

What's black  
and white and  
adored all over?  
A giant panda,  
of course.

Giant pandas are more recognizable than any human celebrity. But panda cubs like Bei Bei and Bao Bao are more than just pretty (adorable) faces. They're also part of an inspiring conservation success story.

# Beyond the Black and White

BY BRITTANY STEFF

## GIANT PANDAS:

Giant pandas are instantly recognizable around the globe, regardless of country, native language, or culture: They are universally beloved.

"It's amazing," says Juan Rodriguez, a panda keeper at the National Zoo. "You don't even have to be looking at the pandas. Even with your eyes closed, you can hear where they are from the reaction of the crowd. You can just hear people going crazy."

There's something about pandas: Their cute, chubby faces; their endearing, oversized eyes; their clumsy, fun-loving antics; and their human-like posture in eating and resting. Whatever it is, the attraction seems to be universal and irresistible.

That popularity is certainly in evidence at the National Zoo. The births of panda



*Aquas rae. Iliatiae vid et volupis ipicillam, ut ulparunt.*

## GIANT PANDAS: Beyond the Black and White

cubs Bao Bao in 2013 and Bei Bei earlier this year have drawn thousands of visitors to the Zoo and millions of viewers to the panda cam.

### A Black-and-White Issue

Giant pandas are endangered in the wild. More people visit the Zoo each day than there are giant pandas left on the planet.

Bei Bei, Bao Bao, and Tai Shan—the three surviving panda cubs to be born at the Zoo—are the faces of a highly sophisticated and scientific research and conservation program working hard to save pandas as a species.

trouble reproducing. But replicating those results in human care was proving difficult, in China as well as at the National Zoo. For decades pandas remained a critically endangered and poorly understood species. As of TKYEAR, only 121 lived in human care.

There were no experts in giant panda breeding to turn to for help. Then, in 1996, China invited a handful of international experts in reproductive science in other animals to meet in China.

Wildt was one of those experts. He was one of seven Americans who met with over 60 Chinese scientists—only one of whom spoke English—in an unheated building in

All that work paid off in the form of births: Tai Shan was born at the National Zoo in 2005. He was followed by a cub born in 2012 that survived for a week, then by Bao Bao and her stillborn twin in 2013, and then by Bei Bei and his twin in 2015. Meanwhile, in China the birth rate has also increased: more than 400 giant pandas now live in human care.

“Beginning in about 2005, you started to see these photographs coming out of China of piles of baby pandas,” Wildt says. “We’ve been wildly successful. Our goal, in 1996, was to get the population to 300 animals. Our colleagues in China have blown by that and are well on their way to 500.”



Panda enthusiasts know that panda breeding is a delicate science. Females are fertile only for a few hours each year and pandas in human care have notorious difficulty breeding successfully.

Dave Wildt, the head of the Center for Species Survival at the Zoo’s Conservation Biology Institute, has worked with giant pandas for more than three decades. His experience with pandas dates back to Ling Ling and Psing Psing, the original Zoo pandas who were state gifts from China to President Nixon in 1972. The pair had difficulty breeding and, when Ling Ling eventually did give birth, none of her cubs survived more than a few days.

“We knew so very little about the basic biology of the panda back then,” Wildt explains. “Trying to get her pregnant, and get a surviving cub, was very, very difficult.”

In the wild, pandas have no apparent

December in a park in Chengdu. With the help of a lone translator, the team analyzed the state of panda knowledge, and laid out research priorities that would guide giant panda research for the next twenty years and more.

Out of that meeting came countless research projects across the world and most of what science now knows about pandas. In 2004, Wildt and a team of researchers collected all that data and deepening knowledge into the canonical book, “Giant Pandas: Biology, Veterinary Medicine, and Management.”

“We conducted a massive biomedical survey to identify the factors limiting the success of giant pandas,” Wildt explains. “Everybody in China and in the US worked hand in hand. Everybody was working together. But the most exciting part of this was, once we had collected all this scholarly information, the Chinese actually applied it.”

### It Takes More than Two to Tango

Improved animal management, veterinary care, nutrition, and knowledge of panda reproduction translates directly to the births of more healthy babies. Managing pandas has changed significantly since biologists worked with Ling Ling.

As giant panda biologist Laurie Thompson explains, “When we had Ling Ling and Hsing Hsing we didn’t have the training crate we use now. We had to do everything under anesthesia. Now we can do almost everything we need to do in the training crate—blood draws, blood pres-

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## Someone to Watch Over Mei

It takes a village to raise a human baby, and a panda cub requires no less attention. Maybe more in fact—before Mei Xiang even undergoes artificial insemination, a dedicated corps of FONZ volunteers is at the Panda House 24 hours a day, watching for any indication that she's about ready to go into estrous.

And the watch doesn't end with insemination—volunteers also mount a 24/7 watch as the date for a potential cub birth nears and continue their observations once the cub arrives. Volunteers have watched giant pandas at the Zoo since 1972, when the pandas they were watching were Ling Ling and Hsing Hsing, and they have kept watch over Tai Shan, Bao Bao, and now Bei Bei. Now that animal care staff feel that Mei Xiang and Bei Bei have settled into a groove and are secure in each other, the watch has been reduced to about 12 to 15 hours a day, rather than 24.

The volunteers are FONZ volunteer-behavior watchers, a dedicated group that receives comprehensive training and testing to be able to operate the complex system of 38 cameras, as well as record data for behavioral studies by Zoo scientists. The volunteers operate the web cams that anyone can tune into across the globe.

