, tiger sharks are able to crush and slice through an adult turtle's shell in a way most sharks can't. This robust morphology might help explain the tiger's famously unselective eating habits. Tires, license plates, paint cans, farm animals, unexploded munitions, a suit of armor—all these things have been found in tiger sharks' stomachs, proving they're willing to bite just about anything (apparently with minimal adverse effects). So if more turtles are sharing the water with more people, more shark bites might be the result.

But this is where the story becomes much more than just a "shark bites man" story, because the relationship between tiger sharks and sea turtles could have broad implications for the health of ocean ecosystems around the globe. On a remote part of Australia's western coast

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■ **Grant** Brian Skerry's fieldwork was funded in part by your National Geographic Society membership.

called Shark Bay, a research team led by Mike Heithaus of Florida International University has documented how tiger sharks prevent sea turtles and dugongs (sea cows) from overgrazing the sea grass beds that anchor the ecosystem. It's not just by eating the animals, researchers discovered. The mere presence of the sharks changes the turtles' and dugongs' habits, creating a "landscape of fear" that forces them to graze more judiciously in order to lessen their risk of being eaten.

What this means is that protecting animals like sea turtles without also protecting the predators that keep them in check could lead to degraded ocean ecosystems. "If you look at places where shark populations have declined and turtle populations are protected—places like Bermuda—it looks like those areas are having losses in their sea grass," Heithaus says.

In the Bahamas, which prohibited longline fishing in 1993 and designated its waters a shark sanctuary in 2011, the marine ecosystems are relatively healthy. But the adjacent western Atlantic, which includes Bermuda, has much weaker shark protections and appears to be suffering the consequences. Neil Hammerschlag, a marine ecologist at the University of Miami who studies tiger sharks in the western Atlantic, says sea turtles there don't seem to alter their behavior in response to tiger sharks the way the turtles in Shark Bay do, and that might be because Atlantic tiger shark populations are already significantly compromised. "I do work in Florida and the Bahamas, and it's night and day. We see massive differences in the size and numbers of the sharks. They're doing well in the Bahamas, but we almost never catch them off Florida. And they're just 50 miles apart." Florida prohibited the killing of tiger sharks in its waters in 2012, but it's the only state on the eastern seaboard to have done so, and federal law allows them to be caught and killed in U.S. waters, within certain limits, by commercial and recreational fishermen.

**JAWS ISN'T RESPONSIBLE** for most of the threats tiger sharks face—coastal development, marine pollution, longline fishing, the popularity of shark fin soup—but it did create a cultural

attitude that has had a remarkably long shelf life. After *Jaws*, people didn't just become paranoid about sharks; they became callous, even vengeful. In the 1970s and '80s, shark-fishing tournaments sprouted like weeds on the eastern seaboard of the U.S., and dozens of them continue, celebrating the spectacle of "monster sharks" hanging on the docks. I went to one of these tournaments last summer, and the memory that sticks is of a woman with her little boy, pointing at a mako with its bloody jaws propped open for the cameras and saying, as if to prompt him to follow suit, "Oooh, scary!"

Sharks can be scary, that's true. But I spent a couple of days on Kauai with Mike Coots, a photographer who lost half his right leg to a tiger shark while bodyboarding in 1997, when he was 18. He was soon back in the water and says he almost never thinks about sharks when he's surfing. "Hawaii is an ocean culture," he told me. "People here are in the water from the time they're in diapers. They're just not that afraid of sharks." To test that, I asked the boys playing four square in front of his house whether they were afraid of sharks, and they said, "No," like it was the stupidest question they'd ever heard. They were about the age I was when I saw *Jaws*.

Last summer, as I was planning my dive at Tiger Beach and hysteria about recent shark attacks in North Carolina was in full bloom, news broke that an 800-pound tiger shark had been caught off the South Carolina coast. *USA Today* called the shark "monstrous" and described the fishermen as "brave souls." When I got home from Hawaii, I looked at the story again. Seeing the picture of the gutted, deflated shark on the dock, I thought about how it was once the same size as Sophie, and those weren't at all the words that came to mind—for either the shark, or the men who killed it. □



Go underwater with photographer Brian Skerry to see video of tiger sharks in action at [ngm.com/Jun2016](http://ngm.com/Jun2016) and get a close-up look at how he captures images like the ones shown here.



Above a reef deep in the Indian Ocean, a tiger shark is trailed by remoras, which conserve energy by attaching themselves to the shark and feeding off scraps of its prey and parasites on its skin.



2010



# Juárez

Frozen in a final embrace, this couple and the woman's unborn baby were killed by a single shot. At the peak of the crime wave that convulsed the rapidly growing city, 10 people a day died violently.

Denise Fuentes and Ulises Escobedo, posing on an overlook with baby Eros, both were touched by the drug war that raged in the neighborhood below. Now they're searching for a home there.

2015



# Returns to Life

*Once the most dangerous place in the world, this hard-luck city on the U.S. border has seen crime rates plunge and civic life revive after Mexico fixed the city's broken criminal justice system.*





On Easter Sunday the Ramos Gutiérrez children play in El Chamizal Park, one of the city's few green spaces. The decades-old Juárez tradition of outings at the park on the holy day was too dangerous during the violent years.

By Sam Quinones

Photographs by Dominic Bracco II

**A**s night falls over San Antonio, a shantytown turned neighborhood with concrete-block houses, rugged streets, and few trees, children head excitedly to a warehouse stacked with tires. There the din of Ciudad Juárez recedes, replaced by grunts, slaps, and thuds—*bam!*—of supple young bodies slamming onto canvas.

The makeshift wrestling ring, fashioned from iron and cable scavenged from junkyards, belongs to Inés Montenegro, who opened it two years ago after one of his sons suggested the neighborhood's children needed somewhere to play. In Mexico *lucha libre*, a style of pro wrestling with masked fighters performing scripted acrobatic moves, is a national obsession. Montenegro's funky arena was an instant hit.

Tonight four boys ages 11 to 15—Omar, Alfonso, Eric, and Antonio—hurtle against the ropes, which slingshot them into the center of the ring. They bound gleefully, learning the choreography for such classic moves as the “tiger jump,” vaulting melodramatically into the ring, and the “scissors,” jumping from the ropes to wrap your legs around your opponent's neck.

The scene would have been unimaginable six years ago, when I last visited Juárez, the largest city in Chihuahua state. Child's play had been banished from public spaces as drug cartels battled street by street to control the border city, a gateway to the lucrative U.S. drug market. I watched as Mexican soldiers in helmets and sunglasses rumbled in atop armored vehicles to reclaim those streets, gripping assault rifles and machine guns, one of many attempts to halt the macabre violence that had made Juárez infamous worldwide.