Before becoming a giant panda behavior watcher, volunteers must have worked in one of the other FONZ volunteer behavior watch programs at the Zoo for at least a year. Currently about 60 volunteers watch Mei and Bei, and nearly 200 have watched the pandas over the years.

Other behavior watches currently include cassowaries, emus, kori bustards, and gorillas, and past programs have included tigers, lions, Andean bears, elephants, Japanese giant salamanders, and octopus. To become a panda watcher, keep an eye on the Zoo website for behavior watch volunteer opportunities: [fonz.org/volunteer](http://fonz.org/volunteer).

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sure checks, ultrasounds. Everything other than the artificial insemination.”

Avid Zoo followers know producing a panda baby is still far from trivial. Veterinarians and scientists monitor Mei Xiang’s hormones throughout the spring (the typical breeding season) and keep a close eye for signs that she is getting ready to go into estrous, an effort that involves veterinarians, reproductive biologists, keepers, and often includes visiting experts from China.

At the same time, keepers in breeding centers in China and other American zoos collect semen from their pandas. Tian Tian and Mei Xiang are always given a

There still aren’t more than a dozen experts in panda reproduction on the planet—and many of them work at the National Zoo. National Zoo veterinarians conducted the insemination of Zoo Atlanta’s panda Lun Lun, which resulted in the births of twins Mei Lun and Mei Huan in 2013. Keepers and experts from Toronto Zoo were present at Mei Xiang’s insemination this spring, and the knowledge they gained helped them inseminate their female, Er Shun, who gave birth to twins in October 2015.

After a baby’s birth, Zoo geneticists determine both the cub’s sex and his or her paternity. The geneticists at the Zoo’s Center

the Zoo has to go to China to participate in the breeding program and support the survival of their species there.

Tai Shan, who was born at the National Zoo in 2005, now lives in China where he is part of their breeding program. “As sad as it is to say goodbye to animals we’ve gotten attached to, they’re going to China to do what they’re supposed to be doing,” says Nicole MacCorkle, a panda keeper at the National Zoo who worked with Tai Shan. “They’ll go, and have cubs of their own, and bring everything full circle.”

Eventually, descendants of cubs born at the National Zoo may roam the mountains in China as their ancestors did, an en-



chance to breed naturally, but have seldom been successful. Consequently, reproductive biologists also inseminate Mei Xiang artificially, a procedure that has been perfected over the last ten years. To increase the chances of a pregnancy, they often use semen from more than one male. Often the semen from Tian Tian is fresh frozen, while sperm from farther away has been preserved for longer.

Once the insemination occurs, the long wait begins. Fertilized panda embryos can float free in the uterus for weeks or even months before implanting. Pandas also experience pseudopregnancy, a state where their bodies act like they’re pregnant whether they’re actually carrying a cub or not.

Improved monitoring techniques and understanding means that scientists are now better able to pinpoint when a panda is about to come out of her pregnancy or pseudopregnancy, and either give birth or return to her normal non-breeding status.

for Conservation and Evolutionary Genetics are experts at such tests, which they often perform for other zoos with pandas.

### The Faces of Conservation

Giant pandas live solitary lives, coming together only to breed. In the wild cubs stay with their mothers for about two years before dispersing to a new territory. Cubs born at the National Zoo are separated from Mei Xiang when they are about two years old. And when they’re four or five, they go even farther—all the way to China.

China no longer gives out giant pandas as state gifts: they’re considered too precious. Instead, countries “lease” pandas from China. Originally, the National Zoo paid \$1 million to China each year to have Tian Tian and Mei Xiang, though now that number is \$500,000. The money supports giant panda programs in China. Part of the agreement is that any cub born at

couraging and hopeful possibility. To help make it a reality, each American zoo that wishes to house giant pandas must submit proposals to the Fish and Wildlife Service to get the permits to import the animals. The Fish and Wildlife Service also insists that zoos track the money they give to China, to ensure that it goes toward giant panda conservation.

“No American zoo gets giant pandas unless they have an approved research and training plan for China that shows how they are directly going to enhance the conservation of the giant panda and its habitat,” says Dave Wildt. “It’s not just giving China

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money. It's beyond that. We are directly helping support the 65 or more panda reserves and those people who are working very hard to protect the giant panda."

In 2012, the National Zoo, along with the San Diego Zoo, the Memphis Zoo, and Zoo Atlanta, won the Association of Zoos and Aquariums' International Conservation Award for work with giant pandas and their habitat.

The Smithsonian's National Zoo supports pandas more directly as well, by training Chinese scientists to be panda experts. Over the past few decades, the National Zoo and Smithsonian Conservation Biology Institute (SCBI) have trained more than 1,500

**"As sad as it is to say goodbye to animals we've gotten attached to, they're going to China to do what they're supposed to be doing," says Nicole MacCorkle, a panda keeper at the National Zoo who worked with Tai Shan.**

Chinese professionals in fields including reproductive biology, breeding, population management, camera trapping, wildlife mapping, and conservation biology. Many of those people have been trained in China itself, though a few also come every year to study at the Zoo or SCBI.

#### **Bear Necessities**

National Zoo scientists train their colleagues in China, and they also partner with them on wide-ranging research projects on wild pandas.

Melissa Songer is one of the SCBI conservation biologists working in China. "There is so much going on for pandas beyond having them on exhibit. We're not just keeping these animals so people can see them," Songer says. "It's keeping them in the wild. They need habitat, we need space for them, and we need to understand their ecology, how they use habitats, and how they move—especially for the reintroductions to be successful. It's not

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just a case of setting aside land for them. We have to make sure we're giving them the resources they need."

Songer and her colleagues—both American and Chinese—study panda ecology from a variety of angles. They map how giant pandas use reserves and how they move between them, study how the nutritional content of bamboo shifts with the seasons and affects the pandas, model how climate change will impact giant panda habitat, and analyze how formerly logged habitat can be restored to once again support giant pandas.

National Zoo scientists were among the first in the world to use camera trapping to

track giant pandas in reserves. A camera trap uses infrared technology to sense motion and take a picture when an animal passes by. Such tactics allow scientists to get a better sense of how many animals are in an area and how they move.

This research is allowing wildlife and forestry officials in China to create corridors between giant panda reserves, restore bamboo habitat, and create new reserves.

"Our scientists are out there working in the field, developing relationships, putting boots on the ground, publishing papers, and training the next generation of scientists," says Dave Wildt.

National Zoo scientists are training the next generation of scientists in a new discipline as well: veterinary medicine and wildlife diagnostics. As giant pandas move into the wild, scientists are worried about diseases: both captive-born animals encountering diseases in the wild they're not prepared for and those animals introducing novel diseases into the ecosystem.

In December 2015, SCBI head veterinarian Copper Aitken-Palmer and vet technician Jennifer Santiestevan trained a group of 20 Chinese veterinarians on wildlife veterinary and diagnostic tech-

### 3 little bears

Since 2005, the Smithsonian's National Zoo has celebrated the births of three healthy, robust giant panda cubs.



#### BEI BEI (PRECIOUS TREASURE)

**Born:** August 22, 2015

Bei Bei was born with a twin, another male, who was much smaller than he was. Despite intensive care from the animal care team, that twin died four days after being born.

**Weight at birth:** 137 grams (0.30 pounds)

**Weight at ~10 weeks:** 3.99 kilograms (8.77 pounds).

**Personality:** Panda personality doesn't really develop until the cubs open their eyes and start moving around independently of their mom. But so far, keepers say that Bei Bei is extremely vocal and seems very attached to Mei Xiang—crying out for her when she leaves, and not just when he's hungry. He seems to like being held. He's also very feisty with the keepers—lunging and barking at them when they take him to be weighed. Bei Bei is the biggest of Mei Xiang's cubs so far

#### BAO BAO (PRECIOUS TREASURE)

**Born:** August 23, 2013

Bei Bei's big sister, Bao Bao, was born with a stillborn twin, another female. In early 2015, she started spending time away from Mei Xiang, as part of the natural weaning process.

**Weight at birth:** 123 grams (0.27 pounds)

**Weight at ~10 weeks:** 3.05 kilograms (6.73 pounds).

**Personality:** Keepers describe Bao Bao as very independent. She is very quiet, not very aggressive, and wasn't worried much about being away from Mei Xiang when she was a cub. Bao Bao is also the smallest of the surviving cubs so far. Keepers don't know whether these differences are due to sex or simply inherent personality. Bao Bao began spending time away from her mom in early 2015, as part of the natural weaning process.



niques to keep the giant panda population healthy both in human care and in the wild.

### Beacons of Hope

All this work is aimed at the giant panda, but it benefits countless other species as well. Pierre Comizzoli, reproductive biologist at the National Zoo explains, “It’s not just because they’re such a charismatic animal, they also play a huge role in the ecosystem. It’s really important to save them. The babies they’re producing aren’t just for us; they’re for the global population.”

Saving the giant panda benefits hundreds of other plant and animal species that share their habitat.

“The giant pandas don’t live out in the forest by themselves,” says Aitken-Palmer. “They share habitat with the red panda, the golden takin, the golden monkey, and a bunch of other species that aren’t as visible. The pandas are beacons that attract funding and interest, but we also need to learn about and conserve these other species to save the giant pandas.”

Giant pandas like Bao Bao and Bei Bei are ambassadors for their species, but giant panda conservation work goes far beyond cute cubs.

“Everyone loves giant pandas,” says Aitken-Palmer. “And they’re an amazing conservation success story. Everything that should happen with an endangered species has happened: we’ve been successful in breeding them to grow the population, and we’re starting reintroduction programs. China’s protected their habitat, and there’s almost no poaching. It worked. And it’s all been science-driven.”

Giant panda conservation is a story of victory, and one of hope. **SZ**

BRITTANY STEFF *is an editor for the Zoo’s website and a veteran Smithsonian Zoogoer contributor.*

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### TAI SHAN (SACRED MOUNTAIN)

Bei Bei’s big brother, and the first panda cub born at the National Zoo to survive more than a few days. He went to China in 2009, where he now participates in the giant panda conservation program.

**Born:** July 9, 2005

**Weight at birth:** Unknown (Keepers didn’t get to weigh him until he was 24 days old, when he weighed 771 grams (1.7 pounds))

**Weight at ~10 weeks:** 3.39 kilograms (7.48 pounds)

**Personality:** Panda keepers describe Tai Shan as being Mei’s shadow; he didn’t like to be away from her. He was very feisty with keepers, and very interested in them as playthings. His personality was similar to what they’ve observed of Bei Bei so far.







The Zoo's  
newest  
monkeys  
are  
serious  
fun for  
keepers  
and  
visitors  
alike.