From 2008 to 2012, the city of 1.3 million

Onetime gang members, some now community organizers, paint a mural meant to bring together youth from different, often rival, neighborhoods. Juárez had hundreds of gangs that were drawn into the war between drug cartels.



people was widely deemed the most dangerous place on Earth. Murders shot above 3,700 in the worst year. Criminals kidnapped and extorted with impunity. A quarter of all cars stolen in Mexico were stolen in Juárez. Businesses closed by the thousands. Anarchy descended.

The San Antonio neighborhood was among the worst. The boys now cavorting in the wrestling ring each had relatives killed or jailed. Two of Antonio's uncles were murdered. “We'd be out playing and hear gunshots, and we'd run for home,” he recalls.

Out in the *colonias*, or neighborhoods, at least 11 *lucha libre* rings now draw hundreds of kids donning personae such as Aztec Falcon and Ex-Convict. Juárez's once empty streets are crowded again. Around the cathedral, clothing stores and Popsicle shops do a brisk business; cover bands play Spanish versions of



“Johnny B. Goode” and “Jailhouse Rock” for shoppers who stop, listen, and dance. A children’s museum opened, aimed in part at the 14,000 who the museum’s director estimates were orphaned in the violence. Neighborhoods have organized sports leagues. Parks—including some new ones—are again places to socialize. “People are losing their fear,” Montenegro says.

What happened in Juárez to allow Montenegro and others to stop cowering and resume living? This is no wrestling melodrama in which a masked hero triumphs. Mexico found the political will, in Juárez at least, to strengthen the criminal justice system and invest in the local government. Doing so encouraged bravery from some unexpected protagonists: law enforcement officials who forged a more professional police force in a country where cops are often corrupt, businesspeople who stayed to fight rather than

flee, and government officials who challenged the sclerotic bureaucracy and spearheaded dramatic reforms.

IN 1996, WHEN I FIRST WENT to Juárez, it was a whirring cog in the emerging global economy. Legions of rancheros and peasant farmers were arriving to assemble stereos, televisions, and car parts for the U.S. market in duty-free manufacturing plants called maquiladoras.

Many migrants arrived planning to cross the border into neighboring El Paso, Texas, but found that in Juárez’s expanding economy they could have what was denied them back home: a solid house, a used car, a steady job. Juárez filled with family businesses, including markets, beauty parlors, and upholstery shops.

Montenegro, who came to Juárez as a boy in the 1970s, was part of this entrepreneurial

flowering. He bought land when San Antonio was just a shantytown. He started the tire shop that now houses his wrestling arena, then others, each to be run by a son.

Juárez grew chaotically. As with all Mexican cities, its tax revenue went to Mexico City. Not much came back. Police officers rationed gasoline and bullets. Basic infrastructure—roads, sewers, storm drains, parks—was neglected.

“People didn’t perceive we had any needs, because we kept growing,” says Alfonso Murguía, a pastor whose church has funded centers for orphans and drug addicts in Juárez for almost 30 years. “There was money and jobs, but the city wasn’t necessarily improving.”

As rural people became an industrial workforce, family ties withered. Thousands of kids grew up in the streets. Gangs multiplied into the hundreds. The Juárez cartel formed to control the main drug-smuggling routes. Lawlessness became commonplace.

I had come to Juárez two decades ago to write about the first of what would become hundreds of murdered young women—“the dead women of Juárez,” as they became known around the world. Through the dark years I returned a dozen times. Most factory workers were women who arrived without family, making them especially vulnerable. Many bodies were dumped in the desert, where the heat mummified them into anonymity. With killers facing no consequences, the deaths multiplied.

In 2008 Juárez lost 90,000 jobs as the U.S. plunged into recession, marooning a flotilla of desperate unemployed. About the same time the Sinaloa cartel moved in to try to wrest control of the drug routes from the Juárez cartel. Both groups began deploying the city’s street gangs in a vicious battle. For five years violence engulfed the city.

When Montenegro, a pleasant yet wary and taciturn man, tells me the story of Arena San Antonio, he starts by counting the families on his street who had loved ones kidnapped. “There were five,” he says finally, “including us.”

Kidnappers snatched his youngest son. Montenegro had to borrow money for the ransom.

When he’d almost finished paying back the loan, his son was kidnapped again. For seven years Montenegro struggled to repay his debts, roughly \$50,000. He sold some tire shops and was left almost broke. After a blood vessel in his eye burst from stress, he became partially blind. “I don’t wish kidnapping on anyone,” he says.

WHEN I RETURN TO JUÁREZ, I hire a taxi driver named Jesús Amable to drive through a half dozen neighborhoods. That we could even take such a trip is proof of Juárez’s new peace. Still, many stores stand gaping empty, their owners having fled.

At a bustling flower shop Claudia Saucido tells me she ran it alone while her husband worked elsewhere to help pay the hundred-dollar *cuota*—about a week’s pay in Juárez—levied by extortionists. Across the street Alfredo Rodríguez says his family couldn’t afford such bribes and closed the market his father started, only recently reopening it. Amable tells me he used to pay \$20 a week, and so did nine colleagues at his taxi stand. “Fifteen-year-old kids would come, in brand-new cars, to collect,” he says.

By 2010 Juárez authorities estimated that some 8,000 businesses were being extorted. The next year, Carlos Salas, the newly appointed state attorney general, ordered the Chihuahua state police to create an anti-extortion squad.

Many crimes had gone unpunished. “There was no professional investigation; no bad investigation either. There just wasn’t any investigation,” says César Muñoz, a short, dapper man who was the squad’s first supervisor and is now chief of the Juárez city police. “When crimes happened, police would hide in our offices.”

The handpicked squad of young, untainted officers spent its first two weeks going door-to-door in downtown Juárez, urging business owners to report extortionists. This kind of community policing was unheard of in Mexico. “No one wanted to talk. Many of them thought we were extortionists ourselves,” says Luis Hernández, who now commands the squad.