# monkey business

BY KATHARINE SUCHER

**t**he old saying, “If you’ve seen one, you’ve seen them all,” definitely does not apply when it comes to guenons.

Guenons are the largest and most diverse primate group in Africa—and these Old World monkeys are some of the newest additions to the Smithsonian’s National Zoo. Last July, a troop of seven guenons, including three Schmidt’s red-tailed monkeys and four Allen’s swamp monkeys, went on display at a shared exhibit in Think Tank.

They’ve been enchanting visitors and Zoo staff alike ever since.

“Everyone is immediately taken by them,” says primate biologist Becky Malinsky. “Usually visitors move fairly quickly between exhibits, but I’ve seen people sit down and watch

the guenons for 15 minutes or more. They stop people in their tracks.”

## Getting to Know Guenons

Before exploring what makes guenons so diverse, it’s important to understand what makes them the same. Like baboons and macaques, guenons are Old World monkeys, meaning they are native to Africa or Asia (in the guenon’s case—Africa). Guenons are of medium size and have long tails and rounded heads. Says Malinsky, “When someone pictures a monkey in their head, it’s often what a guenon looks like.”

All guenons have cheek pouches that allow them to store extra food while foraging. These pouches can store nearly as much food as a guenon’s stomach—a handy feature

considering, compared to other monkeys, guenons aren't picky eaters. Most guenons will eat a range of foods including fruits, leaves, nuts, invertebrates, and even small reptiles or mammals.

But this is where most blanket statements about guenons end. Beyond these basic similarities, "there's very little you can say about one species of guenon that's going to be true of all guenons," says curator of primates Meredith Bastian.

There are more than 20 species of guenon—the newest of which was identified as recently as 2007. These species range in size from the two-pound southern talapoin monkey to the nearly 30-pound patas monkey. Guenon species sport a variety of coat colors and distinctive facial features, including white beards, mustaches, tufted ears, and even blue faces.

This physical diversity make it easy to distinguish between the two guenon species at the National Zoo. Allen's swamp monkeys have a stouter build than Schmidt's monkeys, and have brown, grey, and green hair on their back. Schmidt's red-tailed monkeys have a purplish-blue hue to their face and,

as their name suggests, bright red fur on their tails. Schmidt's monkeys also have a distinctive patch of heart-shaped white fur on their nose.

For many who learn about guenons, these differences between species are part

**t**he exhibit includes plenty of features to keep the monkeys active—branches, a hollow log, a bridge, different substrates, and more.

of what makes the monkeys so fascinating.

"I think the most interesting thing about guenons is how diverse they are," Malinsky says. "Each species is so unique."

#### In the Wild

Guenon diversity extends beyond physical appearance. Guenons occupy a large geographic range in Africa and live in a variety of habitats, stretching from the arid edges

of the Sahara Desert, to mountainous bamboo forests, and to Africa's wetlands and rainforests.

Both species of guenon at the National Zoo—the Schmidt's monkey and the swamp monkey—are native to central Africa. Schmidt's monkeys inhabit a variety of tropical, swamp, mountain, and lowland forests, while swamp monkeys are primarily concentrated in the lowland forests of the Congo basin.

Guenons also employ varying social structures. Bastian explains: "In the wild, Schmidt's monkeys have a hierarchical social structure with one male and multiple females. Swamp monkeys have a different structure, with multiple males and multiple females living in the same group."

None of the National Zoo's Schmidt's monkeys or swamp monkeys currently have a breeding recommendation, and the Zoo is not directly involved in any guenon conservation efforts. Still, Bastian says it's important to be aware of the threats facing these animals in the wild.

In their native Africa, the primary threats to guenons include hunting for



Aquas rae. Iliatiae vid et voluptis ipicillam, ut ulparunt.

## Meet the Monkeys Get to know the guenons of the Smithsonian's National Zoo



•••••  
NAME: Nub Armstrong  
SPECIES: Allen's swamp monkey  
GENDER: Male  
AGE: 15 years old  
ABOUT: The origin of his name is a mystery, but keepers affectionately call him "Nub" for short. Easy to identify because of his size—he's almost twice the size of the swamp monkey females—he's also an exceptionally laid-back primate.



•••••  
Name: Kinah  
SPECIES: Allen's swamp monkey  
GENDER: Female  
Age: 9 years old  
ABOUT: Hand-reared at the San Diego Zoo, Kinah is the biggest crowd-pleaser. The smallest of the swamp monkeys, she is very interested in people and will come right up to the glass to interact with visitors.



•••••  
NAME: Deiriai  
SPECIES: Allen's swamp monkey  
GENDER: Female  
AGE: 8 years old  
ABOUT: Deiriai spends a lot of time grooming and hanging out with Layla. Keepers call her "D" for short.

•••••  
NAME: Layla  
SPECIES: Allen's swamp monkey  
GENDER: Female  
AGE: 9 years old  
ABOUT: Layla and Deiriai can often be seen together. If you're trying to tell them apart, Layla is the more slender of the two monkeys.

•••••  
NAME: Tiko  
Species: Schmidt's red-tailed monkey  
GENDER: Male  
Age: 15 years old  
ABOUT: The largest of the Schmidt's monkeys, Tiko spends a lot of time running around and bouncing off branches to look impressive. You may also hear him vocalizing.

•••••  
NAME: Indi  
SPECIES: Schmidt's red-tailed monkey  
GENDER: Female  
AGE: 16 years old  
ABOUT: Indi sticks pretty closely to Tiko, and you will often see her grooming him. You can identify her as the larger of the two female Schmidt's.



•••••  
NAME: Chi Chi  
SPECIES: Schmidt's red-tailed monkey  
GENDER: Female  
AGE: 13 years old  
ABOUT: Chi Chi may be the smallest of the Schmidt's monkeys, but don't underestimate her. Although she spends most of her time alone, she's been known to chase around the swamp monkey females.



guenons are the largest and most diverse primate group in Africa

bushmeat, retaliation for crop-raiding, collection for the pet trade, and habitat loss due to deforestation. These pressures have driven the Preuss' guenon to be classified as endangered by the International Union for Conservation of Nature (IUCN), and several other species, including the white-throated guenon and Diana's monkey, to be classified as vulnerable.

Both the Allen's swamp monkey and Schmit's red-tailed monkey are classified as species of least concern by the IUCN, but these pressures continue to impact their wild populations. So while their numbers are stable in the wild for now, Bastian says, "these are all threats to the survival of these animals in the long-term."

#### Plays Well with Others

Although the three Schmidt's monkeys and four swamp monkeys shared an exhibit at their previous home at the San Diego Zoo, the troop had to go through a reintroduction process when they arrived at the National Zoo. The reintroduction was fairly uneventful, but Bastian says "there was still the mischief you would expect in any group."

Some of that mischief included running around and chasing each other. During the reintroduction, Zoo staff paid especially close attention to the two males. "We expected some kind of stand-off between them because one of their roles is to protect the females," Malinsky says. "The stand-off did happen, but they never had any physical contact. They did a lot of displaying to make themselves look impressive and that was it."

The displaying consisted of baring their teeth, smacking the ground with their hands, and bouncing off branches. Since the introduction, the Schmidt's monkeys and swamp monkeys have generally minded their own business.

In the wild, guenons are known to be socially tolerant of other guenon species. This means that different species can share

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the same habitat peacefully, but it doesn't mean that there is much cross-species interaction. At the National Zoo, the swamp monkeys and Schmidt's monkeys are more like roommates than family.

Although the monkeys have shared an exhibit for years, they tend to self-separate by species, just like they would in the wild. Because the troop often has access to both an indoor and outdoor exhibit at Think Tank, it's easy to see this in action.

"It's almost like musical monkeys," Malinsky explains. "The swamp monkeys will wander in and the Schmidt's monkeys will wander out and they will rotate back-and-forth like that throughout the day."

#### Active Monkeys

The guenon's outdoor yard is fully enclosed in glass with a mesh top. The exhibit includes plenty of features to keep the monkeys active—branches, a hollow log, a bridge, different substrates, and more. But one of the guenon's favorite features wasn't designed with the monkeys in mind at all.

"There are rafters at the top of their exhibit that we didn't even think about

them using, but they walk along them a lot," says Malinsky. "We're often pointing out to visitors, 'Look up! You can see the monkeys up there!'"

The guenon exhibit also includes a large outdoor pool and a smaller water feature indoors. Although most Old World monkeys can swim, swamp monkeys are especially adapted for water—they have webbing between their toes—and are known to be particularly hydrophilic (water-loving). In the wild, groups of swamp monkeys are even known to sleep by the water. Zoo staff were looking forward to the swamp monkeys taking advantage of their pool, but haven't seen much interest from the troop yet.

"I know of swamp monkeys at other zoos that will literally dive off of branches and go completely underwater, but so far we've only seen our monkeys go up to their knees," Malinsky says. "But," she continues, "one of our keepers did see a female swamp monkey soaking wet one day, so she must have gone in!"

Just as the features of their exhibit are designed to imitate their natural habitat, Zoo staff work hard to provide the guenons

with enrichment that encourages behaviors the monkeys would naturally do in the wild. Much of that enrichment centers around foraging for food.

For example, Zoo staff will sometimes dump one of the guenon's favorite treats, mealworms, into a mop head before giving it to the monkeys. The mealworms wriggle down into the mop head and the guenons have to carefully pick through it to find their meal.

"It's all about making them think and do things that are species appropriate," explains Malinsky. "If the guenons were looking for bugs in the wild they wouldn't be picking through a mop head, but they might be picking through the dirt to find an insect or worm."

Like all animals at the Zoo, the guenons receive enrichment every day. For animals as curious and active as guenons, that can stretch the minds of keepers just as much as the monkey's.

"I always tell people that it's more of a challenge for us to come up with puzzles that will keep primates busy than it is for the primates to actually figure out the puzzle. They're just so intelligent," says Malinsky.

#### Big Personalities

The guenons consistently attract large crowds to their exhibit, which makes for great learning opportunities. "Visitors always want to know more about the cute monkeys, and that makes it easy for us to educate people about them," Malinsky says.