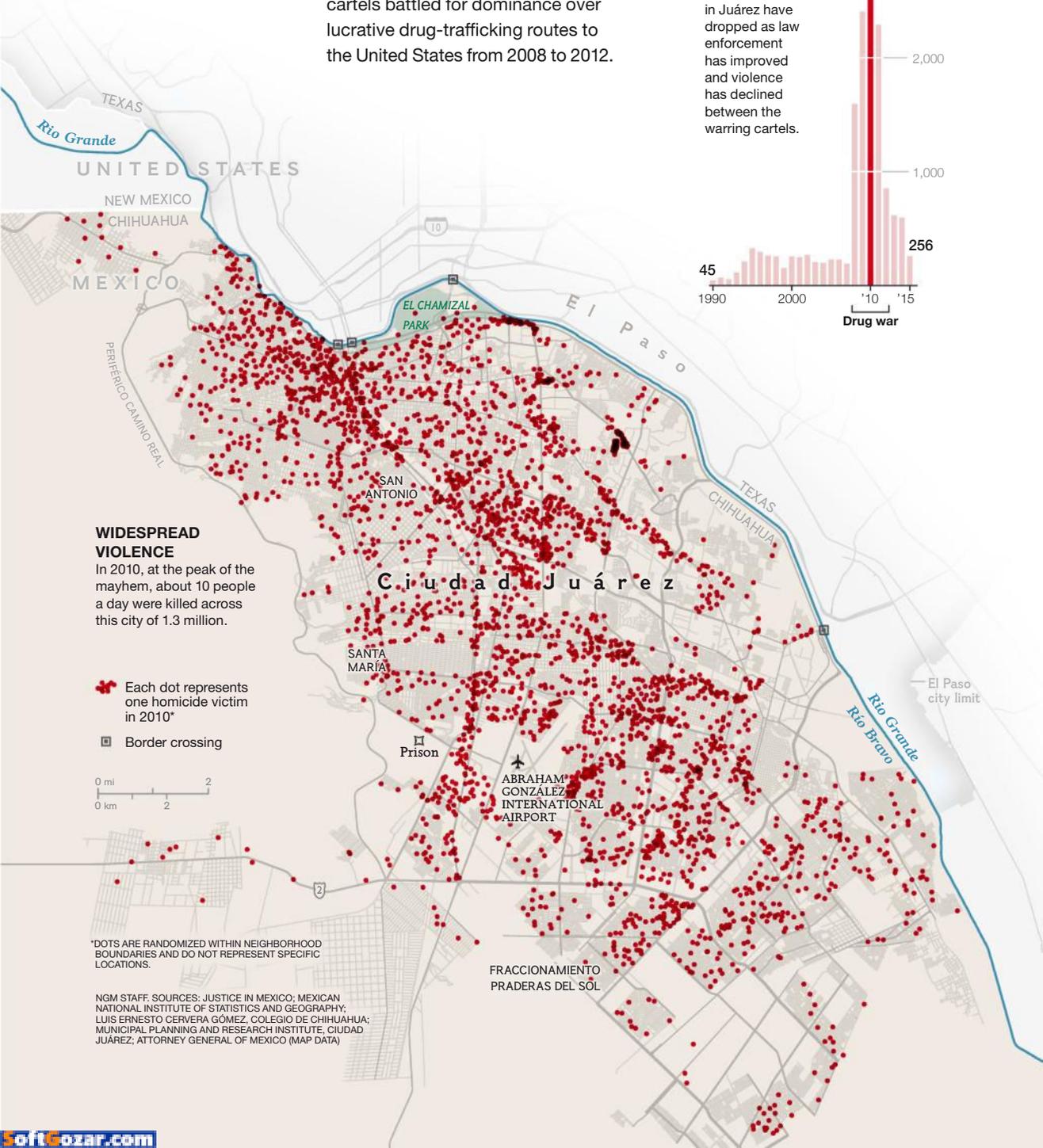
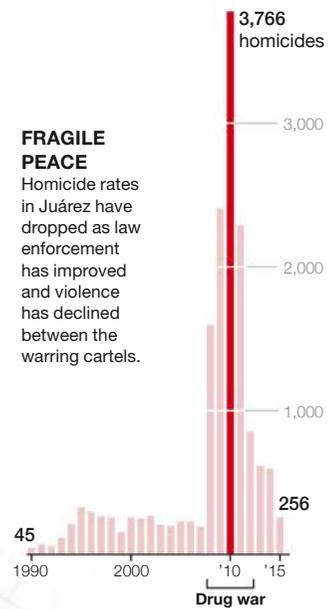
The phone rang for the first time in the squad’s office two weeks later. It was a baker. Extortionists



# A Tale of Two Cartels

Juárez suffered a dramatic spike in crime when the Sinaloa and Juárez cartels battled for dominance over lucrative drug-trafficking routes to the United States from 2008 to 2012.

**FRAGILE PEACE**  
Homicide rates in Juárez have dropped as law enforcement has improved and violence has declined between the warring cartels.



**WIDESPREAD VIOLENCE**  
In 2010, at the peak of the mayhem, about 10 people a day were killed across this city of 1.3 million.

Each dot represents one homicide victim in 2010\*

Border crossing



\*DOTS ARE RANDOMIZED WITHIN NEIGHBORHOOD BOUNDARIES AND DO NOT REPRESENT SPECIFIC LOCATIONS.

NGM STAFF. SOURCES: JUSTICE IN MEXICO; MEXICAN NATIONAL INSTITUTE OF STATISTICS AND GEOGRAPHY; LUIS ERNESTO CERVERA GÓMEZ; COLEGIO DE CHIHUAHUA; MUNICIPAL PLANNING AND RESEARCH INSTITUTE; CIUDAD JUÁREZ; ATTORNEY GENERAL OF MEXICO (MAP DATA)

Mourners attend funerals for three young women, victims of a massacre at a birthday party that left 14 dead, most in their teens or 20s. When the gunmen didn't find the man they were after, they herded others into a corner and executed them in one of the year's worst crimes.



wanted \$5,000, or they'd burn down his business. Then the squad listened in on his phone calls. The officers tailed the baker to the drop. When he handed over the money, they pounced. The arrest was the first successfully investigated extortion in Juárez during the violence. The extortionists—a housewife, a factory worker, and two tire-shop employees—were convicted.

“Soon we had too many businesses reporting the crime,” Hernández says.

A few months later the squad shot it out with a crew of extortionists, capturing three of them. That was new too. Until then, Juárez cops had bolted when criminals started shooting.

In October 2011 three officers were staking out a mom-and-pop grocery when gunmen ambushed and killed them. That night, the attorney general for the Juárez region visited the

wakes. Miguel Ángel Saucedo, whose 23-year-old son was among the officers killed, urged him to continue the fight. “If you stop,” he said, “the effort he made will be worth nothing.”

“He wanted a better society,” Saucedo says, as we sit in the family’s modest living room. “When they formed that squad, things were very scary. Even so, he joined up.”