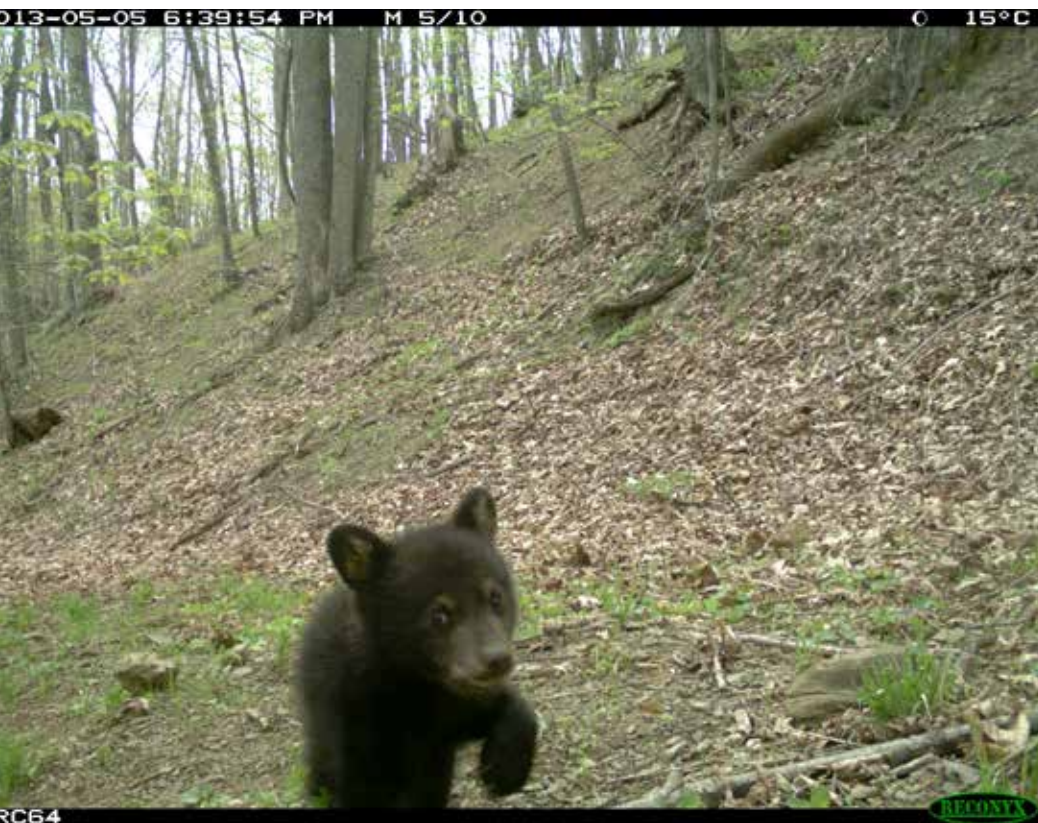
The guenons are occasionally involved in demonstrations at Think Tank, and Zoo staff are in the process of developing a more formal program. During demonstrations, visitors constantly ask questions about the guenons, their natural habitat, and their personalities. For Bastian, the positive reception makes sense.

"It hasn't been surprising that visitors are so interested in the guenons—they're really active, engaging animals and people are drawn to that," Bastian says. Malinsky agrees: "For such tiny little animals, they have big personalities." [SZ](#)

— KATHARINE SUCHER is a former *Smithsonian's National Zoo* intern and a recent graduate of *The College of William & Mary*.

# CAUGHT [on Camera]

Boots on the ground and cameras in the trees capture pictures of wildlife in action near D.C. and beyond.



The woods are so still that glowing, golden leaves gently float almost straight to the ground on this warm early November afternoon. Water splashes over rock, quietly humming as it descends the hill behind Joyce and Mike Wenger's house outside Flint Hill, Virginia.

The Wengers have just climbed the hill, dried leaves crackling beneath their hiking boots, to a slightly open spot where paths meet. Both retired professionals, certified Master Naturalists, and trained citizen science volunteers, they work quickly and carefully to attach a motion- and heat-activated digital trail camera to a tree trunk between the stream and the path.

For the next three weeks, the camera will record images of whatever moves in front of it, mostly mammals that are quiet and difficult to detect or may be nocturnal or disappear at the sight, scent or sound of a human. Each image will provide information about the photographed animal: The camera records information useful to scientists like the precise location, time, and temperature.

The Wengers' instructions come from scientists studying how well predators like coyotes, bears, bobcats, and foxes in the Mid-Atlantic states re-colonize an area following development. Their pictures will join those collected by at least 600 of their fellow citizen science volunteers, adding to a growing collection of more than 3.5 million images.



FROM LEFT TO RIGHT: *Ur sunt lanihicient doluptam*; *Nestinc illitas sitaturibus*; *Nestinc illitas sitaturibus*,



## CAUGHT [on camera]

That's the heart of eMammal—a project focused on collecting, managing, and using citizen science data that may transform conservation scientists' understanding of mammals, particularly their response to human activities from development to hunting to hiking to climate change. The project is a partnership of the Smithsonian Conservation Biology Institute (SCBI), the Smithsonian National Museum of Natural History, the Smithsonian Tropical Research Institute, and the North Carolina Museum of Natural Sciences.

For the curious public, especially middle and high school students, eMammal is a way to discover what's out there: What the animals are doing just outside their back door or in their favorite park. The cameras have caught a coyote bumping into a bobcat, deer sparring, and a red fox playing with a ball, among other highlights.

Anyone can search for and view the best images from the collection on the eMammal website ([emammal.si.edu](http://emammal.si.edu)). There, they can see all of the scientific studies and projects that collect images,

download much of the data, and even do simple analyses.

Spot a black bear in your backyard? Visit [emammal.si.edu](http://emammal.si.edu) to look at pictures of other bears seen in your county or elsewhere.

"It's lifting the veil for mammals, which are cryptic and hard to see," says Tavis Forrester, a conservation biologist at SCBI, a founding partner and the home of eMammal.

"Camera traps are the window into that world," says Forrester. "In terms of science it's huge. It lets science move at the speed that's actually relevant to conservation. Look at what people are able to do with citizen science data for birds. Some of the best studies on climate change and birds are coming from that data."