The tragedy proved a turning point. The squad was expanded and targeted José “El Junior” Gómez Castañeda, the mastermind of an extortion racket raking in \$400,000 a week. Ten suspects were rolled up, but not El Junior, who would call Muñoz to taunt him. The squad finally caught up with El Junior in 2013, storming a house with a pool, a gym, a video-game playroom, and a stripper’s pole. El Junior went to prison for life and hanged himself in his cell.

In the city's forensic lab, Alejandro Cárdenas examines a once desiccated body that he rehydrated, making it easier to identify. Cárdenas perfected the technique to thwart killers who dump bodies in the desert, where the intense heat and dry air deform them.



As the state police were launching their anti-extortion squad in 2011, the Juárez police department turned to a retired army lieutenant colonel who had modernized the Baja California state police and, as Tijuana's police chief, helped squelch its throbbing violence in a year.

Julián Leyzaola, who retired from the police force in 2013, is a thin, unassuming fellow, easy with a smile. He is well-known in Mexico—notorious to some, heroic to others. His methods were hard-line, with what many activists insist was little appreciation for human rights. “There were confrontations, chases,” he says unapologetically. “Suspects would come out of them beaten up. That’s what happens.”

In Juárez, he says, he found a department with hundreds of *aviadores*, or “aviators,” government workers who show up just for their

paychecks. “We had only about 300 officers out of 2,500 who were really working,” Leyzaola says. He fired the *aviadores* and let the others know that they had to patrol the streets.

Leyzaola bought new patrol cars to bolster the department’s fleet of 80 barely functioning vehicles, armed officers with Beretta and Glock handguns, and switched uniforms from “rat gray” to dark blue. “We fed that pride in wearing a uniform,” he says.

The police began to take the city back, military style, from the cartels, gangs, and others who had turned to crime. “We pushed them out,” he says, “little by little, always giving them an exit so as not to corner them.”

DAVID ALAMILLO, A JUÁREZ restaurateur and bar owner, was living in Europe in 2008 when





Employees of the criminal justice system and their families cool down at a country club only for them. The facility was built to demonstrate support for law enforcement as a way to combat corruption, improve morale, and encourage professionalism.

A guard dog strains his chain in the unadorned courtyard of a home. As cartels and gangs fought over drug routes and jobless residents turned to extortion and kidnapping, Juárez became the most dangerous city in the world—its streets menacing, its houses fortified.



his managers began to call, telling him about robberies, murders, and terrified employees. He decided he had to return, but he would go only for six months, he told his wife.

Alamillo is a bull of a guy, heavysset and loquacious—fitting for an impresario in the city’s rough-and-tumble nightlife. Within a week of his return, a man accompanied by six gunmen visited him, demanding \$35,000. Alamillo didn’t pay; a week later one of his discos was torched.

As time went on, the extortionists became more suave. “Without curse words—like a good salesman,” Alamillo says. “They were smart. You begin to think maybe it’s not so bad to pay. Many people began not to pay taxes and instead paid the extortion. There was a turn, a culture of payment to organized crime. The

other payments—for electricity, water—you stopped making those payments.”

Soon Alamillo was paying \$2,000 a week. A man in a baseball cap came by every week, helping himself to booze and the payoff envelope.

Outraged by what was going on, Alamillo joined other influential community leaders in 2010 to form the Mesa de Seguridad, a public safety committee, to coordinate with police. The risk was so extreme that they met in secret, often at the airport in El Paso.

The well-connected leaders had the heft to push politicians to act. At their urging, Chihuahua’s legislators made kidnapping, extortion, and the murder of police officers, journalists, and three or more people punishable by life in prison. The maximum sentence had been 50 years.

For Mexico the committee was novel. For

Victoria Acosta, a seamstress who makes car seats and air bags, cleans her house while towels dry on a line. Until the violence subsided, outward displays of money, such as gaily painted walls, were rare as residents tried to avoid attracting the attention of criminals.



decades the paternalistic federal government discouraged such civic participation. And Mexico's wealthy don't have much social contact with police officers, who are often from the poorest families. "The narcos came from that class and understood the rejection the police felt," Alamillo says. "The bad guys would invite them to parties, would offer them social recognition that society wouldn't."

So while the committee pushed for higher salaries, more training, and new equipment, it also promoted police appreciation. Using state and federal funds, the city opened a country club for officers and their families—with swimming pools, weights, bicycling, a picnic area, and a memorial to fallen officers.

At a meeting I attend, police administrators give accounts of their work while the

businesspeople ask what crimes need more attention. The mood is cordial and familiar. For Mexico it feels like a revolutionary act when Jorge Contreras, a former chamber of commerce president, tells the officers, "We are very proud of the work you are doing."

Sitting against the wall on the edge of his chair is a Juárez patrolman named Emilio Fernández, accompanied by his wife, two sons, and a daughter. Every month the committee honors a police officer. The committee's coordinator, Alejandra de la Vega, asks Fernández to stand and praises him for hiking up hillside roads impassable to cars to hoist an old man with heart problems on his back and carry him down to paramedics.

"It was a heroic act, and we thank you and your family," she says. Everyone stands and





Blaring music from an iPod, Juan Manuel Alvarado Gómez rides a tricked-out, custom-made bicycle in the Santa María neighborhood, an activity that would have been dangerous not long ago. In the distance looms the Sierra de Juárez.

applauds. Fernández's lip quivers. The eyes of his wife and daughter fill with tears.

The next day, Alamillo volunteers to show me around the city. We drive for miles past clusters of squat, white maquiladoras. We cross intersections where mini-markets and gas stations have staked out every corner. Alamillo turns into Fraccionamiento Praderas del Sol, a neighborhood where hundreds of tiny prefab box houses are vacant—a residue of the violence and the collapse of Mexico's housing boom.

But Alamillo points out that most cars we see have license plates, unlike a few years ago. "You'd see three out of every 10 cars had no license," he says. "An unlicensed car is the perfect

**'People think someone's going to come from outside and cure the problem. People think a messiah will come. No. The key to success is to strengthen what's local.'**

Julián Leyzaola, former Juárez police chief

vehicle for criminality. Correcting it was just about political will."

By early afternoon we end up downtown again, at his new venture. Bathed in warm oranges, reds, yellows, and browns, Restaurante Viva México boasts street lamps, a walkway, singers, and a ring in the center for riders on horses to display lassoing tricks. Alamillo now has seven businesses, employing 300 people.

"We still have a long way to go," he says. "We have to keep on."

WHEN I FIRST VISITED JUÁREZ, much of the criminal justice apparatus, including its jail and court system, was dysfunctional. The city had a tiny, grimy morgue and no forensic lab.

Alejandro Cárdenas came to the lab in 2002, when it was a small room at the local medical

school with a corpse refrigerator that often broke down and stank horribly. He was asked to identify leathery corpses shrunk by the desert into gruesome unrecognizability.

Cárdenas is a quiet, stout man with graying hair and a trim mustache—a forensic dentist by training. Today he works in a modern building that was expanded twice in the violent years and now has a team of forensic anthropologists, a DNA lab, and a genetics lab.

The morning I arrive, his assistants place a mummified older man in a rectangular tub. Cárdenas fills it with a chemical bath. Over three days the man's nose, mouth, ears, and cheeks become more defined, until he is identifiable.

The rehydrating solution Cárdenas concocted is among the unheralded changes that helped pull the city from its nightmare. Like the business leaders and law enforcement officers who responded to Juárez's violence, Cárdenas too had improvised.

He made his discovery by experimenting with animal tissues as well as dehydrated fingers, placing them in baby-food jars filled with different solutions. This went on for two years and a couple hundred fingers, to the skeptical amusement of his colleagues, until one day Cárdenas found a fully formed index finger.

Cárdenas shows me slides of many bodies he has rehydrated. From this chemical treatment emerged faces, tattoos, moles, scars, birthmarks, even tan lines. His invention has helped foil criminals who had relied on the desert to shroud their murders, as so many were doing in the years when hundreds of women were being killed. "Now if they do that," he says, "we have ways of finding them."

The transformation of Juárez's criminal justice system can also be seen in its prison. Once virtually run by inmates, it was among the most dangerous lockdowns in Latin America. The state took it over in 2011. The most violent inmates were sent to federal prisons. Graffiti was scrubbed. Inmate-run stores and restaurants were closed. An altar to Santa Muerte, a folk saint favored by kidnappers, was removed. Equipment was installed on a tower to block

cell phone calls. On a visit I found gleaming tile, bright lights, clean yards. By 2014 there were no killings, escapes, or riots. The prison, along with seven others in Chihuahua, is now accredited by the American Correctional Association.

As the violence was exploding, Mexico was instituting a U.S.-style trial system, with judges who hear testimony from sworn witnesses in courtrooms open to the public. For centuries Mexican judges had weighed written evidence and testimony, deciding guilt or innocence behind closed doors. Verdicts could take years.

Chihuahua was one of the first states to adopt the open-trial system, and Juárez was quick to implement it. The state built a spacious, airy courthouse complex. Things got worse at first. Prosecutors made rookie blunders. But by mid-2011, they were winning life sentences for extortionists and kidnappers.

In one courtroom I visit, a three-judge panel, after a month of testimony open to the public, convicts three men on trial for invading homes at gunpoint, robbing families, raping women, then making off with computers and televisions. Police had arrested the men, investigated the case, and found witnesses to testify.

"These guys were doing what so many young guys started doing," Josefina Soara, the prosecutor, tells me as afternoon shadows spread across the complex. "They were getting a gun, going and robbing anyone that occurred to them. They figured that since the wave of violence was so huge, no one was going to pay any attention."

IN JUÁREZ HOMICIDES HAVE FALLEN, from 3,766 in 2010 to 256 in 2015. Juárez is no longer on the list of the 50 most violent cities in the world. No cases of kidnapping or extortion have been reported in more than two years. Helped by the U.S. economic recovery, Juárez added 17,000 new jobs in the first half of last year, the best such figure in five years.

Alamillo insists that Juárez can be a model for other regions of Mexico still beleaguered by eruptions of medieval violence. "If Juárez can do it, why can't they? It's the same country," he says. "We can change this."

I'd like to believe him. Yet Juárez is in the north, a region closer to the U.S. market and typically more open to new ideas than the rest of Mexico.

Much of what weakened Juárez remains: low-paying, dead-end jobs; street gangs and drug cartels; more billboards than trees; and proximity to a neighbor with an insatiable appetite for drugs and few controls on guns.

What's more, politicians haven't touched the political system's corruption and lack of accountability, which allowed small-time drug traffickers to become national security threats. Though almost half of Chihuahua's tax revenue is generated in Juárez, only a small percentage of that money returns to the city. Juárez remains a city of too many potholes and too few parks.

Still, the transformation seems credible, though some say it is also the result of an accord between the Sinaloa and Juárez drug cartels. "It's possible. I don't know," de la Vega says. "What I do know is that police are doing a much better job. There are murderers in prison, kidnappers in prison, extortionists in prison."

The answer was always in Juárez, Leyzaola tells me when we meet for breakfast.

"People think someone's going to come from outside and cure the problem," he says. "People think a messiah will come. No. The key to success is to strengthen what's local."

Two months after our conversation Leyzaola was shot multiple times while parked on a Juárez street, a reminder of how dangerous the city remains. He is now paralyzed and uses a wheelchair but has moved back to Tijuana and is running for mayor. As evidence of how much has changed in the city he left behind, the police quickly caught and charged two alleged attackers. Their trials will be open to the public and reported by the media. And if convicted, they'll spend years in prisons run by guards, not inmates. □



Go to [ngm.com/Jun2016](http://ngm.com/Jun2016) to hear Diego Montejano tell about growing up poor in Juárez—where he belonged to a gang and bagged drugs for money—and why helping other kids is now so important to him.