### Thrill of the Catch

"Trap" is a misnomer, a linguistic remnant from a time not all that long ago when an animal triggered the camera by walking across a pressure plate or a laser beam. Now, the "traps" rely on motion and infrared sensors to detect movement. No

animals are detained or disturbed. Rather, the digital camera captures a moment in time. Once it picks up motion, it snaps one or several images, each a second apart.

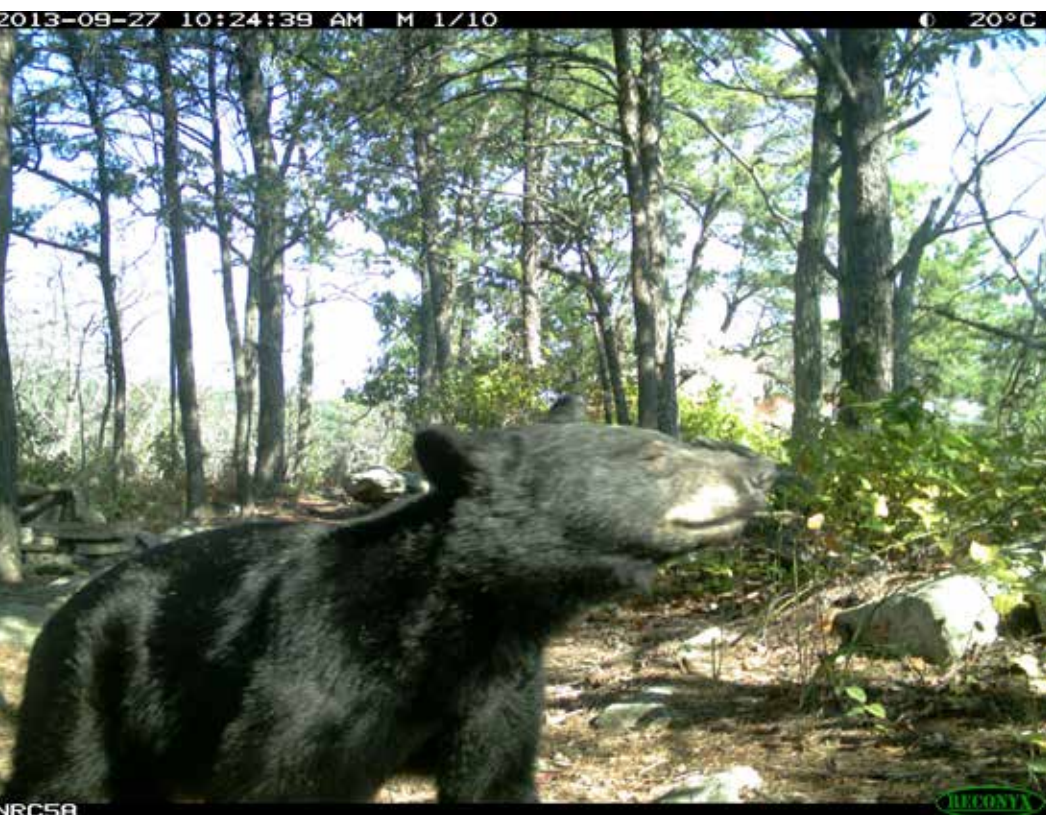
Seeing what the cameras catch turns out to be quite surprising and fun for volunteers.

Megan Baker, the eMammal volunteer coordinator, helped seventh-graders at the SEED public charter school in Southeast Washington, D.C., set cameras in woods close to their school.

The kids expected to see raccoons or white-tailed deer, but not the red fox den they spotted when they hiked into the woods to install their camera.

"They were just amazed by this huge compound of red foxes in the middle of a small park in Washington, D.C.," says Baker. "They completely enjoy it and learn a lot about themselves and a lot about the animals using nature in their backyards."

Back in the classroom, students use the eMammal desktop apps to help them identify animals. The eMammal system provides a whole curriculum and project-



based learning for middle school students called eMammal Academy.

“They get excited,” says Baker. “They ask when they can see more photos.”

The thrill of the find isn’t just for kids. The Wengers also love to see what’s roaming in the woods.

“I think everybody comes back all excited: ‘What did we find?’” says Joyce Wenger.

Her husband, Mike, agrees. “All these other citizen scientists we’ve talked to rush back in,” he says. “We download pictures, look at them, and then as soon as we possibly can we upload them to the website.”

Mike Wenger hopes to get a picture of an Eastern spotted skunk, a dynamic little creature with white stripes against black fur like the more familiar striped skunk. But this one also has a spattering of white spots, is smaller and pops up on its front paws, “handstand”-style, before spraying.

“I’m never going to see a spotted skunk under normal circumstances, but I might, I just might see a spotted skunk on one of these cameras,” says Wenger.

### Transformation in the Works

The Wengers began participating in eMammal a few years ago by placing cameras in Prince William Forest Park for a study on the effects of recreation on wildlife in the Mid-Atlantic U.S.

They trust their contribution is a valuable use of their time, because of all the structure in place. Each project has clear research questions. Trainings stress the importance of following the protocol and collecting the data. Their instructions include where and how to place the cameras. There is often a meeting of volunteers following a study period when people can compare notes and may learn some of the research findings. At any time, they can track the state of the project on the eMammal website—and learn about other participating eMammal projects all over the globe.