# The Art of Solar Energy

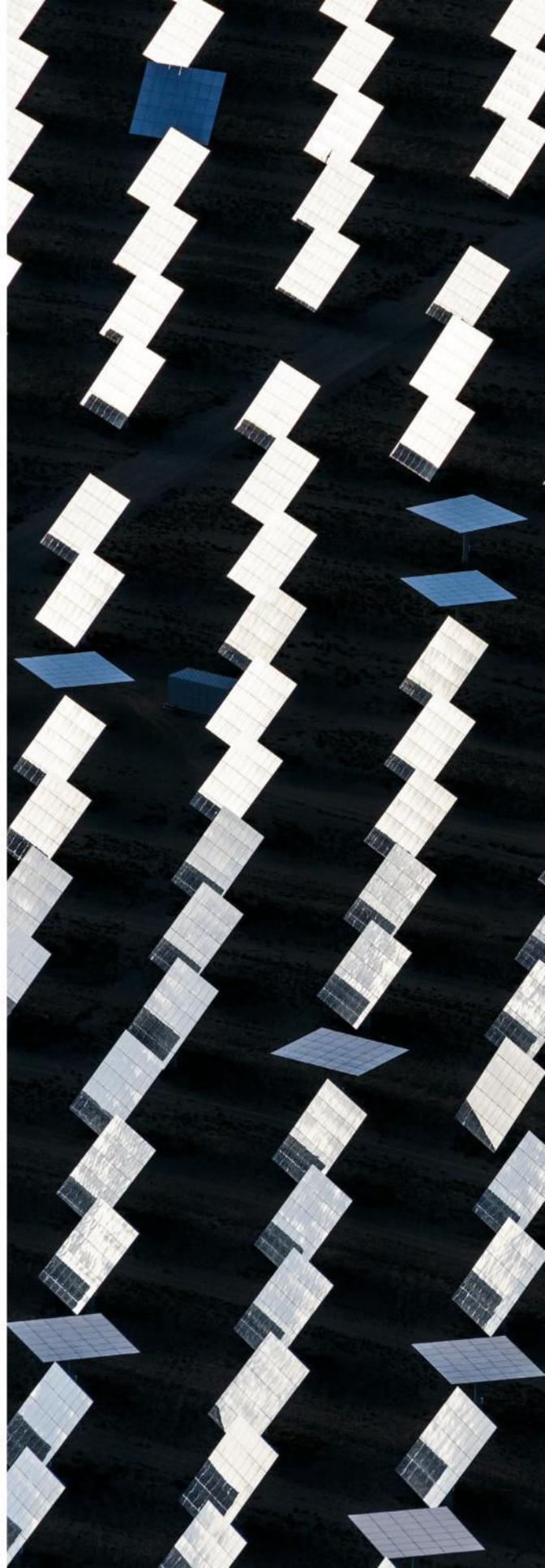
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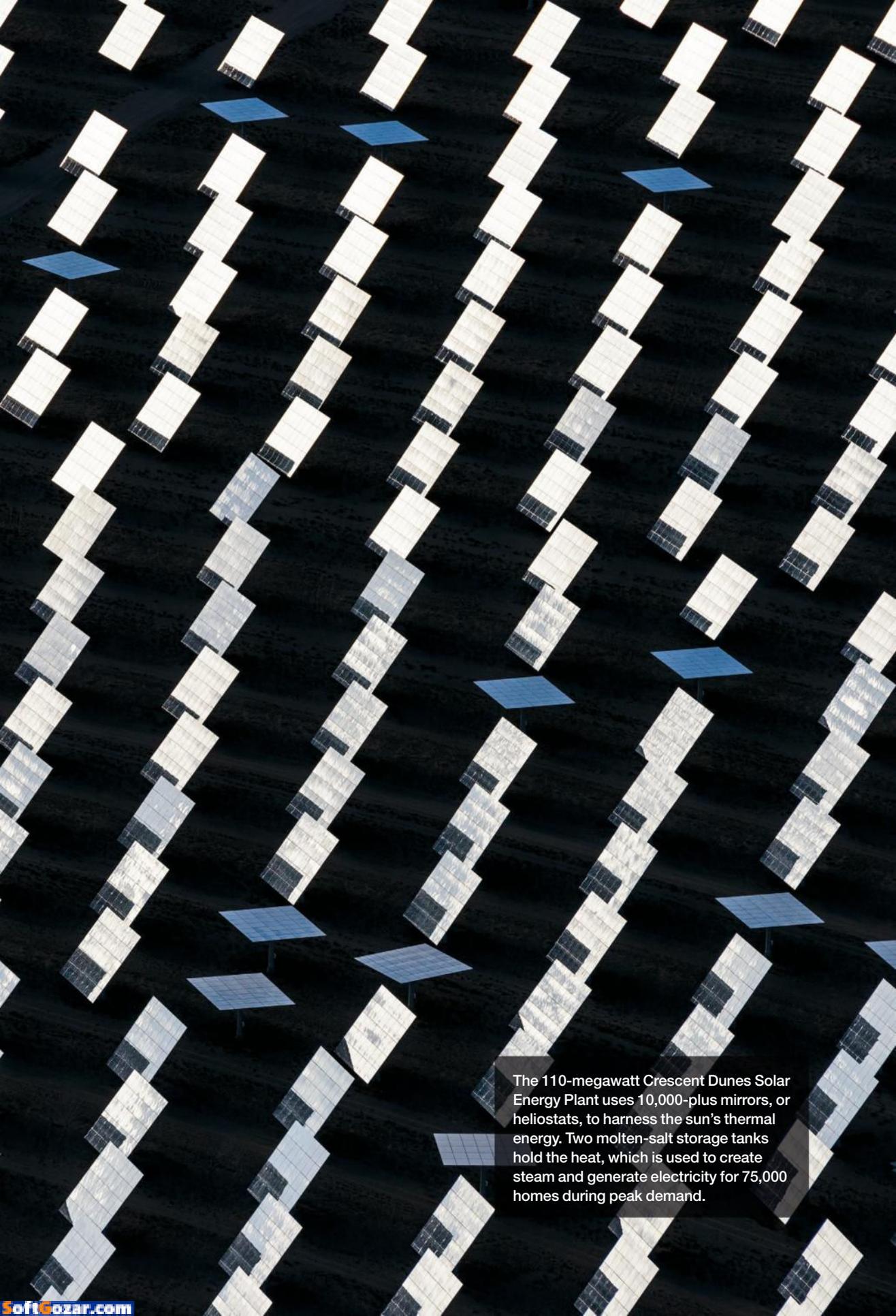
Our environmental problems are easy to see. But what do the solutions look like? This project—a series of aerial shots taken above the Crescent Dunes Solar Energy Plant near Tonopah, Nevada—is my attempt to document our efforts to build a more sustainable future.

I've always been interested in the intersection of nature and human activity. Whenever we use the land and its resources, there's a nuanced tension involved. We've come to rely on our smartphones, cars, and computers, yet to create them we often exploit the Earth's finite resources.