By mounting cameras in the woods and collecting and uploading their photographs, these citizen scientists have allowed the scientific partners behind eMammal to expand the geographic and time scales of

mammal surveys. Their efforts may prove to be pivotal for the research and conservation of mammals.

Enthusiastic, diligent volunteers have already transformed conservation science around birds.

The Audubon Christmas Bird Count has its origins on Christmas Day, 1900, when ornithologist Frank M. Chapman began replacing a holiday bird hunting tradition with one that instead counts birds, according to the National Audubon Society.

Now, each December 14 through January 5, tens of thousands of volunteers throughout the Americas participate in the Audubon Christmas Bird Count, collecting data that helps conservation scientists and wildlife managers study the long-term health and status of bird populations across North America, helping them understand how those populations have changed in time and space during the last century.

“The long-term perspective is vital for conservationists,” explains the National Audubon Society. “It informs strategies to protect birds and their habitat—and helps



FROM LEFT TO RIGHT: *Ursus americanus*; *Nestor americanus*; *Nestor americanus*,

identify environmental issues with implications for people as well.”

William McShea, an ecologist at SCBI who envisioned eMammal before it was named, was one of the scientists who pointed to volunteer-based bird surveys like Audubon’s Christmas Bird Count as “instrumental in discovering population trends used for conservation efforts of forest, grassland and shore birds. There is a need for similar data on mammal distributions because of their ecological and economic importance.”

### Scaling Up

About 15 years ago, McShea was working with the staffs of wildlife reserves in developing countries to use camera traps to survey animals on the land. He would train the staff for a few days, then give them cameras and coordinates. Later, he would study the data and publish the findings.

building a pipeline that moved images and data from citizen scientists to experts and then back to the volunteers.

“What we needed to do was go from the person collecting the data, to an expert at the Smithsonian, and then back out so the person collecting the data could see the fruits of their labor,” says McShea. “That became the eMammal project.”

McShea and his partners knew they needed the project to be able to scale up over time. They knew the available data on mammals fell short of what was needed to understand populations and inform policy decisions. And they knew they needed to be tracking changes in populations and behavior over time.

“We think that everything is constant,” says McShea. “But actually everything is shifting. Only when we look at results over time do we see that. You

### Infinite Uses

Yet, more work lies ahead for eMammal to realize its full potential.

“The full vision is that eMammal is a catalyst for widespread citizen monitoring of mammals and a center for data that can be used for conservation and science and does that in ways that are fast, involve local people, are publicly available, and transparent,” says Forrester. “Someday, I hope we can have anyone be able to take their camera data and upload it into the system and we’ll have this data-rich, real-time picture of what mammals are doing across the landscape.”

Anyone would be able to send trail camera pictures into the eMammal collection and retrieve a global picture of what’s happening with that animal and others like it. Meanwhile, scientists can use those perhaps billions of data points to

**eMammal—a project focused on collecting, managing, and using citizen science data that may transform conservation scientists’ understanding of mammals, particularly their response to human activities from development to hunting to hiking to climate change.**

“I thought, ‘If I can do this in China, I can probably do this in America. Rather than using reserve staff, why don’t I use citizen groups that already exist here?’” says McShea.

So he zoomed in on the Appalachian Trail (AT), where there were already volunteer teams assigned to sections of the trail. He taught them how to use the cameras, then set them loose on the AT to see what would happen.

For about three years, volunteers from AT clubs, the Sierra Club, and the Virginia Master Naturalists took cameras out along the AT to see what they could see.

“What we found is it pretty much maxed out our ability,” says McShea. “They were generating thousands of images. It was a great idea and there was great demand, but we didn’t have the infrastructure to ramp up.”

In time, McShea spoke with Robert Costello in the Office of Education and Outreach at the National Museum of Natural History, who had worked on similar challenges with a colleague, Roland Kays, now at the North Carolina Museum of Natural Sciences. They envisioned

only see that when you take a big enough chunk of time—our sense that everything will stay the same is not usually borne out by the data.”

So the three initial partners secured a three-year, \$650,000 National Science Foundation grant to build the infrastructure for eMammal that includes both a robust network of citizen scientists and a sophisticated “cyber-infrastructure” and data repository, created by the Smithsonian’s Information Technology department. “Their support to bring in outside data and push it back out to the public is an essential part of the system,” says McShea.

The system’s key components include the website, the database, an app that lets volunteers easily upload and identify species, and a review tool that lets experts swiftly move through the images to verify they were correctly identified.

The system is live and working well, notes McShea. “We have 5 million images in the system right now. The original AT project with 2,000 images almost broke our backs. We now have two orders of magnitude more images and are still chugging along.”

study mammal populations as they adapt to changing conditions—or fail to.

For now, scientists use eMammal’s millions of data points for their research. One study prompted by concern for songbird populations, for example, showed that parks with resident coyotes did not have many feral or domestic cats. Educators, meanwhile, use eMammal to teach middle and high school students how to design studies to learn about the animals around them. National, state, and local park managers who have cameras set up in their parks also receive reports about the animals spotted on their properties.

And, of course, citizen scientists like the Wengers have even more reason to enjoy their hikes through the woods, knowing they are making an important contribution to understanding and conserving the animals who share their favorite places—and that the “eyes” they leave behind may see a creature as unusual and fascinating as a spotted skunk. **SZ**

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xxxxxxxxxxxxx xxxxxxx xxxxxx.



CLOCKWISE FROM TOP: *Ur sunt lanihicient doluptam; Nestinc illitas sitaturibus; Nestinc illitas sitaturibus,*