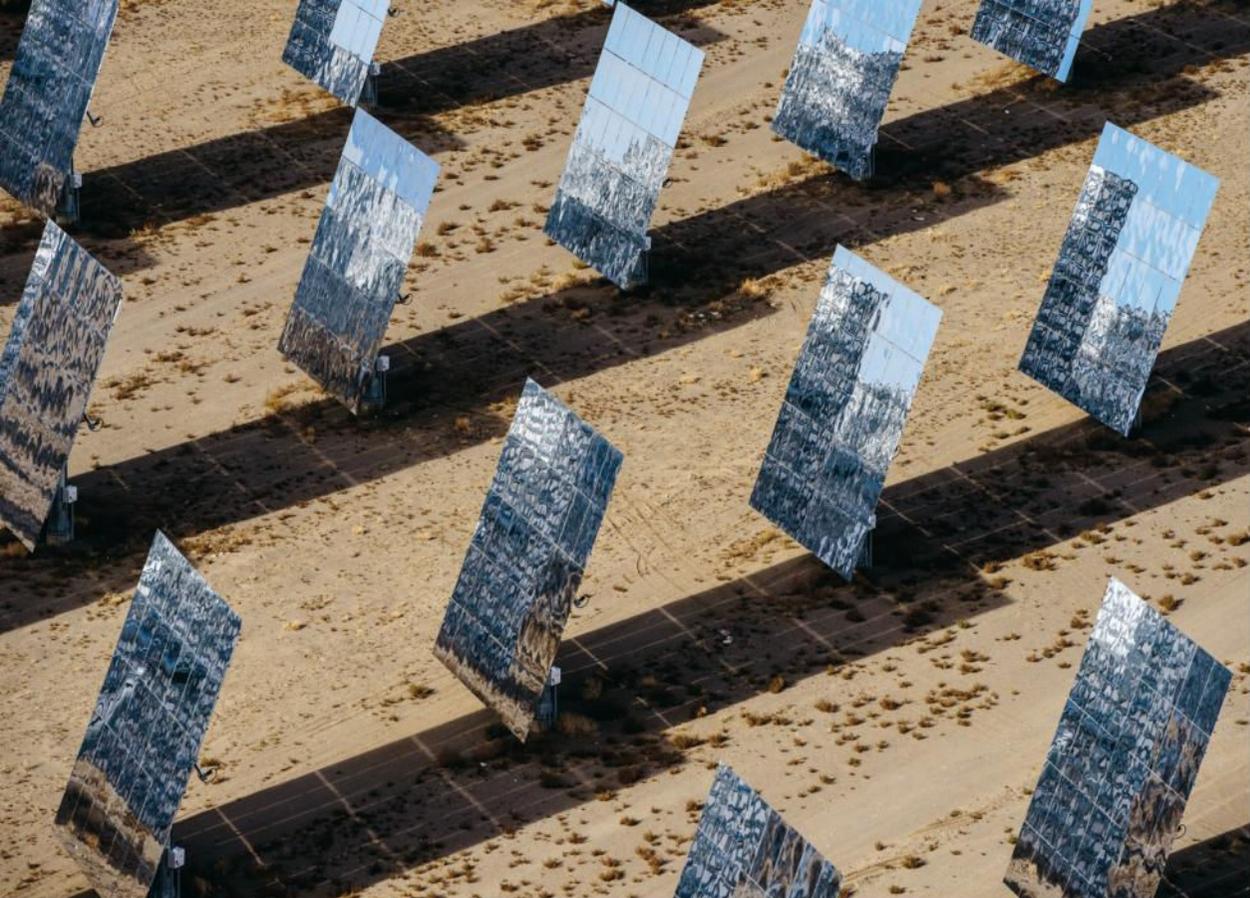
Photographing from a helicopter, I aim to show what an alternative energy source looks like—both the visual delight of its shapes and shadows and the way it fits into the context of the landscape. Even a progressive idea like solar energy means utilizing land that may have been in a natural state beforehand.

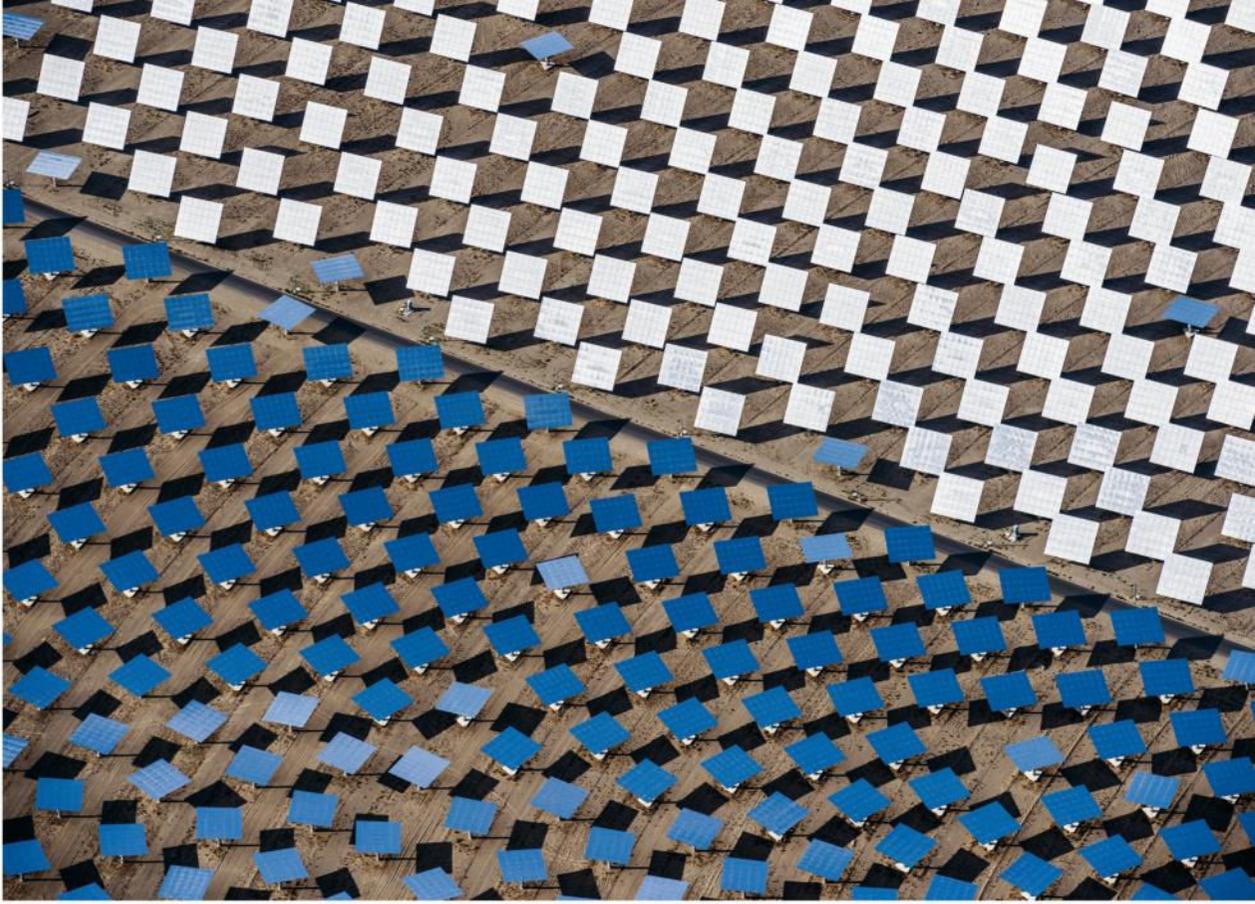
To look at renewable energy projects is to see both the practical and aspirational aspects of who we are—how we apply knowledge, ingenuity, and skill to find solutions for the future. This series is a visual exploration of that quest. □





The 110-megawatt Crescent Dunes Solar Energy Plant uses 10,000-plus mirrors, or heliostats, to harness the sun's thermal energy. Two molten-salt storage tanks hold the heat, which is used to create steam and generate electricity for 75,000 homes during peak demand.



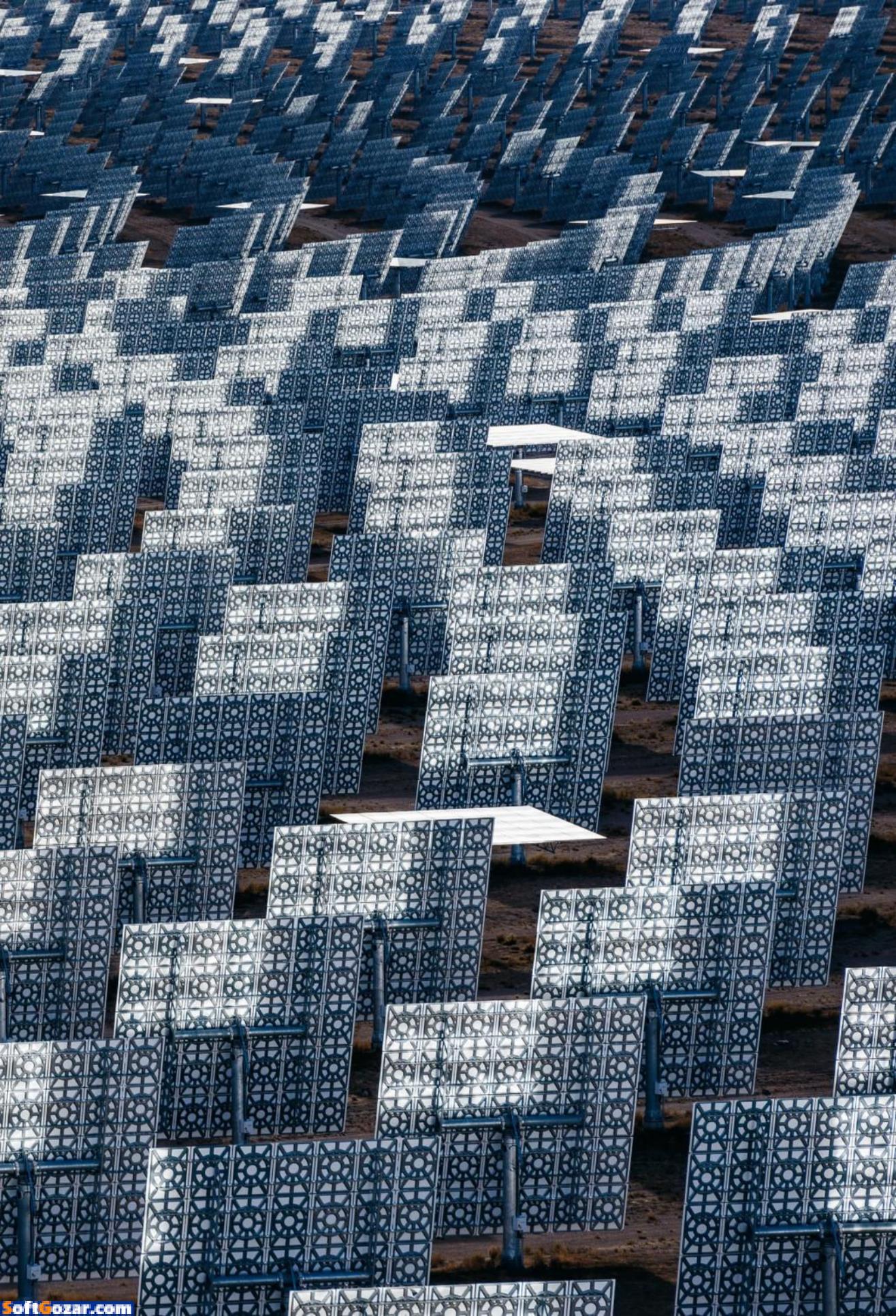


To find the best shots and perspectives, I flew over the site before the sun was up. As the light increased, I focused on the drama in the details—the geometry of the heliostats, their angles and dimensions, the abstract shadows they cast. But I had to work fast: The light was ideal for 30 minutes at best.





Pragmatically speaking, my aim was to document an alternative to fossil fuels. But I was also on a visual mission: to capture the compelling patterns and shapes I found. From the air, the marks we've made on our planet are easy to see—and impossible to ignore.



## In the Loupe

With Bill Bonner, National Geographic Archivist



# Burying the Hatchet

Fifty years after the Battle of the Little Bighorn, survivors gather in Montana. The men—including 82-year-old Brig. Gen. Edward S. Godfrey (wearing glasses) and Cheyenne and other veterans—assembled in June 1926 to shake hands, honor their lost, and ritually bury the tomahawk of the aging Sioux chief White Bull.

Edwin L. Wisherd's photographs of the region would run a year later in *National Geographic* with dramatic captions about how the "braves swirled and charged, sweeping [Lt. Col. George A.] Custer and his outnumbered command with a rain of fire." Godfrey described the aftermath in his field journal on June 28, 1876: "We found the bodies strewn from a few hundred yards of the ford up to a ridge. We buried as nearly as I can count 212 bodies including Genl Custer, whose face & expression was natural." —*Eve Conant*

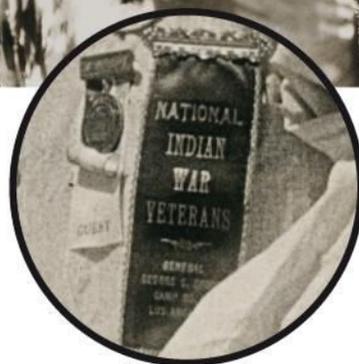


PHOTO: EDWIN L. WISHERD, NATIONAL GEOGRAPHIC CREATIVE

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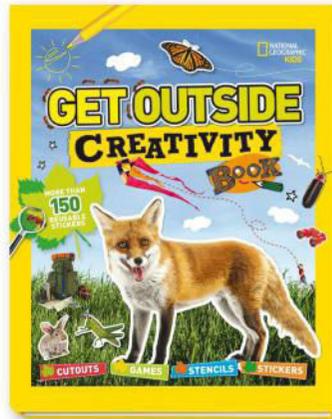
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